VOLUME II OF III

STATE OF SOUTH CAROLINA
IN THE SUPREME COURT

Appeal from Horry County
The Honorable Benjamin H. Culbertson, Circuit Court Judge

Court of Common Pleas Case No. 2011-CP-26-3907
(Capital PCR Action)
Appellate Case No. 2014-000904

RECEIVED
AUG - 5 2014
S.C. Supreme Court

LOUIS MICHAEL WINKLER, JR.,

Respondent/Petitioner,

vs.

STATE OF SOUTH CAROLINA,

Petitioner/Respondent.

SUPPLEMENTAL APPENDIX

EMILY C. PAAVOLA, ESQ.
Death Penalty Resource & Defense Center
900 Elmwood Avenue, Suite #101
Columbia, South Carolina 29201

JOHN R. MILLS, ESQ.
The Law Offices of John R. Mills
3145 Geary Blvd, Unit #213
San Francisco, California 94118

ATTORNEYS FOR
RESPONDENT/PETITIONER

ALAN WILSON
Attorney General

JOHN W. McINTOSH
Chief Deputy Attorney General

DONALD J. ZELENKA
Senior Assistant Deputy Attorney General
No. 4425

J. ANTHONY MABRY
Assistant Attorney General

ALPHONSO SIMON, JR.
Assistant Attorney General

Post Office Box 11549
Columbia, South Carolina 29211
(803) 734-6305

ATTORNEYS FOR
PETITIONER/RESPONDENT

INDEX

INDEX i

Applicant's Exhibit Number 1 1

Applicant's Exhibit Number 2 538

Applicant's Exhibit Number 7 738

Applicant's Exhibit Number 8 804

Age/Sex: 81 M
Admitting: Aggen,Yeshitila MD
Account #: [redacted]
Location: [redacted]
Room/Bed: B.A559-1
Admitted: 03/30/11 at 0245
Patient DIS IRa

WINKLER,LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD HPF

Printed 04:12:11 at Tad2

Problem/Goal/Intervention Description	Activity Type	Occurred Date	Occurred Time	Recorded Time	By Init	By Category	Shift	Charge

Activity Date: 04/01/11 Time: 1539 Event Num:

130065 CVC/PICC (Insertion (continued)
Washed/sanitized hands (immediately prior to procedure)- Yes
Used sterile gloves- Yes
Used mask- Yes
Used sterile gown- Yes
Used cap/hair covering- Yes
Large body drape placed over patient- Yes
Sterile field maintained- Yes
Measures taken to reduce risk of air embolism- Supine Only
Start date: 04/01/11
Start time: 1539
Dept where line inserted- Radiology/Imaging
Inserted by- WICLMS
Procedure- PICC - Multi lumen
Catheter type- Other non - tunneled
Insertion site- Cephalic vein
Right/Left- Right
External Line Length(cm): 5.0
# of unsuccessful line attempts: 0
Ultrasound guidance used? Y
Additional findings: PICC IN 42 CM
OUT 5 CM
ARM CIRCUMFERENCE 29 CM
Right Cephalic Vein- PICC - Multi lumen
Line present on admission? N
Start date: 04/01/11
Start time: 1539
Right Cephalic External Line Length(cm): 5.0
Dressing Date: 04/01/11
Dressing Time: 1539
Dressing Type: Gauze

Activity Date: 04/01/11 Time: 1603

191010 CLINICAL MONITORING* A MD
Document 04/01/11 1603 ZA 04/01/11 1603 ZA
Pulse: 106
Pulse: 105
Resp: 33
Non-Invasive BP-Systolic: 132
Non-Invasive BP-Diastolic: 69
Non-Invasive BP-Mean: 84
Pulse Ox: 96
Ventricular Pressure Beats: 8

191020 CLINICAL MONITORING* A MD
Document 04/01/11 1700 ZA 04/01/11 1700 ZA
Pulse: 106
Pulse: 105
Resp: 32
Non-Invasive BP-Systolic: 131
Non-Invasive BP-Diastolic: 66
Non-Invasive BP-Mean: 82
Pulse Ox: 96
Ventricular Pressure Beats: 0

Activity Date: 04/01/11 Time: 1700

191020 CLINICAL MONITORING* A MD
Document 04/01/11 1700 ZA 04/01/11 1700 ZA
Pulse: 105
Pulse: 103
Resp: 31
Non-Invasive BP-Systolic: 86
Non-Invasive BP-Diastolic: 58
Non-Invasive BP-Mean: 64
Pulse Ox: 96
Ventricular Pressure Beats: 0
146003 BCTA- Blood Bank Product, IBD* A per standard PS
Document 04/01/11 1700 ZA 04/01/11 1700 ZA
Packed Cells, Volume Transfused: 350
410600 Plan of Care Review* A QSHIFT CP
Document 04/01/11 1700 ZA 04/01/11 1700 ZA
< PLAN OF CARE REVIEW >
Link to Plan of Care. Y
Care plan reviewed and/or individualized and reprioritized: Y
Nurse signature: ACOSTA,ZAYDEE - RN
. Y
130040 Isolation: Standard Precautions A QSHIFT CP
Document 04/01/11 1700 ZA 04/01/11 1700 ZA
130173 Standards of Care: Critical Care-Medical A QSHIFT CP
Document 04/01/11 1700 ZA 04/01/11 1700 ZA
: Y
By signing off on this intervention, the nurse verifies that
the Facility and Care Area Standard of Care has been met.
Untoward events or care outside of the Standards of Care
must be documented in supplemental interventions or notes.
Nurse signature: ACOSTA,ZAYDEE - RN
160011 Shift Evaluation A QIZh CP
Document 04/01/11 1700 ZA 04/01/11 1700 ZA
<< SHIFT EVALUATION >>
Neurological WDP: N
FEMT WDP: Y

Problem/Intervention/Observation Description	SCD Indication	Activity Type	Occurred Date	Recorded Time by	Date	Documented Time in Current	Units	Charge

Problem/Goal/Intervention Description	SCD Indication	Activity Type	Occurred Date	Recorded Time by	Date	Documented Time in Current	Units	Charge

Activity Date: 04/01/11 Time: 1700 (continued)

160011 Shift Evaluation (continued)
Cardiovascular WDP: N
Respiratory WDP: N
Gastrointestinal WDP: Y
Integumentary WDP: N
Musculoskeletal WDP: Y
Genitourinary WDP: N
Psycho-social WDP: Y
Mode of Transport: Stretcher
Code Status: FULL
Skin Risk Evaluation: Y
FALL RISK ASSESSMENT: Y
- PAIN EVALUATION -
Does Patient Currently Have Pain: N
-Pain Scale Used: NUMBERS 0-10
-Pain Score: 0
- ISOLATION PRECAUTIONS -
Isolation Type: NONE
Infection control and transmission prevention information provided to patient/family/visitors and questions answered: Y
Invasive Line Management: Y
Tubes & Drains Management: Y
< NEUROLOGICAL EVALUATION >
LOC: ALERT/AWARE
Oriented: N
Disoriented to: PLACE
Speech: APPROPRIATE FOR AGE
Sensation-RUE: WITHDRAWS FROM PAIN
RLE: WITHDRAWS FROM PAIN
LUE: WITHDRAWS FROM PAIN
LLE: WITHDRAWS FROM PAIN
Motor Skill Eval: Y
Right Grip: SPONTANEOUS MOVEMENT
Right Arm: SPONTANEOUS MOVEMENT
Right Leg: SPONTANEOUS MOVEMENT
Left Grip: SPONTANEOUS MOVEMENT
Left Arm: SPONTANEOUS MOVEMENT
Left Leg: SPONTANEOUS MOVEMENT
Impaired Memory: UNABLE TO ASSESS
Behavior: WITHDRAWN
Right Eye(OD) mm: 3
Reaction: BRISK
Left Eye(OS) mm: 3
Reaction: BRISK
Pupils Equal, Round, React to Light, and Accomodating: Y
< EENT EVALUATION >
< CARDIOVASCULAR EVALUATION >
Is Patient on Cardiac Monitoring: Y

Activity Date: 04/01/11 Time: 1700 (continued)

160011 Shift Evaluation (continued)
Pacer/Defibrillator: N
Heart Sounds: REGULAR
Cap Refill Eval: Y
RUE: BRISK < 3 SECONDS
LUE: BRISK < 3 SECONDS
RLE: BRISK < 3 SECONDS
LLE: BRISK < 3 SECONDS
Peripheral Pulse Eval: Y
R Radial: 2+ NORMAL
L Radial: 2+ NORMAL
R Dorsal Pedis: 2+ NORMAL
L Dorsal Pedis: 2+ NORMAL
R Post Tibial: 2+ NORMAL
L Post Tibial: 2+ NORMAL
Additional Pulses: N
JVD Present: N
Edema: Y
Edema Location: GENERALIZED
Edema Type: GENERALIZED
Chest Pain: N
>< TELEMETRY EVALUATION ><
EKG Rhythm: SINUS TACHYCARDIA
Rate: 104
Change from previous: N
ST/T-Wave Changes: N
< PACER EVALUATION SCREEN >
< RESPIRATORY EVALUATION >
Depth: DEEP
Effort: TACHYPNEA
Cough: NONE
Chest Shape: SYMMETRICAL
Chest Movement: SYMMETRICAL
O2 Therapy: Y
Breath Sounds Eval: Y
R Upper Anterior: CLEAR
L Upper Anterior: CLEAR
R Mid Anterior: CLEAR
R Lower Anterior: DIMINISHED
L Lower Anterior: DIMINISHED
< RETRACTIONS >
< OXYGEN THERAPY >
O2 Device: NASAL CANNULA
O2 Flow (L/M): 2
FIO2 % : 96
< INCENTIVE SPIROMETRY >
< GASTROINTESTINAL EVALUATION >
< INTEGUMENTARY EVALUATION >

Problem/Self-Intervention Description	Activity Type	Occurred Date	Occurred Time	By	Recorded Date	Recorded Time	By	Self-Intervention Comment	Units	Self-Intervention Documented Charge	Self-Intervention Documented Verified

Nursing/Medical Intervention Description	Activity Type	Occurred Date	Occurred Time	By	Recorded Date	Recorded Time	By	Nursing/Medical Intervention Comment	Units	Nursing/Medical Intervention Documented Charge	Nursing/Medical Intervention Documented Verified

Activity Date: 03/30/11 Type: FLOW (continued)

16001I Shift Evaluation (continued)
Skin Appearance: APPROPRIATE FOR PATIENT
Skin Temp: WARM
Skin Moisture: DRY
Skin Turgor: GOOD
Mucous Membrane: MOIST
Wounds/Ulcer: Y
Incisions: Y
New Onset Skin Breakdown: N
< WOUND/ULCER EVALUATION >
Type #1: LACERATION
Location: TIP OF TONGUE
Type #2: ULCER
Location: COCCYX
Type #3: LACERATION
Location: LUMBAR SPINE
Type #4: SCAR
Location: FIRST 3 FINGERS LT HAND
< INCISION EVALUATION >
Type #1: INCISION
Location: LT CLAVICLE
Type #2: INCISION
Location: LUMBAR SPINE
Sensory perception- Slightly limited
Moisture- Rarely moist
Activity- Bedfast
Mobility- Very limited
Nutrition- Very poor
Friction and shear- Potential problem
Braden Skin Score: 13
Braden Risk Level: Medium
Skin risk interventions: Manage moisture. Avoid drying the skin
Manage nutrition. Maintain good hydration
Manage friction and shear
No massage of reddened bony prominences
Reposition Q2hrs and PRN
Offer rolling when turning
Pericare PRN
Use moisture barrier: body wash and lotion routinely
Maximal reconditation-up in chair for meals when appropriate
Protect (offload) heels
Use turn sheets to reduce friction/shear
HOB < 30 degrees unless medically contraindicated
Consider pressure relieving surface (if bed or chair bound)
Provide education on pressure ulcers to patient and family
Assess nutrition status, obtain nutrition consult prn
Use foam wedges for 30 degree lateral positioning
Consider trapeze if indicated

Activity Date: 03/30/11 Type: FLOW (continued)

16001I Shift Evaluation (continued)
Monitor all body folds for moisture, yeast, rash, irritation
< MUSCULOSKELETAL EVALUATION >
< GENITOURINARY >
Urinary Elimination: CATHETER-INDWELLING
Secured with: LEG STRAP
Urine Color: YELLOW
Urine Clarity: CLEAR
Consider catheter removal based on criteria: N
Penile Discharge: N
< PSYCHOSOCIAL EVALUATION >
Event/Issue:
Taken:
<Suicide Risk Assessment, Modified SAD PERSONS>
Pt Has 3 or more meds in drug classes known to
be indicator of fall risk: N
Is patient Responsive: Yes
Is patient following fall prevention directions: Y
Fall Risk Elements: Confused at times
Add'l Fall Risk Elements: Unsteady Gait
High Risk for Falls: Y
Fall Precautions: Alert: Signage (i.e. Armband, chart, door)
Non-slip footwear
Assist: Mobility
Assist: ADLs
Assist: Toilet program
Tethered devices: Move poles to exit side of bed, secure tubes
Bed Alarm
Diversional Activities
< SPECIAL EQUIPMENT >
<< INVASIVE LINES >>
Peripheral IV: Y
PICC/CVC Catheter: Y
Peripheral Site #1: Y
<< PERIPHERAL LINE >>
Monitor/Manage: Y
Location: LEFT ANTECUBITAL
IV Type: ANGIOCATH
Size: 20 GAUGE
Saline Lock: Y
<< PERIPHERAL LINE >>
Right Cephalic Vein- PICC - Multi Lumen
Right Cephalic External Line Length(cm): 5.0
Dressing changed per evidence base recommendations- No
CVC or PICC line reserved- No
Has line necessity been reviewed? Y
Line maintenance performed? Y
< MIDLINE >

Problem/Goal/Intervention Description — Src — Interaction — Provider
Activity — Type — Date — Time — By — Value — Time — Qty — Comment — Documented — Init — Cosign

Activity Date: 04/01/11 Time: 1744 (continued)

160011 Shift Evaluation (continued)
<< ARTERIAL LINE >>
<< INTRACRANIAL PRESSURE CATHETER >>
<< PULMONARY ARTERY CATHETER >>
PRESSURES:
<< SHEATH-PERCUTANEOUS INTRODUCER >>
PULSES:
<< INTRAORTIC BALLOON PUMP >>
Condition:
PULSES
<< VENTRICULAR ASSIST DEVICE >>
< INDWELLING CATHETER / TUBES & DRAINS >
< TUBES AND DRAINS >
Manage: Y
< INDWELLING CATHETER REMOVAL >
< TUBES AND DRAINS - MANAGE > Y
#1 Tube/Drain: FOLEY
Location: URETHRA
Secured with: LEG STRAP
<< TEACHING & LOCATION >>
Education Content:
Pharmacological Prophylaxis due to
130028 Age Guidelines: 90 Years, Adult-Elderly A H QSHIFT CP
Document 04/01/11 1703 ZA 04/01/11 1744 ZA

Activity Date: 04/01/11 Time: 1720

191020 CLINICAL MONITORING> A MQ
Pulse: 105
Pulse: 104
Resp: 30
Non-Invasive BP-Systolic: 138
Non-Invasive BP-Diastolic: 61
Non-Invasive BP-Mean: 77
Pulse Ox: 94
Ventricular Premature Beats: 2

Activity Date: 04/01/11 Time: 1730

191020 CLINICAL MONITORING> A MQ
Pulse: 106
Pulse: 104
Resp: 31
Non-Invasive BP-Systolic: 137
Non-Invasive BP-Diastolic: 63
Non-Invasive BP-Mean: 83

Activity Date: 04/01/11 Time: 1740 (continued)

191020 CLINICAL MONITORING> (continued)
Pulse Ox: 96
Ventricular Premature Beats: 2

Activity Date: 04/01/11 Time: 1744

160012 Admit: Acute Guidelines A 60 admission A3
Create 04/01/11 1715 ZA 04/01/11 1744 ZA
Document 04/01/11 1743 ZA 04/01/11 1744 ZA
<< CARE GUIDELINES >>
Location: CRITICAL CARE-MEDICAL
Age Group: ADULT 80+ YEARS

Activity Date: 04/01/11 Time: 1744

160011 Shift Evaluation E 3AM CP
Ed Status 04/01/11 1744 ZA 04/01/11 1744 ZA
60100 Shift Re-Eval Verification> E QSHIFT CP
Ed Status 04/01/11 1744 ZA 04/01/11 1744 ZA
191000 Vital Signs> (NOT BCTA) E QAM CP
Ed Status 04/01/11 1744 ZA 04/01/11 1744 ZA
191020 CLINICAL MONITORING> E MST protocol CP
Ed Status 04/01/11 1744 ZA 04/01/11 1744 ZA
Problem: Standard of Care: Critical Care-Medical A
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
Goal: SOC: Will Receive Standard of Care A
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
60002 MRSA CDC STUDY ARM 3> A Daily CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
30021 Standards of Care, Critical Care-Medical A QSHIFT CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
30A00 Ventilator Acquired Pneumonia Protocol> A Q2H CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
160011 Shift Evaluation A Q4H CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
60100 Shift Re-Eval Verification> A Q2H CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
160013 NUR:Procedure Consent A pre bedside procedure CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
191000 Vital Signs> (NOT BCTA) A Q2H CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
191020 CLINICAL MONITORING> A MST protocol CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA
210010 Monitor: EKG Rhythm Strip> A E,Q/SHIFT+PRN CP
Create 04/01/11 1744 ZA 04/01/11 1744 ZA

Age/Sex: 81 M
Unit #: [redacted]
Admitted: 03/30/11 at 0245
Status: DIS Thx

Attending: Azrak,Yeshitila MD
Account #: [redacted]
Location: M.SSIC
Room/Bed: M.A359-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD M/F

Printed 04/12/11 at 1002

Procedure/Goal/Intervention Description | Site/Information | Event | Activity Date/Time | Occurred By/Date/Time | Entered By/Date/Time | Documented Date/Time | Comments

Activity Date: 04/01/11 Time: 0745

210312 Monitor; Invasive Spirometry A - QSH CP
Created: 04/01/11 1749 ZA - 04/01/11 1744 ZA
210545 Eval; Modified Ramsay Scale A Q4H CP
Created: 04/01/11 1749 ZA - 04/01/11 1744 ZA
300020 IV Therapy; Medication Infusion A when titrate rate changed Q CP
Created: 04/01/11 1744 ZA - 04/01/11 1744 ZA

Activity Date: 04/01/11 Time: 0745

191020 CLINICAL MONITORING A MD
Documented: 04/01/11 0745 ZA - 04/01/11 0745 ZA
Pulse: 104
Pulse: 96
Resp: 24
Non-Invasive BP-Systolic: 137
Non-Invasive BP-Diastolic: 65
Non-Invasive BP-Mean: 83
Pulse Ox: 96
Ventricular Premature Beats: 0

Activity Date: 04/01/11 Time: 0756

191020 CLINICAL MONITORING A MD
Created: 04/01/11 0756 ZA - 04/01/11 0756 ZA

Activity Date: 04/01/11 Time: 0800

196040 BCTA: Transfusion Documentation A per standard RS
Documented: 04/01/11 0800 ZA - 04/01/11 0810 ZA
Temp-C: 36.9
Temp-F: 98.5
Pulse: 109
Resp: 30
BP: 137/66
Pulse Ox: 98
Signs & Symptoms of Possible Transfusion Reaction: N

Activity Date: 04/01/11 Time: 0815

191020 CLINICAL MONITORING A MD
Documented: 04/01/11 0815 ZA - 04/01/11 0815 ZA
Pulse: 105
Pulse: 72
Resp: 26
Non-Invasive BP-Systolic: 96
Non-Invasive BP-Diastolic: 74
Non-Invasive BP-Mean: 33

Activity Date: 04/01/11 Time: 0915 (continued)

191020 CLINICAL MONITORING (continued)
Pulse Ox: 94
Ventricular Premature Beats: 15

Activity Date: 04/01/11 Time: 92?

196040 BCTA: Transfusion Documentation A per standard RS
Documented: 04/01/11 0825 ZA - 04/01/11 0900 ZA
Temp-C: 36.4
Temp-F: 97.8
Pulse: 100
Resp: 24
BP: 158/73
Pulse Ox: 98
Signs & Symptoms of Possible Transfusion Reaction: N

Activity Date: 04/01/11 Time: 0825

191040 CLINICAL MONITORING A MD
Documented: 04/01/11 0825 ZA - 04/01/11 0910 ZA
Pulse: 105
Pulse: 109
Resp: 26
Non-Invasive BP-Systolic: 155
Non-Invasive BP-Diastolic: 72
Non-Invasive BP-Mean: 93
Pulse Ox: 96
Ventricular Premature Beats: 9

Activity Date: 04/01/11 Time: 0900

191020 CLINICAL MONITORING A MD
Documented: 04/01/11 0900 ZA - 04/01/11 0910 ZA
Pulse: 103
Pulse: 101
Resp: 27
Non-Invasive BP-Systolic: 158
Non-Invasive BP-Diastolic: 74
Non-Invasive BP-Mean: 95
Pulse Ox: 98
Ventricular Premature Beats: 6

Activity Date: 04/01/11 Time: 0945

191020 CLINICAL MONITORING A MD
Documented: 04/01/11 0945 ZA - 04/01/11 0945 ZA
Pulse: 100
Pulse: 98

Problem/Goal/Intervention Description

Activity Type	Documented Date	Documented Time	By	Comment	Last Documented Date	Last Documented Time	By	Comment	Status

Activity Date: 04/01/11 Type: [illegible]

191020 CLINICAL MONITORING (continued)
0450: 26
Non-Invasive BP-Systolic: 148
Non-Invasive BP-Diastolic: 84
Non-Invasive BP-Mean: 101
Pulse Ox: 96
Ventricular Premature Beats: 2

Activity Date: 04/01/11 Time: 0600

191020 CLINICAL MONITORING (continued) A MD
Documented: 04/01/11 0600 RN 04/01/11 0600 RN
Pulse: 104
Pulse: 102
Resp: 26
Non-Invasive BP-Systolic: 150
Non-Invasive BP-Diastolic: 73
Non-Invasive BP-Mean: 93
Pulse Ox: 96
Ventricular Premature Beats: 14

Activity Date: 04/01/11 Time: 0745

191020 CLINICAL MONITORING (continued) A MD
Documented: 04/01/11 0745 RN 04/01/11 0745 RN
Pulse: 103
Pulse: 94
Resp: 26
Non-Invasive BP-Systolic: 148
Non-Invasive BP-Diastolic: 68
Non-Invasive BP-Mean: 80
Pulse Ox: 97
Ventricular Premature Beats: 11

Activity Date: 04/01/11 Time: 0900

191020 CLINICAL MONITORING (continued) A MD
Documented: 04/01/11 0900 RN 04/01/11 0900 RN
Pulse: 101
Pulse: 98
Resp: 26
Non-Invasive BP-Systolic: 150
Non-Invasive BP-Diastolic: 69
Non-Invasive BP-Mean: 87
Pulse Ox: 97
Ventricular Premature Beats: 2

Problem/Goal/Intervention Description

Activity Type	Documented Date	Documented Time	By	Comment	Last Documented Date	Last Documented Time	By	Comment	Status

Activity Date: 04/01/11 Time: 1045

191020 CLINICAL MONITORING (continued) A MD
Documented: 04/01/11 1045 RN 04/01/11 1045 RN
Pulse: 132
Pulse: 101
Resp: 26
Non-Invasive BP-Systolic: 151
Non-Invasive BP-Diastolic: 80
Non-Invasive BP-Mean: 97
Pulse Ox: 98
Ventricular Premature Beats: 3
Lab Results: 04/01/11 1945 RP 04/01/11 1957 RP ADDITIONAL INFO
Type: 28.2 fl

Activity Date: 04/01/11 Time: 1951

192000 Intake and Output (NOT BCMA) A 0120 CP
Documented: 04/01/11 1951 RN 04/01/11 1951 RN
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids: 100
Blood Prod: 125
<< OUTPUT >>
Foley: 60
210062 Eval: Venous Thromboembolism A on admission - CSHLEE CP
Documented: 04/01/11 1951 RN 04/01/11 1951 RN
Is patient currently on anticoagulation medication? Y
Pharmacological Prophylaxis due to:
210270 ADLs: A 0120 CP
Documented: 04/01/11 1951 RN 04/01/11 1951 RN
< ADL ASSISTANCE >
ACTIVITY
Assistance Required: Y
Assisted By: STAFF
Type: REPOSITIONED
Patient Response: COOPERATIVE
Tolerance: WELL
TOILETING
ORAL CARE
Assistance Required: Y
Assisted By: STAFF
Type: SWAB MOUTH
EATING
PERSONAL HYGIENE
LINEN CHANGED
DRESSING

[redacted] Attending: Agzam,Yeshitila MD WINKLER, LOUIS Page: 39
Admitted: 03/30/11 at 0246 Account #: [redacted]
Status: DIS INA Location: M.SSIC Brandon Regional Hospital Nursing "Live" Printed 04/12/11 at 1002
Room/Bed: M.A539-1 CLINICAL DOCUMENTATION RECORD

Problem/Goal/Intervention Description	Type	Activity	Occurred Date	Occurred Time	By	Discontinued Date	Discontinued Time	By	Comment	Initials	Charge
Problem/Goal/Intervention Description	Type	Activity	Occurred Date	Occurred Time	By	Discontinued Date	Discontinued Time	By	Comment	Initials	Charge

Activity Date: 04/01/11 Time: 1454

245000 Pain Management+ A with VS and PRN CP
Document 04/01/11 1953 RN 04/01/11 1956 RN
Pain Evaluation: Y
Evaluation Type: EVALUATION
*Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:
230010 Invasive Line Management+ A E Q/SHIFT+PRN CP
Document 04/01/11 1953 RN 04/01/11 1956 RN
<< INVASIVE LINES >>
Peripheral IV: Y
PICC/CVC Catheter: Y
Peripheral Site @1: Y
<< PERIPHERAL LINE >>
Monitor/Manage: Y
Location: LEFT ANTECUBITAL
Insertion Date: 03/30/11
IV Type: AUGICCATH
Size: 18 GAUGE
<< PERIPHERAL LINE >>
<< PERIPHERAL LINE >>
<< PERIPHERAL LINE >>
Right Cephalic Vein- PICC - Multi Lumen
Right Cephalic External Line Length(cm)- 5.0
Dressing changed per evidence base recommendations- NO
CVC or PICC line removed- No
Was the necessity been reviewed? Y
Line maintenance performed? Y
< MIDLINE >
<< ARTERIAL LINE >>
<< INTRACRANIAL PRESSURE CATHETER >>
<< PULMONARY ARTERY CATHETER >>
PRESSURES:
<< SWAN-GANZ CARDIAC THERMODILUTION >>
PULSES:
<< INTRAAORTIC BALLOON PUMP >>
Condition:
PULSES
<< VENTRICULAR ASSIST DEVICE >>
330020 Tubes & Drains Management+ A E Q/SHIFT+PRN CP
Document Foley Insert/Discontinue Here.
Document Foley Monitor/Manage In Shift
Eval GU Body System or Focus Care: GU
Document 04/01/11 1953 RN 04/01/11 1956 RN
< INDWELLING CATHETER / TUBES & DRAINS >
< TUBES AND DRAINS >
Manage: Y
< INDWELLING CATHETER INSERTION >

Activity Date: 04/01/11 Time: 1454 (continued)

330030 Tubes & Drains Management+ (continued)
< INDWELLING CATHETER REMOVAL >
< TUBES AND DRAINS - MANAGE > Y
#1 Tube/Drain: FOLEY
Location: URETHRA
330025 Special Equipment Management+ A QSHIFT CP
Document 04/01/11 1953 RN 04/01/11 1956 RN
< SPECIAL EQUIPMENT >
Special Equip: IV PUMP
Special Equip: WALL SUCTION
Special Equip: SEQ. COMPRESSION DEVICE
Comment: MACHINE ENTERED ON
450106 Education: Interdisciplinary+ A QSHIFT CP
Document 04/01/11 1953 RN 04/01/11 1956 RN
<< TEACHING & EDUCATION >>
Department: NURSING
Setting: BEDSIDE
Learner: PATIENT
Readiness to Learn: ASKS QUESTIONS
Preferred Method: EXPLANATION
Barriers: MEDICAL CONDITION
Education Content:
Hospital Core: Plan of Care
Patient Safety
Strategies: EXPLANATION
Evaluation: STATES UNDERSTANDING
460400 Education: Interdisciplinary Meds+ A QSHIFT CP
Document 04/01/11 1953 RN 04/01/11 1956 RN
<< MEDICATION EDUCATION >>
Med: ROCEPHIN
Content: SIDE EFFECTS
DOSAGE
ACTIONS OF DRUG
ROUTE OF ADMINISTRATION
Setting: BEDSIDE
Learner: PATIENT
Readiness: ASKS QUESTIONS
Preferred Method: EXPLANATION
Barriers: MEDICAL CONDITION
COGNITIVE LIMITATION
Strategies: EXPLANATION
Evaluation: NEEDS REINFORCEMENT
140011 Shift Evaluation A GLOW CP
Document 04/01/11 1953 RN 04/01/11 1956 RN
<< SHIFT EVALUATION >>
Neurological WDP: N
GENT WDP: Y
Cardiovascular WDP: N

Problem/Goal/Intervention Description | Site/Orientation | Freq

Activity Type | Occurred Date | Occurred Time by Date | Recorded Time by Current | Initials | Source

Problem/Goal/Intervention Description

Activity Type | Scheduled Date | Required Time by Date | Discontinued Time by Current | Initials | Source

Activity Date: 03/30/11 Time: 1955 (continued)

160011 Shift Evaluation (continued)
Respiratory WDP: N
Gastrointestinal WDP: Y
Integumentary WDP: N
Musculoskeletal WDP: N
Genitourinary WDP: N
Psycho-social WDP: Y
Code Status: DNR
Skin Risk Evaluation: Y
FALL RISK ASSESSMENT: Y
~ PAIN EVALUATION ~
Does Patient Currently Have Pain: N
>Pain Scale Used: NUMERICS 0-10
>Pain Score: 0
~ ISOLATION PRECAUTIONS ~
Isolation Type: NONE
Infection control and transmission prevention information provided to patient/family/visitors and questions answered: Y
< NEUROLOGICAL EVALUATION >
LOC: AROUSABLE
Oriented: N
Disoriented to: SITUATION/EVENT
Speech: SLOW
Impaired Memory: RECENT PAST
Behavior: CONFUSED
COOPERATIVE
Comment: MAE WEAK
< CCNT EVALUATION >
< CARDIOVASCULAR EVALUATION >
Is Patient on Cardiac Monitoring: Y
Edema: Y
Edema Location: LEFT UPPER EXTREMITY
LOWER EXTREMITIES
Edema Type: 3+ > 1 MINUTE
2+ 1 MINUTE
<< TELEMETRY EVALUATION >>
EKG Rhythm: SINUS RHYTHM
Rate: 95
< PACER EVALUATION SCREEN >
< RESPIRATORY EVALUATION >
O2 Therapy: Y
Breath Sounds Eval: Y
R Upper Anterior: CLEAR
L Upper Anterior: CLEAR
R Mid Anterior: CLEAR
R Lower Anterior: DIMINISHED
L Lower Anterior: DIMINISHED
R Upper Posterior: CLEAR

Activity Date: 03/30/11 Time: 1955 (continued)

160011 Shift Evaluation (continued)
L Upper Posterior: CLEAR
R Lower Posterior: DIMINISHED
L Lower Posterior: DIMINISHED
< RETRACTIONS >
< OXYGEN THERAPY >
O2 Device: NASAL CANNULA
O2 Flow (L/M): 2
< INCENTIVE SPIROMETRY >
< GASTROINTESTINAL EVALUATION >
< INTEGUMENTARY EVALUATION >
Wounds/Ulcer: Y
< WOUND/ULCER EVALUATION >
Type #1: LACERATION
Location: TIP OF TONGUE
Type #2: ULCER
Location: COCCYX
< INCISION EVALUATION >
Sensory perception- Slightly limited
Moisture- Occasionally moist
Activity- Chairfast
Mobility- Very limited
Nutrition- Probably inadequate
Friction and Shear- Potential problem
Braden Skin Score: 14
Braden Risk Level: Medium
Skin risk interventions: Manage moisture, Avoid drying the skin
Manage nutrition, Maintain good hydration
Manage friction and shear
No damage of reddened bony prominences
Reposition Q2hrs and PRN
Offer toileting when turning
Pericare PRN
Use moisture barrier; body wash and lotion routinely
Maximal rehabilitation-up in chair for meals when appropriate
Protect (offload) heels
Use turn sheets to reduce friction/shear
HOB < 30 degrees unless medically contraindicated
Consider pressure relieving surface (if bed or chair bound)
Provide education on pressure ulcers to patient and family
Assess nutrition status, obtain nutrition consult prn
Use foam wedges for 30 degree lateral positioning
Consider trapeze if indicated
Monitor all body folds for moisture, yeast, rash, irritation
< MUSCULOSKELETAL EVALUATION >
ROM R Arm: WEAKNESS
ROM L Arm: WEAKNESS
ROM R Leg: WEAKNESS

Age/Sex: 81 M
Unit #: [redacted]
Admitted: 03/30/11 06:02:45
Status: DIS INN

Attending: Aurea Yehuda MD
Account #: [redacted]
Location: H.ICU
Room/Bed: H.A539-1

WINKLER, LOUIS

Brandon Regional Hospital Nursing "Live"
CLINICAL DOCUMENTATION RECORD MAR

Printed 04/12/11 at 1002

Problem/Goal/Intervention Description	Sig Interaction	Flag
Activity Type	Occurred Date Time	Recorded Date Time	By	Code	Documented Date Time	Charge

Activity Date: 04/01/11 Time: 1557 (continued)

16001 Shift Evaluation (continued)
RCM L Leg: WEAKNESS
< GENITOURINARY >
Urinary Elimination: CATHETER-INDWELLING
Secured with: STABILIZATION DEVICE
Urine Color: YELLOW
Urine Clarity: CLEAR
Consider catheter removal based on criteria: N
< PSYCHOSOCIAL EVALUATION >
Event/Issue:
Taken:
<Suicide Risk Assessment. Modified SAD PERSONS>
Pt has 3 or more meds in drug classes known to
be indicator of fall risk: N
Is patient Responsive: Yes
Is patient following fall prevention directions: Y
Fall Risk Elements: Confused at times
Add'l Fall Risk Elements: Unsteady Gait
Tethered Device
Decreased Muscle Coord
Fall Risk Comment: ICU
High Risk for Falls: Y
Fall Precautions: Alert, Signage (i.e. Armband, chart, door)
Non-slip Footwear
Assist: Mobility
Assist: ADLs
Assist: Toilet program
Tethered devices: Move poles to exit side of bed, secure tubes
Bed Alarm
Diversional Activities
< SPECIAL EQUIPMENT >
<< INVASIVE LINES >>
<< PERIPHERAL LINE >>
<< PERIPHERAL LINE >>
< MIDLINE >
<< ARTERIAL LINE >>
<< INTRACRANIAL PRESSURE CATHETER >>
<< PULMONARY ARTERY CATHETER >>
PRESSURES:
<< SHEATH-PERCUTANEOUS INTRODUCER >>
PULSES:
<< INTRAORTIC BALLOON PUMP >>
Condition:
PULSES
<< VENTRICULAR ASSIST DEVICE >>
< INDWELLING CATHETER / TUBES & DRAINS >
< TUBES AND DRAINS >
< INDWELLING CATHETER REMOVAL >

Activity Date: 04/01/11 Time: 1557 (continued)

16001 Shift Evaluation (continued)
<< TEACHING & EDUCATION >>
Education Content:
Pharmacological Problem's due to:

Activity Date: 04/01/11 Time: 1556

00012	Admit: Adult Guidelines*	C	on admission	AS
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	Y3 RF			
	ACCU AC HS			
	SCDS INT PROPHYLAXIS			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	WHEN PHARMACY AND PRIMARY MD FOUND CALL			
	OR .4G			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	3/30-4: NC C2			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	3:30-4:00, C2 8PM, AM LABS			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	3/30-GRAIN SYPHILIS/CONSENTS FOR			
	BLOOD# SUBCLAVICLAN LYMPH NODE BX			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	3/31/11 DVC ROOKEPIN 4/2/11			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	4/1-16 PT ACBEES . TRANSFUSE 2 UNITS			
	PRBC			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	4/1- ABG			
[redacted]				
540000	Patient Care Orders*	C	QSHIFT	OE
	4/1- 06) ACCUCHEK, SS TO FOSE REG INS.			
[redacted]				
00014	Home Med List Clarification*	C	PRN	CP
[redacted]				
190010	Hangar	C	on admission	CP
[redacted]				

Age/Sex: 81 M
Admitted: 03/30/11 at 0245
Status: OIS 14a

Attending: Eazaw, Yeshitila MD
Account #: [redacted]
Location: A-ESTC
Room/Bed: H A539-1

WINKLER, LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD (IP)

Printed 04/12/11 at 1802

Activity Type	Occurred Date	Time	By	Recorded Date	Time	By	Comment	Documented Units	Charge
210068	Eval: Suicide Risk*						on admission		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210061	Eval: Elopement Risk*						on admission		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210066	Eval: Fall Risk*								CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
330070	Tubes & Drains Management*						Q/SHIFT+PRN		CP
Ed Test:	04/01/11 1958 RP	04/01/11 1958 RP							
O/C Test Value:				=> New Test Value:					
Document Foley Insert/Discontinue Note:									
Document Foley Maintenance Urinary Drain:									
Eval CV Assessment Focus Care: CV									
130117	Standards of Care: Telemetry-Medical						QSHIFT		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210610	Monitor: EKG Rhythm Strip*						QSHIFT		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210013	Monitor: Incentive Spirometry*						QSHIFT		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
30800	Ventilator Acquired Pneumonia Protocol*						Q2H		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
151020	CLINICAL MONITORING*						per protocol		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210018	Monitor: EKG Rhythm Strip*						Q/SHIFT+PRN		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210012	Monitor: Incentive Spirometry*						Q2H		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210065	Eval: Modified Ramsay Scale*						4HR		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
330038	IV Therapy: Medication Infusion						when citrate rate changes o		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP					QSHIFT		
Problem: PROB: Potential/Actual Altered Mental St									
- Ed Status: 04/01/11 1958 RP 04/01/11 1958 RP								A => C	
Goal: (D Altered Mental Stat/n/Maintain Safety									
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210052	Eval: Mental Status*						PRN		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
Problem: PROB: Impaired ENMT Function									
- Ed Status: 04/01/11 1958 RP 04/01/11 1959 RP								A => C	
Goal: GOAL: Maintain/Improve ENMT function									
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
160275	Enhanced Care: ENT*								CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
Problem: PROB: Impaired GI Function									
- Ed Status: 04/01/11 1958 RP 04/01/11 1958 RP								A => C	

Activity Type	Occurred Date	Time	By	Recorded Date	Time	By	Comment	Documented Units	Charge
Goal: GOAL: Maintain/Improve GI Function									
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
160220	Focused Care: GI*								CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210056	Eval: Glascow Coma Scale*								CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
210045	Eval: Wound & Skin*						QSHIFT		CP
Ed Status:	04/01/11 1958 RP	04/01/11 1958 RP							
330005	CVC/PICC Insertion*						per standard		CP
Ed Test:	04/01/11 1958 RP	04/01/11 1958 RP							
O/C Test Value:				=> New Test Value:					
Document both CVC/PICC Insertions AND									
Chest placed prior to portal vein									
151020	CLINICAL MONITORING*								MD
Ed Status:	04/01/11 2000 RP	04/01/11 2000 RP							
Pulse: 101									
Pulse: 90									
Resp: 27									
Non-Invasive BP-Systolic: 141									
Non-Invasive BP-Diastolic: 73									
Non-Invasive BP-Mean: 68									
Pulse Ox: 99									
Ventricular Premature Beats: 2									
460010	RT: Respiratory Therapy Treatment*						per order		RT
Ed Status:	04/01/11 2000 RP	04/01/11 2000 RP							
- RESPIRATORY THERAPY TREATMENT -									
Oxygen Therapy: Y									
- RT INH TREATMENT -									
Pre-treatment breath sounds									
Post-treatment breath sounds									
- RT INH TREATMENT -									
Pre-treatment breath sounds									
Post-treatment breath sounds									
- OXYGEN FLOW SHEET -									
O2 Flow: 3									
l/gn									
%									
O2 Type: NASAL CANNULA									
- CPT TREATMENT/POSTURAL DRAINAGE -									
Minutes									
- CMITTED TREATMENT -									
- SUCTIONING -									

Age/Sex: 81 M
Unit #: [redacted]
Admitted: 03/30/11 at 0245
Strategy: DIS THx

Attending: Aslam,Yashitla MD
Account #: [redacted]
Location: M.5S1C
Room/Bed: M.A539-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD HPF

Printed 04/12/11 at 1002

Problem/Goal/Intervention Description	Seq	Interdisc	Freq
Activity Type	Ordered Date	Ordered Time	By	Received Date	Time	By	Comment	Documented Date	Time	Initials

Activity Date: 04/01/11 Time: 2000, continued

480016 RT: Respiratory Therapy Treatment (continued)
< INCENTIVE SPIROMETRY >
-PULSE OXIMETRY -
E
I

Activity Date: 04/01/11 Time: 2015

191020 CLINICAL MONITORING A MD
Document 04/01/11 2015 RP 04/02/11 0624 RP
Pulse: 101
Pulse: 99
Resp: 27
Non-Invasive BP-Systolic: 140
Non-Invasive BP-Diastolic: 55
Non-Invasive BP-Mean: 78
Pulse Ox: 98
Ventricular Premature Beats: 1

Activity Date: 04/01/11 Time: 2030

191020 CLINICAL MONITORING A MD
Document 04/01/11 2030 RP 04/02/11 0624 RP
Pulse: 104
Pulse: 100
Resp: 29
Non-Invasive BP-Systolic: 125
Non-Invasive BP-Diastolic: 95
Non-Invasive BP-Mean: 104
Pulse Ox: 98
Ventricular Premature Beats: 2

Activity Date: 04/01/11 Time: 2045

191020 CLINICAL MONITORING A MD
Document 04/01/11 2045 RP 04/02/11 0624 RP
Pulse: 106
Pulse: 103
Resp: 26
Non-Invasive BP-Systolic: 127
Non-Invasive BP-Diastolic: 68
Non-Invasive BP-Mean: 75
Pulse Ox: 98
Ventricular Premature Beats: 0

Problem/Goal/Intervention Description	Seq	Interdisc	Freq
Activity Type	Ordered Date	Ordered Time	By	Received Date	Time	By	Comment	Documented Date	Time	Initials

Activity Date: 04/01/11 Time: 2100

191020 CLINICAL MONITORING A MD
Document 04/01/11 2100 RP 04/02/11 0624 RP
Pulse: 101
Pulse: 101
Resp: 26
Non-Invasive BP-Systolic: 130
Non-Invasive BP-Diastolic: 60
Non-Invasive BP-Mean: 75
Pulse Ox: 98
Ventricular Premature Beats: 0
- Edit Results 04/01/11 2100 RP 04/02/11 0624 RP ADDITIONAL INFO
Temp-F: 99.4 []
192000 Intake and Output (NOT BCTA) A Q12H CP
Document 04/01/11 2100 RP 04/02/11 0112 RP
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids. 100
<< OUTPUT >>
Foley: 60
240300 Pain Management A with IS and PRN CP
Document 04/01/11 2100 RP 04/02/11 0112 RP
Pain Evaluation: Y
Evaluation Type: EVALUATION
>Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:

Activity Date: 04/01/11 Type: 2100

LSK000 BCTA: Transfusion Documentation* A per standard PS
Document 04/01/11 2100 RP 04/02/11 0112 RP
Temp-C: 37.4
Temp-F: 99.4
Pulse: 104
Resp: 26
BP: 130/80
Pulse Ox: 99
Signs & Symptoms of Possible Transfusion Reaction: N
196003 BCTA: Blood Bank Product IAD+ A per standard PS
Document 04/01/11 2100 RP 04/02/11 0112 RP
Packed Cells, Volume Transfused: 350

WINKLER, LOUIS

Brandon Regional Hospital Nursing Flow
CLINICAL DOCUMENTATION RECORD MAR

Provider: 81 M [redacted]
Admitted: 03/30/11 at 0946
Service: DIS INx

Attending: Agtem, Yashitla MD
Account #: [redacted]
Location: H.CSIC
Room/Bed: H.A339-1

Prn/Clinical Intervention Description — Activity Type — Activity Date — Activity Time — Activity Time by Patient — Documented By — Documented Date/Time — Charge

Activity Date: 04/01/11 Time: 2100

1910:0 CLINICAL MONITORING+ A MD
Document: 04/01/11 2133 RR/ 04/02/11 0626 RP
Pulse: 104
Pulse: 86
Resp: 26
Non-Invasive BP-Systolic: 136
Non-Invasive BP-Diastolic: 56
Non-Invasive BP-Mean: 76
Pulse Ox: 98
Ventricular Premature Beats: 2

Activity Date: 04/01/11 Time: 2200

1910:0 CLINICAL MONITORING+ A MD
Document: 04/01/11 2310 RR/ 04/02/11 0626 RP
Pulse: 109
Pulse: 87
Resp: 23
Non-Invasive BP-Systolic: 134
Non-Invasive BP-Diastolic: 46
Non-Invasive BP-Mean: 52
Pulse Ox: 98
Ventricular Premature Beats: 27

Activity Date: 04/01/11 Time: 2340

1910:0 CLINICAL MONITORING+ A MD
Document: 04/01/11 2340 RR/ 04/02/11 0626 RP
Pulse: 100
Pulse: 100
Resp: 25
Non-Invasive BP-Systolic: 132
Non-Invasive BP-Diastolic: 63
Non-Invasive BP-Mean: 79
Pulse Ox: 98
Ventricular Premature Beats: 11

Activity Date: 04/02/11 Time: 0000

1910:0 CLINICAL MONITORING+ A MD
Document: 04/02/11 0010 RR/ 04/02/11 0626 RP
Pulse: 99
Pulse: 97
Resp: 25
Non-Invasive BP-Systolic: 140
Non-Invasive BP-Diastolic: 69
Non-Invasive BP-Mean: 78
Pulse Ox: 97

Prn/Clinical Intervention Description — Activity Type — Activity Date — Activity Time — Activity Time by Patient — Documented By — Documented Date/Time — Charge

Activity Date: 04/01/11 Time: 2200 (continued)

1910:0 CLINICAL MONITORING+ (continued)
Ventricular Premature Beats: 0
197300 Intake and Output+ (NOT ECTA) A CLIN CP
Document: 04/01/11 2200 RR/ 04/02/11 0626 RP
< INTAKE AND OUTPUT >
Intake, Y
Output, Y
<< INTAKE >>
IV Fluids: 100
<< OUTPUT >>
Foley, 70
710270 ADL+ A CLIN CP
Document: 04/01/11 2200 RR/ 04/02/11 0626 RP
< ADL ASSISTANCE >
ACTIVITY
Assistance Required: Y
Assisted By: STAFF
Type: REPOS(OTHER)
Patient Response: COOPERATIVE
Tolerance: WELL
TOILETING
ORAL CARE
Assistance Required: Y
Assisted By: STAFF
Type: SWAB MOUTH
EATING
PERSONAL HYGIENE
Assistance Required: Y
Assisted By: STAFF
Type: FOLEY CARE
SKIN CARE(BACITRACIN/CREAM)
PERINEAL CARE
LINEN CHANGED
Was Linen Changed: Y
Type: COMPLETE LINEN CHANGE
DRESSING
Was Patient Assisted with Changing Clothes: Y
140060 Pain Management+ A with VS and PPA CP
Document: 04/01/11 2200 RR/ 04/02/11 0626 RP
Pain Evaluation: Y
Evaluation Type: EVALUATION
>Pain Score: 5
<< TEACHING & EDUCATION >>
Education Content:
160100 Shift Re-Eval Verification+ A CLIN CP
Document: 04/01/11 2200 RR/ 04/02/11 0626 RP
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift

Age/Sex: 81 M
MRN #: [redacted]
Admitted: 03/30/11 at 0246
Status: DIS Inp

WINKLER, LOUIS

Brandon Regional Hospital Nursing Unit
CLINICAL DOCUMENTATION RECORD MAR

Page: 45
Printed 04/12/11 at 1802

Problem/Goal/Intervention Description	Site/Direction	Time	Problem/Goal/Intervention Description	Site/Direction	Time
Activity Type / Occurred Date / Occurred Time / Recorded Time / Recorded by / Instrument Units / Charge			Activity Type / Occurred Date / Occurred Time / Recorded Time / Recorded by / Instrument Units / Charge		

Activity Date: 04/01/11 Time: 2230 (continued)

160160 Shift Re-Eval Verification (continued)
Re-evaluation and have noted no change from my previous evaluation or have noted changes and have documented said changes appropriately.
Nurse signature: Print Name - PH

Activity Date: 04/01/11 Time: 2230

191060 CLINICAL MONITORING [redacted] A MD
Pulse: 106
Pulse: 104
Resp: 25
Pulse Ox: 97
Ventricular Premature Beats: 3

Activity Date: 04/01/11 Time: 2300

191060 CLINICAL MONITORING [redacted] A MD
Pulse: 106
Pulse: 84
Resp: 23
Non-Invasive BP-Systolic: 119
Non-Invasive BP-Diastolic: 53
Non-Invasive BP-Mean: 66
Pulse Ox: 98
Ventricular Premature Beats: 1
192060 Intake and Output (NOT BCMA) [redacted] A 0120 CP
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV: 60
IV Fluids: 100
<< OUTPUT >>
Foley: 70
240060 Pain Management [redacted] A with VS and PRN CP
Pain Evaluation: Y
Evaluation Type: EVALUATION
*Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:

191060 CLINICAL MONITORING [redacted] A MD
Pulse: 116
Pulse: 110
Resp: 27
Non-Invasive BP-Systolic: 127
Non-Invasive BP-Diastolic: 62
Non-Invasive BP-Mean: 75
Pulse Ox: 98
Ventricular Premature Beats: 0

Activity Date: 04/02/11 Time: 0000

192060 Intake and Output (NOT BCMA) [redacted] A 0120 CP
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids: 100
<< OUTPUT >>
Foley: 50
210070 ADLs [redacted] A 0120 CP
< ADL ASSISTANCE >
ACTIVITY
Assistance Required: Y
Assisted by: STAFF
Type: REPOSITIONED
Patient Response: COOPERATIVE
Tolerance: WELL
TOILETING
ORAL CARE
EATING
PERSONAL HYGIENE
LINEN CHANGED
DRESSING
240060 Pain Management [redacted] A with VS and PRN CP
Pain Evaluation: Y
Evaluation Type: EVALUATION
*Pain Scale Used: NUMBERS 0-10
*Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:

[redacted] WINKLER,LOUIS Page: 46

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD MPF

Printed 04/12/11 at 1002

Activity Type | Activity Date | Time | By | Date | Line # | Comment | Units | Charge | Documented

Activity Date: 04/02/11 Time: 0001

160108 Shift Re-Eval Verification+ A 02H CP
Documented: 04/02/11 0001 RP 04/02/11 0624 RP ADDITIONAL INFO
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift Re-evaluation and have noted no change from my previous evaluation or have noted changes and have documented said changes appropriately.
Nurse signature: Price,Robert - RN

Activity Date: 04/02/11 Time: 0100

191020 CLINICAL MONITORING+ A MD
Documented: 04/02/11 0100 RP 04/02/11 0624 RP ADDITIONAL INFO
Pulse: 106
Pulse: 78
Resp: 23
Non-Invasive BP-Systolic: 125
Non-Invasive BP-Diastolic: 81
Non-Invasive BP-Mean: 72
Pulse Ox: 97
Ventricular Premature Beats: 1
- Edit Results 04/02/11 0100 RP 04/02/11 0624 RP ADDITIONAL INFO
Temp-F: 98.7 ()
192060 Intake and Output+ (NOT BCTA) A 01H CP
Documented: 04/02/11 0100 RP 04/02/11 0624 RP ADDITIONAL INFO
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids: 100
<< OUTPUT >>
Foley: 50
240000 Pain Management+ A with VS and PAIN CP
Documented: 04/02/11 0100 RP 04/02/11 0624 RP ADDITIONAL INFO
Pain Evaluation: Y
Evaluation Type: EVALUATION
-Pain Score- 0
<< TEACHING & EDUCATION >>
Education Content:

Activity Date: 04/02/11 Time: 0100

191020 CLINICAL MONITORING+ A MD
Documented: 04/02/11 0100 RP 04/02/11 0624 RP ADDITIONAL INFO
Pulse: 106
Pulse: 66
Resp: 25
Non-Invasive BP-Systolic: 121
Non-Invasive BP-Diastolic: 68

Activity Date: 04/02/11 Time: 0200 (continued)

191020 CLINICAL MONITORING+ (continued)
Non-Invasive BP-Mean: 78
Pulse Ox: 98
Ventricular Premature Beats: 0
192060 Intake and Output+ (NOT BCTA) A 01H CP
Documented: 04/02/11 0200 RP 04/02/11 0624 RP ADDITIONAL INFO
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids: 100
<< OUTPUT >>
Foley: 40
210210 ADL+ A 01H CP
Documented: 04/02/11 0200 RP 04/02/11 0624 RP ADDITIONAL INFO
< ADL ASSISTANCE >
ACTIVITY
Assistance Required: Y
Assisted By: STAFF
Type: REPOSITIONED
Patient Response: COOPERATIVE
Tolerance: WELL
TOILETING
ORAL CARE
Assistance Required: Y
Assisted By: STAFF
Type: SWAB MOUTH
BRUSH TEETH/DENTURES
EATING
PERSONAL HYGIENE
LINEN CHANGED
DRESSING
240000 Pain Management+ A with VS and PAIN CP
Documented: 04/02/11 0200 RP 04/02/11 0624 RP ADDITIONAL INFO
Pain Evaluation: Y
Evaluation Type: EVALUATION
-Pain Score- 0
<< TEACHING & EDUCATION >>
Education Content:
160100 Shift Re-Eval Verification+ A 02H CP
Documented: 04/02/11 0200 RP 04/02/11 0624 RP ADDITIONAL INFO
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift Re-evaluation and have noted no change from my previous evaluation or have noted changes and have documented said changes appropriately.
Nurse signature: Price,Robert - RN

Age/Sex: 81 M Attending: Agarwa, Yashitila MD

WINKLER, LOUIS

Page: 47

Status: DIS Inx Room/Bed: M_A539-1

Brandon Regional Hospital Nursing <Live>
CLINICAL DOCUMENTATION RECORD MAR

Printed 04/12/11 at 1002

Prescribed/Goal Intervention Description

Activity Type | Occurred Date | Occurred Time | Recorded Date | Recorded Time | Recorded By | Comment | Documented Date | Documented Time | Charge

Activity Date: 04/02/11 Time: 0400

191000 CLINICAL MONITORING+ A MD
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
Pulse: 110
Pulse: 46
Resp: 17
Non-Invasive BP-Systolic: 125
Non-Invasive BP-Diastolic: 56
Non-Invasive BP-Mean: 67
Pulse Ox: 98
Ventricular Premature Beats: 0
192000 Intake and Output+ (NOT BCTA) A 0130 CP
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids: 100
<< OUTPUT >>
Foley: 45
240000 Pain Management+ A with VS and MAR CP
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
Pain Evaluation: Y
Evaluation Type: EVALUATION
>Pain Scale Used: NUMBERS 0-10
>Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:

Activity Date: 04/02/11 Time: 0400

191020 CLINICAL MONITORING+ A MD
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
Pulse: 111
Pulse: 45
Resp: 6
Non-Invasive BP-Systolic: 123
Non-Invasive BP-Diastolic: 56
Non-Invasive BP-Mean: 72
Pulse Ox: 98
Ventricular Premature Beats: 0
- Edit Results 04/02/11 0400 AP 04/02/11 0624 AP ADDITIONAL INFO
Temp-F: 98.1 [ ]
192000 Intake and Output+ (NOT BCTA) A 0130 CP
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>

192000 Intake and Output+ (NOT BCTA) (continued)
IV Fluids: 100
<< OUTPUT >>
Foley: 45
210270 ADLs+ A 0130 CP
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
< ADL ASSISTANCE >
ACTIVITY
Assistance Required: Y
Assisted By: STAFF
Type: REPOSITIONED
Patient Response: COOPERATIVE
Tolerance: WELL
TOILETING
ORAL CARE
EATING
PERSONAL HYGIENE
Assistance Required: Y
Assisted By: STAFF
Type: FOLEY CARE
SKIN CARE(BACK RUB/CREAM)
PERINEAL CARE
COMPLETE BED BATH
LINEN CHANGED
Was Linen Changed: Y
Type: COMPLETE LINEN CHANGE
DRESSING
Was Patient Assisted with Changing Clothes: Y
240000 Pain Management+ A with VS and MAR CP
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
Pain Evaluation: Y
Evaluation Type: EVALUATION
>Pain Scale Used: NUMBERS 0-10
>Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:
100100 Shift Re-Eval Verification+ A CNA CP
Documented: 04/02/11 0400 AP 04/02/11 0624 AP
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have
noted changes and have documented said changes appropriately.
Nurse signature: Prive, Robert - NA

Age/Sex: 81 M
[redacted]
Admitted: 03/30/11 at 0246
Discharge: 04/5 1Hrs

Attending: Agrew,Yeshitila MD
Account #: [redacted]
Location: M-CSIC
Room/Bed: M A529-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing "Live"
CLINICAL DOCUMENTATION RECORD MAR

Printed 04/12/11 at 2002

Problem/Goal/Intervention Description | Activity Type | Ordered Date | Recorded Time by Date | Recorded Time by Clock | Documented By | Documented Date/Time | New Intervention | Error Charge

Activity Date: 04/02/11 Time: 0600

191020 CLINICAL MONITORING [redacted] A MD
Pulse: 107
Pulse: 106
Resp: 26
Non-Invasive BP-Systolic: 113
Non-Invasive BP-Diastolic: 57
Non-Invasive BP-Mean: 70
Pulse Ox: 98
Ventricular Premature Beats: 1
192008 Intake and Output (NOT BCTA) A Q12H CP
[redacted]
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids: 100
<< OUTPUT >>
Foley: 40
240020 Pain Management A with VS and PRN CP
[redacted]
Pain Evaluation: Y
Evaluation Type: EVALUATION
>Pain Scale Used: NUMBERS 0-10
>Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:

Activity Date: 04/03/11 Time: 0600

191020 CLINICAL MONITORING A MD
[redacted]
Pulse: 114
Pulse: 113
Resp: 22
Non-Invasive BP-Systolic: 118
Non-Invasive BP-Diastolic: 61
Non-Invasive BP-Mean: 74
Pulse Ox: 93
Ventricular Premature Beats: 2
192008 Intake and Output (NOT BCTA) A Q12H CP
[redacted]
< INTAKE AND OUTPUT >
Intake: Y
Output: Y
<< INTAKE >>
IV Fluids: 100
<< OUTPUT >>

Problem/Goal/Intervention Description | Activity Type | Ordered Date | Recorded Time by Date | Recorded Time by Clock | Documented By | Documented Date/Time | New Intervention | Error Charge

Activity Date: 04/03/11 Time: 0600 (continued)

192008 Intake and Output (NOT BCTA) (continued)
Foley: 40
210270 ADL A Q12H CP
[redacted]
< ADL ASSISTANCE >
ACTIVITY
Type: REPOSITIONED
TOILETING
ORAL CARE
EATING
PERSONAL HYGIENE
Assistance Required: Y
Assisted By: STAFF
Type: COMB/SHAMPOO HAIR
SHAVE
LINEN CHANGED
DRESSING
240020 Pain Management A with VS and PRN CP
[redacted]
Pain Evaluation: Y
Evaluation Type: EVALUATION
>Pain Scale Used: NUMBERS 0-10
>Pain Score: 0
<< TEACHING & EDUCATION >>
Education Content:
160100 Shift Re-Eval Verification A W2H CP
[redacted]
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift Re-evaluation and have noted no change from my previous evaluation or have noted changes and have documented said changes appropriately.
Nurse signature: Prive,Robert - RN

Activity Date: 04/03/11 Time: 0600

190020 Weight A on admission and PRN CP
[redacted]
<< WEIGHT >>
Lb: 182

Activity Date: 04/03/11 Time: 0600

450600 Plan of Care Review A Q24HFT CP
[redacted]
< PLAN OF CARE REVIEW >
Nurse signature: Prive,Robert - RN

Sex/Dob: [redacted]
[redacted]
Admitted: 03/02/11 at 0246
Status: OIS IN

Attending: Agtew,Yeshitila [redacted]
Account #: [redacted]
Location: [redacted]
Room/Bed: H.A539-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing "Live"
CLINICAL DOCUMENTATION RECORD RPT

Printed 04/12/11 at 1802

Problem/Goal/Intervention Description | Start Information | Stop Information | Initials
Activity | Occurred | Recorded | Documented
Type | Date | Time | By | Date | Time | By | Comment | Units | Dosage

Activity Date: 03/02/11 Time: 0243

30036 Isolation: Standard Precautions A 2SHIFT CP
Document 04/02/11 0423 RP 04/02/11 0423 RP
60006 MRSA CLX START ADM 3+ A DAILY CP
Document 04/02/11 0423 RP 04/02/11 0423 RP
Chlorhexidine Gluconate (CHG) used for bath: Y
30123 Standards of Care: Critical Care-Medical A 2SHIFT CP
Document 04/02/11 0423 RP 04/02/11 0423 RP
By signing off on this intervention, the nurse verifies that
the Facility and Care Area Standard of Care has been met.
Untoward events or care outside of the Standards of Care
must be documented in supplemental interventions or notes.
Nurse signature: Price,Robert - RN
27011E Precautions: Fall A H 2SHIFT CP
Document 04/02/11 0423 RP 04/02/11 0423 RP
30032 Age Guidelines: 80 Years, Adult-Elderly A H 2SHIFT CP
Document 03/02/11 0431 RP 04/02/11 0423 RP

Activity Date: 04/02/11 Time: 0700

191020 CLINICAL MONITORING+ A HU
Document 04/02/11 0700 ZA 04/02/11 1100 ZA
Pulse: 107
Pulse: 107
Resp: 27
Non-Invasive BP-Systolic: 130
Non-Invasive BP-Diastolic: 68
Non-Invasive BP-Mean: 81
Pulse Ox: 97
Ventricular Premature Beats: 1

Activity Date: 04/02/11 Time: 0800

191020 CLINICAL MONITORING+ A HU
Document 04/02/11 0800 ZA 04/02/11 1100 ZA
Pulse: 104
Pulse: 103
Resp: 22
Non-Invasive BP-Systolic: 110
Non-Invasive BP-Diastolic: 55
Non-Invasive BP-Mean: 70
Pulse Ox: 98
Ventricular Premature Beats: 2

Activity Date: 04/02/11 Time: 0900

460860 Plan of Care Review+ A 2SHIFT CP
Document 04/02/11 0900 ZA 04/02/11 0912 ZA
< PLAN OF CARE REVIEW >

Problem/Goal/Intervention Description | Start Information | Stop Information | Initials
Activity | Occurred | Recorded | Documented
Type | Date | Time | By | Date | Time | By | Comment | Units | Dosage

Activity Date: 04/02/11 Time: 0900 (Continued)

460600 Plan of Care Review+ (Continued)
Link to Plan of Care: Y
Care plan reviewed and/or individualized and reprioritized: Y
Nurse signature: ACOSTA,ZAYDEE - RN
: Y
30060 Isolation: Standard Precautions A 2SHIFT CP
Document 04/02/11 0900 ZA 04/02/11 0900 ZA
30123 Standards of Care: Critical Care-Medical A 2SHIFT CP
Document 04/02/11 0900 ZA 04/02/11 0900 ZA
: Y
By signing off on this intervention, the nurse verifies that
the Facility and Care Area Standard of Care has been met.
Untoward events or care outside of the Standards of Care
must be documented in supplemental interventions or notes.
Nurse signature: ACOSTA,ZAYDEE - RN
160011 Shift Evaluation A 01H CP
Document 04/02/11 0900 ZA 04/02/11 0912 ZA
<< SHIFT EVALUATION >>
Neurological WDP: Y
EENT WDP: Y
Cardiovascular WDP: N
Respiratory WDP: N
Gastrointestinal WDP: Y
Integumentary WDP: N
Musculoskeletal WDP: Y
Genitourinary WDP: N
Psycho-social WDP: Y
Mode of Transport: Stretcher
Code Status: DNR
Skin Risk Evaluation: Y
FALL RISK ASSESSMENT: Y
- PAIN EVALUATION -
Does Patient Currently Have Pain: N
>Pain Scale Used: Wong-Baker 0-10
>Pain Score: 0
- ISOLATION PRECAUTIONS -
Isolation Type: NONE
Infection control and transmission prevention information provided to
patient/family/visitors and questions answered: N
Invasive Line Management: Y
Tubes & Drains Management: Y
< NEUROLOGICAL EVALUATION >
< EENT EVALUATION >
< CARDIOVASCULAR EVALUATION >
Is Patient on Cardiac Monitoring: Y
Pacer/Defibrillator: N
Heart Sounds: REGULAR
Cap Refill Eval: Y

Age/Sex: 81 M
Visit #: [redacted]
Admitted: 03/30/11 at 0245
Service: DIS IRA

WINKLER, LOUIS

Brandon Regional Hospital Nursing Unit
CLINICAL DOCUMENTATION RECORD HSF

Printed 04/13/11 at 1032

Problem/Goal/Intervention Description	Start/Interval	From
Activity: Bedfast	Occurrences: 1	
Type	Date	Time by Rate	Time by Interval	Initials	Comments

Problem/Goal/Intervention Description	Start/Interval	From
Activity: Bedfast	Occurrences: 1	
Type	Date	Time by Rate	Time by Interval	Initials	Comments

Activity Date: 03/31/11 Time: 0502 (continued)

1G001] Shift Evaluation (continued)
RUE: SLUGGISH > 3 SECONDS
LUE: SLUGGISH > 3 SECONDS
RLE: SLUGGISH > 3 SECONDS
LLE: SLUGGISH > 3 SECONDS
Peripheral Pulse Eval: Y
R Radial: 2+ NORMAL
L Radial: 2+ NORMAL
R Dorsal Pedis: 1+ WEAK
L Dorsal Pedis: 1+ WEAK
R Post Tibial: 1+ WEAK
L Post Tibial: 1+ WEAK
Additional Pulses: N
JVD Present: N
Edema: Y
Edema Location: GENERALIZED
Edema Type: 3+ > 1 MINUTE
Chest Pain: N
<< TELEMETRY EVALUATION >>
ENG Rhythm: SINUS TACHYCARDIA
Rate: 108
Change From Previous: N
STAT-Have Changes: N
< PACER EVALUATION SCREEN >
< RESPIRATORY EVALUATION >
Depth: SHALLOW
Effort: UNLABORED
Cough: NONE
Chest Shape: SYMMETRICAL
Chest Movement: SYMMETRICAL
O2 Therapy: Y
Breath Sounds Eval: Y
R Upper Anterior: CLEAR
L Upper Anterior: CLEAR
R Mid Anterior: CLEAR
R Lower Anterior: DIMINISHED
L Lower Anterior: DIMINISHED
< RETRACTIONS >
< OXYGEN THERAPY >
O2 Device: NASAL CANNULA
O2 Flow (L/M): 2
FIO2 % : 37
< INCENTIVE SPIROMETRY >
< GASTROINTESTINAL EVALUATION >
< INTEGUMENTARY EVALUATION >
Skin Appearance: APPROPRIATE FOR PATIENT
Skin Temp: WARM
Skin Moisture: DRY

Activity Date: 03/31/11 Time: 0502 (continued)

1G001] Shift Evaluation (continued)
Skin Turgor: GOOD
Mucous Membrane: MOIST
Wounds/Ulcer: Y
Incisions: N
New Onset Skin Breakdown: N
< WOUND/ULCER EVALUATION >
Type #1: LACERATION
Location: TIP OF TONGUE
Type #2: ULCER
Location: COCCYX
Type #3: LACERATION
Location: LUMBAR SPINE
Type #4: SCAR
Location: FIRST 3 FINGERS LT HAND
< FRICTION EVALUATION >
Sensory perception- Completely limited
Moisture- Moist
Activity- Bedfast
Mobility- Very limited
Nutrition- Very poor
Friction and shear- Potential problem
Braden Skin Score: 9
Braden Risk Level: Very High
Skin risk interventions: Manage moisture. Avoid drying the skin
Manage nutrition. Maintain good hydration
Manage friction and shear
Re-assess of reddened bony prominences
Reposition Q2hrs and PRN
Offer bolsters when turning
Pericare PRN
Use moisture barrier: body wash and lotion routinely
Maximal reambilization-up in chair for meals when appropriate
Protect (offload) heels
Use turn sheets to reduce friction/shear
HOB < 30 degrees unless medically contraindicated
Consider pressure relieving surface (if bed or chair bound)
Provide education on pressure ulcers to patient and family
Assess nutrition status, obtain nutrition consult prn
Use foam wedges for 30 degree lateral positioning
Consider trapeze if indicated
Monitor all body folds for moisture, yeast, rash, irritation
Supplement regular turns with small position shifts
Consult specialty support bed algorithm for support surface
Monitor bony prominences,wounds;use pillow for offloading
Consider pressure relieving surfaces for pain/other factors
< MUSCULOSKELETAL EVALUATION >
< GENITOURINARY >

[redacted] MD | WINKLER,LOUIS | Page: 51

Admitting: 04/30/11 at 0845 | Room/Bed: H.A539-1 | Brandon Regional Hospital Nursing *Live* CLINICAL DOCUMENTATION RECORD HDF | Printed 04/12/11 at 1802

Activity Type	Occurred Date	Occurred Time	By	Nursing Comment	Documented Date	Documented Time	By

Activity Date: 04/02/11 Type: 0803 (continued)

160011 Shift Evaluation (continued)
Urinary Elimination: CATHETER-INDWELLING
Secured with: LEG STRAP
Urine Color: YELLOW
Urine Clarity: CLEAR
Consider catheter removal based on criteria: N
Female Discharge: N
= PSYCHOSOCIAL EVALUATION =
Event/Issue:
Taken:
<Suicide Risk Assessment, Modified SAD PERSONS>
Pt has 3 or more meds in drug classes known to
be indicator of fall risk: N
Is patient Responsive: Yes
Is patient following fall prevention directions: Y
Addl Fall Risk Elements: Unsteady Gait
Tethered Device
Decreased Muscle Coord
High Risk for Falls: N
< SPECIAL EQUIPMENT >
<< INVASIVE LINES >>
PICC/CVC Catheter: Y
<< PERIPHERAL LINE >>
<< PERIPHERAL LINE >>
Right Cephalic Vein: PICC - Multi lumen
Right Cephalic External Line Length(cm): 5.0
Dressing changed per evidence base recommendations: No
CVC or PICC line removed: No
Has the necessity been reviewed? Y
Line maintenance performed? Y
< MIDLINE >
<< ARTERIAL LINE >>
<< INTRACRANIAL PRESSURE CATHETER >>
<< PULMONARY ARTERY CATHETER >>
PRESSURES:
<< SHEATH-PERCUTANEOUS INTRODUCER >>
PULSES:
<< INTRAORTIC BALLOON PUMP >>
Condition:
PULSES
<< VENTRICULAR ASSIST DEVICE >>
< INDWELLING CATHETER / TUBES & DRAINS >
< TUBES AND DRAINS >
Manage: Y
= INDWELLING CATHETER REMOVAL =
< TUBES AND DRAINS - MANAGE = Y
#1 Tube/Drain: FOLEY
Location: URETHRA

Activity Date: 04/02/11 Type: 0803 (continued)

160011 Shift Evaluation (continued)
Secured with: LEG STRAP
Drainage Type: URINE
Site Appearance: NO REDNESS OR SWELLING
<< TEACHING & EDUCATION >>
Education Content:
Pharmacological Prophylaxis due to:
120028 Age Guidelines: 80 Years, Adult-Elderly A [redacted] SHIFT CP
[redacted]

Activity Date: 04/02/11 Type: CHK

191020 CLINICAL MONITORING* A MD
[redacted]
Pulse: 107
Pulse: 106
Resp: 20
Non-Invasive BP-Systolic: 128
Non-Invasive BP-Diastolic: 61
Non-Invasive BP-Mean: 78
Pulse Ox: 97
Ventricular Premature Beats: 4

Activity Date: 04/02/11 Type: 0803

191020 CLINICAL MONITORING* A MD
[redacted]
Pulse: 105
Pulse: 68
Resp: 24
Non-Invasive BP-Systolic: 120
Non-Invasive BP-Diastolic: 76
Non-Invasive BP-Mean: 84
Pulse Ox: 96
Ventricular Premature Beats: 20
160100 Shift Re-Eval Verification* A [redacted] CP
[redacted]
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have
noted changes and have documented said changes appropriately.
Nurse signature: ACOSTA,ZAYDEE - RN
Y

Age/Sex: 81 M
MRN: [redacted]
Acct/Bed: 03/30/11 at 1246
Status: DIS INa

Attending: Agnew,Yoshitlla MD
Account #: [redacted]
Location: H.SSIC
Room/Bed: H.A539-1

WINKLER, LOUIS

Brandon Regional Hospital Nursing "Live"
CLINICAL DOCUMENTATION RECORD MDF

Printed 04/12/11 at 1062

Procedure/Intervention Description | Start | Stop | Ordered By | Order | Comments | Initials | Charted

Activity Date: 04/02/11 - Time: 1400

191020 CLINICAL MONITORING< A MD
Documented: 04/02/11 1405 ZA 04/02/11 1400 ZA
Pulse: 110
Pulse: 110
Resp: 27
Non-Invasive BP-Systolic: 125
Non-Invasive BP-Diastolic: 60
Non-Invasive BP-Mean: 76
Pulse Ox: 97
Ventricular Premature Beats: 2

Activity Date: 04/02/11 - Time: 1500

191020 CLINICAL MONITORING< A MD
Documented: 04/02/11 1505 ZA 04/02/11 1500 ZA
Pulse: 112
Pulse: 111
Resp: 27
Non-Invasive BP-Systolic: 131
Non-Invasive BP-Diastolic: 65
Non-Invasive BP-Mean: 79
Pulse Ox: 97
Ventricular Premature Beats: 0
160100 Shift Re-Eval Verification< A CRH CP
Documented: 04/02/11 1505 ZA 04/02/11 1500 ZA
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift Re-evaluation and have noted no change from my previous evaluation or have noted changes and have documented said changes appropriately.
Nurse signature: ACOSTA,ZAYDEE - RN
Y

Activity Date: 04/02/11 - Time: 1600

191020 CLINICAL MONITORING< A MD
Documented: 04/02/11 1605 ZA 04/02/11 1600 ZA
Pulse: 117
Pulse: 53
Resp: 29
Non-Invasive BP-Systolic: 136
Non-Invasive BP-Diastolic: 81
Non-Invasive BP-Mean: 91
Pulse Ox: 97
Ventricular Premature Beats: 18

Activity Date: 04/02/11 - Time: 1400

191020 CLINICAL MONITORING< A MD
Documented: 04/02/11 1405 ZA 04/02/11 1400 ZA
Pulse: 117
Pulse: 64
Resp: 27
Non-Invasive BP-Systolic: 119
Non-Invasive BP-Diastolic: 68
Non-Invasive BP-Mean: 74
Pulse Ox: 98
Ventricular Premature Beats: 1

Activity Date: 04/02/11 - Time: 1400

160100 Shift Re-Eval Verification< A 32H CP
Documented: 04/02/11 1405 ZA 04/02/11 1400 ZA
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift Re-evaluation and have noted no change from my previous evaluation or have noted changes and have documented said changes appropriately.
Nurse signature: ACOSTA,ZAYDEE - RN
Y

Activity Date: 04/02/11 - Time: 1400

192000 Intake and Output (NOT BCMA) A CLIN CP
Documented: 04/02/11 1405 ZA 04/02/11 1400 ZA
< INTAKE AND OUTPUT >
Intake Y
<< INTAKE >>
IV Fluids: 700
PO: 240
<< OUTPUT >>

Activity Date: 04/02/11 - Time: 1600

191020 CLINICAL MONITORING< A MD
Documented: 04/02/11 1605 ZA 04/02/11 1600 ZA
Pulse: 113
Pulse: 67
Resp: 23
Non-Invasive BP-Systolic: 116
Non-Invasive BP-Diastolic: 66
Non-Invasive BP-Mean: 74
Pulse Ox: 97
Ventricular Premature Beats: 4

Age/Sex: 81 M
Unit #: [redacted]
Admitted: 03/30/11 at 0246
Status: DIS INV

Attending: Agzew,Yeshitila MD
Account #: [redacted]
Location: M.SYC
Room/Bed: M.4539-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing Flow*
CLINICAL DOCUMENTATION RECORD (PF

Printed 04/12/11 at 1002

Problem/Goal/Intervention Description

Activity	Occurred	Recorded	Doc Started	Staff Initials	Flag
Type	Date	Time	By	Comment	Units	Change

Activity Date: 04/02/11 Time: 1900

[redacted]

:60100 Shift Re-Eval Verification* A O2H CP
Documented: 04/02/11 1900 EDT 04/02/11 1900 EDT
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have
noted changes and have documented said changes appropriately
Nurse signature: Yost,Kam J. - RN
Y

:91000 Vital Signs* (NOT BCTA) A O2H CP
Documented: 04/02/11 1900 EDT 04/02/11 1900 EDT
<< VITAL SIGNS >>
Temp-F: 98.2
Temp Source: AXILLARY

Activity Date: 04/02/11 Time: 1800

[redacted]

:91000 CLINICAL MONITORING* A MD
Documented: 04/02/11 1900 EDT 04/02/11 1900 EDT
Pulse: 111
Pulse: 108
Resp: 20
Non-Invasive BP-Systolic: 112
Non-Invasive BP-Diastolic: 60
Non-Invasive BP-Mean: 72
Pulse Ox: 97
Ventricular Premature Beats: 13

:92000 Intake and Output* (NOT BCTA) A O2H CP
Documented: 04/02/11 1900 EDT 04/02/11 1900 EDT
< INTAKE AND OUTPUT >
Intake, Y
Output: Y
<< INTAKE >>
PO: 20
IV Fluids: 365
<< OUTPUT >>
Foley: 90

:60100 Shift Re-Eval Verification* A O2H CP
Documented: 04/02/11 1800 EDT 04/02/11 1800 EDT
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have
noted changes and have documented said changes appropriately.
Nurse signature: Yost,Kam J. - RN
Y

Problem/Goal/Intervention Description

Activity	Occurred	Recorded	Doc Started	See In-Patient Documentation	Flag
Type	Date	Time	By	Comment	Units	Change

Activity Date: 04/02/11 Time: 2000

[redacted]

:91000 CLINICAL MONITORING* A MD
Documented: 04/02/11 2000 EDT 04/02/11 2000 EDT
Pulse: 115
Pulse: 98
Resp: 21
Pulse Ox: 98
Ventricular Premature Beats: 4

Activity Date: 04/02/11 Time: 2030

[redacted]

:91000 CLINICAL MONITORING* A MD
Documented: 04/02/11 2030 EDT 04/02/11 2030 EDT
Pulse: 105
Pulse: 85
Resp: 20
Pulse Ox: 98
Ventricular Premature Beats: 17

Activity Date: 04/02/11 Time: 2000

[redacted]

:91000 CLINICAL MONITORING* A MD
Documented: 04/02/11 2000 EDT 04/02/11 2000 EDT
Pulse: 121
Pulse: 110
Resp: 19
Non-Invasive BP-Systolic: 117
Non-Invasive BP-Diastolic: 54
Non-Invasive BP-Mean: 70
Pulse Ox: 97
Ventricular Premature Beats: 11

Activity Date: 04/02/11 Time: 2007

[redacted]

:60000 ADL's* A O2H CP
Documented: 04/02/11 2007 EDT 04/02/11 2007 EDT
< ADL ASSISTANCE >
ACTIVITY
Assistance Required: Y
Assisted By: STAFF
Type: REPOSITIONING IN BED
Oxygen L/min: 2
Tolerance: WELL
TOILETING
ORAL CARE
Assistance Required: Y
Assisted by: STAFF
Type: SWAB MOUTH
EATING

Age/Sex: 81 M [redacted]
DOB: [redacted]
Admit Date: 03/30/11 at 0246 Location: H.ESIC
Status: OIS Inp Room/Bed: H.A539-1

WINKLER, LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD IPF

Printed 04/12/11 at 1802

Problem/Goal/Intervention Description	SIG	Ordered/Performed	Recorded	Discontinued	Ord/Perf By	Cosign Required	Cosigned
Activity	Desired						
Type	Path	Type	By	Date	Time	Comment	Initials

Problem/Goal/Intervention Description	SIG	Ordered/Performed	Recorded	Discontinued	Ord/Perf By	Cosign Required	Cosigned
Activity	Occurred						
Type	Path	Type	By	Date	Time	Comment	Initials

Activities Recorded 04/12/11 (continued)

210270 ADLs* (continued)
PERSONAL HYGIENE
LINEN CHANGED
DRESSING
410660 Plan of Care Review A CSHIFT CP
[redacted]
< PLAN OF CARE REVIEW >
Link to Plan of Care: Y
Care plan reviewed and/or individualized and reprioritized: Y
Nurse signature: SHIRLEY,JENNIFER A - RN
130300 Isolation: Standard Precautions A CSHIFT CP
[redacted]
150121 Standards of Care: Critical Care-Medical A CSHIFT CP
[redacted]
By signing off on this intervention, the nurse verifies that
the Facility and Care Area Standard of Care has been met.
Untoward events or care outside of the Standards of Care
must be documented in supplemental interventions or notes.
Nurse signature: SHIRLEY,JENNIFER A - RN
160011 Shift Evaluation A 0124 CP
[redacted]
<< SHIFT EVALUATION >>
Neurological WDP: N
EENT WDP: Y
Cardiovascular WDP: N
Respiratory WDP: N
Gastrointestinal WDP: N
Integumentary WDP: N
Musculoskeletal WDP: N
Genitourinary WDP: N
Psycho-social WDP: Y
Mode of Transport: Stretcher
W/IV
W/UR
W/Monitor
Code Status: DNR
Skin Risk Evaluation: Y
FALL RISK ASSESSMENT: Y
- PAIN EVALUATION -
Does Patient Currently Have Pain: N
>Pain Scale Used: WONG BAKER/FACES
*Pain Score: 0
- ISOLATION PRECAUTIONS -
Isolation Type: NONE
Infection control and transmission prevention information provided to
patient/family/visitors and questions answered: Y
Special Equipment: Y
Invasive Line Management: Y

Activities Recorded 04/12/11 (continued)

160011 Shift Evaluation (continued)
Tubes & Drains Management: Y
Education (Interdisciplinary): Y
Venous Thromboembolism Eval: Y
< NEUROLOGICAL EVALUATION >
LOC: SOMNOLENT
Oriented: N
Disoriented to: UTA-NONVERBAL
Speech: NON-VERBAL
Sensation-RUE: UTA
RLE: UTA
LUE: UTA
LLE: UTA
Motor Skill Eval: /
Right Grip: DOES NOT OBEY
Right Arm: MINIMAL MOVEMENT
Right Leg: MINIMAL MOVEMENT
Left Grip: DOES NOT OBEY
Left Arm: MINIMAL MOVEMENT
Left Leg: MINIMAL MOVEMENT
Impaired Memory: UTA
Behavior: FLAT
Pupils Equal, Round, React to Light, and Accomodation: Y
< EENT EVALUATION >
< CARDIOVASCULAR EVALUATION >
Is Patient on Cardiac Monitoring: Y
Cap Refill Eval: Y
Peripheral Pulse Eval: Y
R Dorsal Pedis: 1+ WEAK
L Dorsal Pedis: 1+ WEAK
R Post Tibial: 1+ WEAK
L Post Tibial: 1+ WEAK
Edema: Y
Edema Location: BILATERAL LEGS
Edema Type: 4+ PITTING
<< TELEMETRY EVALUATION >>
EKG Rhythm: SUPRA VENTRICULAR TACHY
Rate: 125
Ectopy: PREMATURE VENT CONTRACT
PREMATURE ATRIAL CONTRACT
Change from previous: N
< PACER EVALUATION SCREEN >
< RESPIRATORY EVALUATION >
O2 Therapy: Y
Breath Sounds Eval: Y
R Lower Anterior: SNOROUS RHONCHI
L Lower Anterior: DIMINISHED
R Lower Anterior: SNOROUS RHONCHI

Age/Sex: 81 M
Unit #: [redacted]
Admitted: 03/30/11 at 0245
Status: DIS INA

Attending: Agtew, Kesrilla MD
Account #: [redacted]
Location: H.ESTC
Room/Bed: H.A539-1

WINKLER, LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD HPF

Printed 04/12/11 at 1602

Problem/Goal/Intervention Description	Activity Type	Scheduled Date	Scheduled Time	By	Occurred Date	Occurred Time	By	Location	Discontinued	Signature
Activity Date 03/30/11										

Prompter/Goal/Intervention Description	Activity Type	Occurred Date	Occurred Time	To Be Done	By	Specialty	Discontinued By/Reason	Units	Charge
Activity Date 03/30/11									

L60011 Shift Evaluation (continued)
L Lower Posterior: DRESSING
< RETRACTIONS >
< OXYGEN THERAPY >
O2 Device: NASAL CANNULA
O2 Flow (L/M): 2
< INCENTIVE SPIROMETRY >
< GASTROINTESTINAL EVALUATION >
Bowel Sounds Even: Y
RUQ: HYPOACTIVE
RLQ: HYPOACTIVE
LUQ: HYPOACTIVE
LLQ: HYPOACTIVE
< INTEGUMENTARY EVALUATION >
Wounds/Ulcer: Y
< WOUND/ULCER EVALUATION >
Type #1: LACERATION
Location: TIP OF TONGUE
Type #2: ULCER
Location: COCCYX
Wound Eval: UTA AT THIS TIME
Type #3: LACERATION
Location: LUMBAR SPINE
Wound Eval: UTA AT THIS TIME
Type #4: SCAR
Location: FIRST 3 FINGERS LT HAND
< INCISION EVALUATION >
Sensory perception- Slightly limited
Moisture- Rarely moist
Activity- Bedfast
Mobility- Completely immobile
Nutrition- Very poor
Friction and shear- Problem
Braden Skin Score: 11
Braden Risk Level- High
Skin risk interventions: Manage moisture. Avoid drying the skin
Manage nutrition. Maintain good hydration
Manage friction and shear
No massage of reddened bony prominences
Reposition QHrs and PRN
Offer collating when turning
Pericare PRN
Use moisture barrier: body wash and lotion routinely
Maximal remobilization-up in chair for meals when appropriate
Protect (offload) heels
Use turn sheets to reduce friction/shear
HOB < 30 degrees unless medically contraindicated
Consider pressure relieving surface (if bed or chair bound)

L60011 Shift Evaluation (continued)
Provide education on pressure ulcers to patient and family
Assess nutrition status, obtain nutrition consult prn
Use foam wedges for 30 degree lateral positioning
Consider trapeze if indicated
Monitor all body folds for moisture, yeast, rash, irritation
Supplement regular turns with small position shifts
Consult specialty support bed algorithm for support surface
Monitor bony prominences,wounds;use pillow for offloading
< MUSCULOSKELETAL EVALUATION >
Comment: SEVERE GENERALIZED WEAKNESS
< GENITOURINARY >
Urinary Elimination: CATHETER-INDWELLING
Secured with: STABILIZATION DEVICE
Urine Color: AMBER
Urine Clarity: SEDIMENT
< PSYCHOSOCIAL EVALUATION >
Event/Issue:
Taken:
<Suicide Risk Assessment, Modified SAD PERSONS>
Pt has 3 or more meds in drug classes known to
be indicator of fall risk: N
Is patient Responsive: No
High Risk for Falls: N
< SPECIAL EQUIPMENT >
Special Equip: IV PUMP
<< INVASIVE LINES >>
PICC/CVC Catheter: Y
<< PERIPHERAL LINE >>
<< PERIPHERAL LINE >>
Right Cephalic Vein- PICC , Multi lumen
Right Cephalic External Line Length(cm): 5.0
Dressing changed per evidence base recommendations- Yes
Dressing type- transparent
Dressing Date: 04/08/11
Dressing Time: 2014
CVC or PICC line removed- No
Was the necessity been reviewed? Y
Line maintenance performed? Y
< MIDLINE >
<< ARTERIAL LINE >>
<< INTRACRANIAL PRESSURE CATHETER >>
<< PULMONARY ARTERY CATHETER >>
PRESSURES:
<< SHEATH-PERCUTANEOUS INTRODUCER >>
PULSES:
<< INTRAORTIC BALLOON PUMP >>
Condition:

Age/Sex: 81 M
Unit #: [redacted]
Admitted: 03/30/11 at 0245
Status: OIS INP

Attending: Agzaw,Yesmitila MD
Account #: [redacted]
Location: M.SSIC
Room/Bed: M.A539-1

WINKLER, LOUIS

Brandon Regional Hospital Nursing Flow
CLINICAL DOCUMENTATION RECORD MAR

Printed 04/12/11 at 1002

Problem/Goal/Intervention Description

Activity Type	Occurred Date	Recorded Time	By	Date	Time	Of Event?	Documented Units	Cum Qty

Activity Date: 04/02/11 Time: 2017

160011 Shift Evaluation (continued)
NURSES
<< VENTRICULAR ASSIST DEVICE >>
< UNCATEGORIZED CATHETER / TUBES & DRAINS >
< TUBES AND DRAINS >
Manage: Y
< UNCATEGORIZED CATHETER REMOVAL >
< TUBES AND DRAINS - MANAGE > Y
#1 Tube/Drain: FOLEY
Location: URETHRA
Secured with: STABILIZATION DEVICE
Drainage Type: URINE
Site Appearance: NO REDNESS OR SWELLING
Suction Type: GRAVITY
<< TEACHING & EDUCATION >>
Department: NURSING
Setting: BEDSIDE
Learner: FAMILY
PATIENT
Readiness to Learn: WILLING TO LEARN
PT-UTA
Preferred Method: EXPLANATION
Barriers: NONE
PT-POOR CONDITION
Education Content:
Hospital Care: Plan of Care
Strategies: EXPLANATION
Evaluation: STATES UNDERSTANDING
Is patient currently on anticoagulation medication? Y
Pharmacological Prophylaxis due to:
[redacted]
190060 Vital Signs+ (NOT BCTA) A CSH CP
Document: 04/02/11 2000 JAS 04/02/11 2000 JAS
<< VITAL SIGNS >>
Temp-F: 98.9
Temp Source: AXILLARY
130028 Age Guidelines: 80 Years, Adult-Elderly A H QUINLEY LP
Document: 04/02/11 2017 JAS 04/02/11 2017 JAS

Activity Date: 04/03/11 Time: 2018

[redacted]
191028 CLINICAL MONITORING+ A MD
Document: 04/02/11 2018 JAS 04/02/11 2018 JAS
Pulse: 117
Pulse, 63
Resp: 20
Pulse Ox: 98
Ventricular Premature Beats: 12

Problem/Goal/Intervention Description

Activity Type	Occurred Date	Recorded Time	By	Date	Time	Of Event?	Documented Units	Cum Qty

Activity Date: 04/02/11 Time: 2017

Problem: PROB: Impaired Cardiovascular Function A
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 2 => 1
Problem: Core Guidelines A
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS
Problem: Standard of Care: Telemetry-Medical A
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 13 => 11
Problem: Advance Directives A
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS
Problem: Standard of Care: Critical Care-Medical A
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 16 => 13
Problem: PROB: Potential(Actual) Altered Mental St C
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS
Problem: PROB: Impaired EENT Function C
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 3 => 15
Problem: PROB: Impaired GU Function C
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS
Problem: PROB: Impaired Neuro Function A
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 7 => 2
Problem: PROB: Impaired Hydration/Nutrition A
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS
Problem: PROB: Impaired GU Function A
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 5 => 4
Problem: PROB: Impaired Musculoskeletal A
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS
Problem: PROB: Impaired Respiratory Function A
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 8 => 6
Problem: PROB: Impaired Skin Integrity A
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS
Problem: PREC: Precautions-Fall A
- Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 10 => 8
Problem: Age Guidelines: Adult 50+ Years A
Reassessment 04/02/11 2017 JAS 04/02/11 2017 JAS 11 => 9

Activity Date: 04/02/11 Time: 2000

450100 Physician Notification/Response+ A PRN CP
Document: 04/02/11 2000 JAS 04/02/11 2000 JAS
<< PHYSICIAN NOTIFY/RESPONSE >>
Notification: Y
Physician Called: ALIVE,Agzaw,Yesmitila MD
Person Notified: SERVICE
Method of Notification: PAGED
Reason: CNC REQUEST TO DOWNGRADE
Verbal Orders are to be Written in Chart, Read Back, and Verified.
Physicians are to Read-Back Critical Lab Values/Test Results.

Problem/Goal/Intervention Description

Activity Type	Occurred Date	Occurred Time	By	Recorded Date	Recorded Time	By	Documented Comment	Route	Charted

Activity Date: 04/02/11 Time: 2100

460710 Physician Notification/Response A PRN CP
Document: 04/02/11 2100 JAS 04/02/11 2100 JAS
< PHYSICIAN NOTIFY/RESPONSE >
Response: Y
Physician Spoken to: AGAYE Agaye,Yoshitila MD
Notification Results: KEEP IN ED
Verbal Orders are to be Written in Chart, Read Back, and Verified.
Physicians are to Read Back Critical Lab Values/Oral Results

Activity Date: 04/02/11 Time: 2100

480015 RT: Respiratory Therapy Treatment A per prvdr PS
Document: 04/02/11 2154 JAS 04/02/11 2200 JAS
- RESPIRATORY THERAPY TREATMENT -
Oxygen therapy: Y
- RT THX TREATMENT -
Pre-treatment breath sounds
Post-treatment breath sounds
- RT THX TREATMENT -
Pre-treatment breath sounds
Post-treatment breath sounds
- OXYGEN FLOW SHEET -
O2 Flow: 2
l/pm
%
O2 Type: NASAL CANNULA
SpO2: 96%
- CPT TREATMENT/POSTURAL DRAINAGE -
Minutes
- OMITTED TREATMENT -
- SUCTIONING -
< INCENTIVE SPIROMETRY >
-PULSE OXIMETRY -
%
%

Activity Date: 04/02/11 Time: 2200

190020 CLINICAL MONITORING A MD
Document: 04/02/11 2205 JAS 04/02/11 2205 JAS
Pulse: 113
Pulse: 104
Resp: 19
Non-Invasive BP-Systolic: 113
Non-Invasive BP-Diastolic: 68
Non-Invasive BP-Mean: 79
Pulse Ox: 97
Ventricular Premature Beats: 2

Problem/Goal/Intervention Description

Activity Type	Occurred Date	Occurred Time	By	Recorded Date	Recorded Time	By	Documented Comment	Route	Charted

Activity Date: 04/02/11 Time: 2215

160100 Shift Re-Eval Verification A Q2H CP
Document: 04/02/11 2217 JAS 04/02/11 2217 JAS
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have
noted changes and have documented said changes appropriately.
Nurse statement: SHIFT, JENNIFER A - RN

Activity Date: 04/02/11 Time: 2215

210010 Monitor: Blood Glucose A Q6 CP
Document: 04/02/11 2216 JAS 04/02/11 2216 JAS
< ACCUCHEK RESULTS >
Glucose: 344
Method: FINGERSTICK
Medication: REGULAR INSULIN
Dose: 4 UNITS
Site: LT ARM

Activity Date: 04/02/11 Time: 2200

190020 CLINICAL MONITORING A MD
Document: 04/02/11 2200 JAS 04/02/11 2205 JAS
Pulse: 152
Pulse: 152
Resp: 20
Pulse Ox: 96
Ventricular Premature Beats: 0

Activity Date: 04/02/11 Time: 2300

190020 CLINICAL MONITORING A MD
Document: 04/02/11 2301 JAS 04/02/11 2305 JAS
Pulse: 134
Pulse: 79
Resp: 20
Non-Invasive BP-Systolic: 102
Non-Invasive BP-Diastolic: 61
Non-Invasive BP-Mean: 71
Pulse Ox: 97
Ventricular Premature Beats: 1

Activity Date: 04/03/11 Time: 0045

460100 Physician Notification/Response A PRN CP
Document: 04/03/11 0048 JAS 04/03/11 0048 JAS
< PHYSICIAN NOTIFY/RESPONSE >
Notification: Y

Age/Sex: 81 M
DOB: [redacted]
Admitted: 04/09/11 at 0246
Service: DIS Ins

Referring: Agzew,Yeshitila MD
Account #: [redacted]
Location: H.ESIC
Room/Bed: H.A539-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing Home
CLINICAL DOCUMENTATION RECORD IPF

Printed 04/12/11 at 1002

Problem/Goal/Intervention Description

Activity Type	Occurred Date	Occurred Time	By	Recorded Date	Recorded Time	By	Comment	Documented Units	Charge

ACTIVITY DATE: 04/09/11 Time: 2110 (continued)

460700 Physician Notification/Response+ (continued)
Physician Called: AGZYE Agzew,Yeshitila MD
Person Notified: SERVICE
Method of Notification: PAGE3
Reason: SVT IR 130-170'S
SUSTAINED
Verbal Orders are to be Written in Chart, Read Back, and Verified.
Physicians are to Read-back Critical Lab Values/Test Results

Activity Date: 04/09/11 Time: 2150

460700 Physician Notification/Response+ A HRN CP
Document: 04/09/11 2156 JAS 04/09/11 2156 JAS
< PHYSICIAN NOTIFY/RESPONSE >
Response: Y
Physician Spoken To: AGZYE Agzew,Yeshitila MD
Notification Results: CARDIZEM BOLUS AND GTT FOR HR>140
Verbal Orders are to be Written in Chart, Read Back, and Verified.
Physicians are to Read-back Critical Lab Values/Test Results

Activity Date: 04/09/11 Time: 0010

191020 CLINICAL MONITORING+ A MD
Document: 04/09/11 0012 JAS 04/09/11 0012 JAS
Pulse: 159
Pulse: 161
Resp: 29
Non-Invasive BP-Systolic: 104
Non-Invasive BP-Diastolic: 63
Non-Invasive BP-Mean: 70
Pulse Ox: 99
Ventricular Premature Beats: 3

Activity Date: 04/09/11 Time: 0010

160100 Shift Re-Eval Verification+ A CDH CP
Document: 04/09/11 0010 CDH 04/09/11 0010 CDH
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have
noted changes and have documented said changes appropriately
Nurse Signature: CHAFFY JENNIFER A - RN

Activity Date: 04/09/11 Time: 0010

160210 Focused Care: Cardiac+ A CP
Document: 04/09/11 0010 CDH 04/09/11 0010 CDH
< CARDIOVASCULAR EVALUATION >

Problem/Goal/Intervention Description

Activity Type	Occurred Date	Occurred Time	By	Recorded Date	Recorded Time	By	Comment	Documented Units	Charge

ACTIVITY DATE: 04/09/11 Time: 0010 (continued)

160210 Focused Care: Cardiac+ (continued)
Is Patient on Cardiac Monitoring: Y
<< TELEMETRY EVALUATION >>
EKG Rhythm: SUPRA VENTRICULAR TACHY
Rate: 170
Ectopy: PREMATURE ATRIAL CONTRACT
PREMATURE VENT CONTRACT
Change From Previous: Y
Comment: DR AGZEW NOTIFIED. TO START CARDIZEM GTT
< 12 LEAD ECG EVALUATION >
< PACER EVALUATION SCREEN >

Activity Date: 04/09/11 Time: 0010

191020 CLINICAL MONITORING+ A MD
Document: 04/09/11 0012 JAS 04/09/11 0012 JAS
Pulse: 153
Pulse: 98
Resp: 26
Non-Invasive BP-Systolic: 90
Non-Invasive BP-Diastolic: 54
Non-Invasive BP-Mean: 69
Pulse Ox: 97
Ventricular Premature Beats: 2

Activity Date: 04/09/11 Time: 0010

330030 IV Therapy: Medication Infusion A QSWIFT CP
Document: 04/09/11 0010 JAS 04/09/11 0010 JAS
< IV DRIP TITRATION >
IV Drip @1: CARDIZEM
Concentration: 1
- MG/ML
Current Rate: 2.5
- MILLIGRAMS/HR
Comment: 5MG BOLUS GIVEN. STARTED AT 2.5MG/HR PER MD ORDER
< BLOOD SUGAR RESULTS >

Activity Date: 04/09/11 Time: 0012

191020 CLINICAL MONITORING+ A MD
Document: 04/09/11 0013 JAS 04/09/11 0013 JAS
Pulse: 152
Pulse: 79
Resp: 22
Non-Invasive BP-Systolic: 105
Non-Invasive BP-Diastolic: 70
Non-Invasive BP-Mean: 78

Procedure/Intervention Description | Activity | Occurred | Recorded | Documented | Type | Date | Time | By | Date | Time or Current | Units | Comments

191020 CLINICAL MONITORING (continued)
Pulse Ox: 98
Ventricular Premature Beats: 1

Activity Date: 04/09/11 Time: 0030

330010 IV Therapy: Medication Infusion A (Shift) CP
Document: [redacted]

Activity Date: 04/09/11 Time: 0100

191020 CLINICAL MONITORING A MD
Document: [redacted]
Pulse: 151
Pulse: 69
Resp: 22
Non-Invasive BP-Systolic: 94
Non-Invasive BP-Diastolic: 55
Non-Invasive BP-Mean: 65
Pulse Ox: 97
Ventricular Premature Beats: 1

Activity Date: 04/09/11 Time: 0200

330010 IV Therapy: Medication Infusion A 0SHIFT CP
Document: [redacted]
< IV DRIP TITRATION >
IV Drip #1: CARDIZEM
Concentration: 1
- MG/ML
Current Rate: 5
- MILLIGRAMS/HR
Current: 5 ML/HR
< IV DRIP START (0200) >

Activity Date: 04/09/11 Time: 0300

191020 CLINICAL MONITORING A MD
Document: [redacted]
Pulse: 150
Pulse: 149
Resp: 25
Non-Invasive BP-Systolic: 111
Non-Invasive BP-Diastolic: 85
Non-Invasive BP-Mean: 90
Pulse Ox: 98
Ventricular Premature Beats: 1

Activity Date: 04/09/11 Time: 0400

191020 CLINICAL MONITORING A MD
Document: [redacted]
Pulse: 155
Pulse: 74
Resp: 26
Non-Invasive BP-Systolic: 126
Non-Invasive BP-Diastolic: 63
Non-Invasive BP-Mean: 71
Pulse Ox: 99
Ventricular Premature Beats: 0

Activity Date: 04/09/11 Time: 0500

330010 IV Therapy: Medication Infusion A 0SHIFT CP
Document: [redacted]
< IV DRIP TITRATION >
IV Drip #1: CARDIZEM
Concentration: 1
- MG/ML
Current Rate: 10
- MILLIGRAMS/HR
Current: 10 ML/HR
< IV DRIP START (0500) >

Activity Date: 04/09/11 Time: 0515

191020 CLINICAL MONITORING A MD
Document: [redacted]
Pulse: 159
Pulse: 64
Resp: 23
Non-Invasive BP-Systolic: 89
Non-Invasive BP-Diastolic: 51
Non-Invasive BP-Mean: 58
Pulse Ox: 97
Ventricular Premature Beats: 0

Activity Date: 04/09/11 Time: 0600

191020 CLINICAL MONITORING A MD
Document: [redacted]
Pulse: 150
Pulse: 149
Resp: 24
Non-Invasive BP-Systolic: 100
Non-Invasive BP-Diastolic: 55
Non-Invasive BP-Mean: 66
Pulse Ox: 98

[redacted] MD

WINKLER,LOUIS

Page: 60

Grandon Regional Hospital Nursing Flow
CLINICAL DOCUMENTATION RECORD I-F

Printed 04/12/11 at 1002

Problem/Goal/Intervention Description

Activity Type	Occurred Date	Time	By	Recorded Date	Time	By	Comment	Documented Units	Charge	Infection	Time

Activity Date: 04/03/11 Time: 0140 (continued)

191020 CLINICAL MONITORING (continued)
Ventricular Premature Beats: 0

Activity Date: 04/03/11 Time: 0145

191020 CLINICAL MONITORING A MD
Pulse: 150
Pulse: 150
Resp: 27
Non-Invasive BP-Systolic: 96
Non-Invasive BP-Diastolic: 58
Non-Invasive BP-Mean: 66
Pulse Ox: 97
Ventricular Premature Beats: 0

Activity Date: 04/03/11 Time: 0200

191020 CLINICAL MONITORING A MD
Pulse: 149
Pulse: 148
Resp: 26
Non-Invasive BP-Systolic: 92
Non-Invasive BP-Diastolic: 48
Non-Invasive BP-Mean: 59
Pulse Ox: 97
Ventricular Premature Beats: 0

Activity Date: 04/03/11 Time: 0215

191020 CLINICAL MONITORING A MD
Pulse: 148
Pulse: 41
Resp: 26
Non-Invasive BP-Systolic: 103
Non-Invasive BP-Diastolic: 58
Non-Invasive BP-Mean: 57
Pulse Ox: 99
Ventricular Premature Beats: 0
330038 IV Therapy: Medication Infusion A QSHIFT CP
< IV DRIP TITRATION >
IV Drip #1: CARDIZEM
Concentration: 1
- MG/ML
Current Rate: 10

Activity Date: 04/03/11 Time: 0230 (continued)

330030 IV Therapy: Medication Infusion (continued)
- MILLIGRAMS/HR
Comment: 10 M.HR
< BLOOD SUGAR RESULTS >
160100 Shift Re-Eval Verification A QSHI CP
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift Re-evaluation and have noted no change from my previous evaluation or have noted changes and have documented said changes appropriately.

Activity Date: 04/03/11 Time: 0315

191020 CLINICAL MONITORING A MD
Pulse: 149
Pulse: 149
Resp: 28
Non-Invasive BP-Systolic: 82
Non-Invasive BP-Diastolic: 51
Non-Invasive BP-Mean: 66
Pulse Ox: 98
Ventricular Premature Beats: 0
330038 IV Therapy: Medication Infusion A QSHIFT CP
< IV DRIP TITRATION >
IV Drip #1: CARDIZEM
Concentration: 1
- MG/ML
Current Rate: 5
- MILLIGRAMS/HR
Comment: 5 M./HR
< BLOOD SUGAR RESULTS >

Activity Date: 04/03/11 Time: 0330

191020 CLINICAL MONITORING A MD
Pulse: 144
Pulse: 146
Resp: 27
Non-Invasive BP-Systolic: 76
Non-Invasive BP-Diastolic: 48
Non-Invasive BP-Mean: 55
Pulse Ox: 98
Ventricular Premature Beats: 0

Age/Sex: 87 M
Unit: [redacted]
Admitted: 03/30/11 at 0245
Status: DIS IN#

Attending: Aaron Yeshaiahu MD
Location: R.ESIC
Room/Bed: R.A539-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing Home
CLINICAL DOCUMENTATION RECORD PPF

Printed 04/12/11 at 1042

Predicted/Goal/Intervention Description

Activity Type	Occurred Date	Occurred Time	By	Recorded Date	Recorded Time	By	Screen	SOS Direction	Code	Title	Interv

Activity Date: 04/03/11 Time: 0230

330030 IV Therapy: Medication Infusion A 03HY3FT CP
Document: 04703A1L 0230 JAS 04703A1L 0240 JAS
< IV DRIP TITRATION >
IV Drip #1: CARDIZEM
Concentration: 1
- MG/ML
Current Rate: 2
- MILLIGRAMS/HR
Comment: 2 MG/HR
< BLOOD SUGAR RESULTS >

Activity Date: 04/03/11 Time: 0230

191020 CLINICAL MONITORING+ A MD
Document: 04703A1L 0230 JAS 04703A1L 0240 JAS
Pulse: 146
Pulse: 146
Resp: 29
Non-Invasive BP-Systolic: 77
Non-Invasive BP-Diastolic: 48
Non-Invasive BP-Mean: 56
Pulse Ox: 98
Ventricular Premature Beats: 6

Activity Date: 04/03/11 Time: 0215

191020 CLINICAL MONITORING+ A MD
Document: 04703A1L 0215 JAS 04703A1L 0230 JAS
Pulse: 143
Resp: 29
Non-Invasive BP-Systolic: 73
Non-Invasive BP-Diastolic: 52
Non-Invasive BP-Mean: 57
Ventricular Premature Beats: 0

Activity Date: 04/03/11 Time: 0200

191020 CLINICAL MONITORING+ A MD
Document: 04703A1L 0200 JAS 04703A1L 0215 JAS
Pulse: 139
Resp: 27
Non-Invasive BP-Systolic: 79
Non-Invasive BP-Diastolic: 37
Non-Invasive BP-Mean: 36
Ventricular Premature Beats: 2

Activity Date: 04/03/11 Time: 0230

191020 CLINICAL MONITORING+ A MD
Document: 04703A1L 0230 JAS 04703A1L 0245 JAS
Pulse: 139
Resp: 21
Non-Invasive BP-Systolic: 73
Non-Invasive BP-Diastolic: 34
Non-Invasive BP-Mean: 41
Ventricular Premature Beats: 16

Activity Date: 04/03/11 Time: 0230

330030 IV Therapy: Medication Infusion A 03HY3FT CP
Document: 04703A1L 0230 JAS 04703A1L 0245 JAS
< IV DRIP TITRATION >
IV Drip #1: CARDIZEM
Concentration: 1
- MG/ML
Current Rate: 0
Comment: OFF FOR HYPOTENSION
< BLOOD SUGAR RESULTS >

Activity Date: 04/03/11 Time: 0230

142000 Intake and Output- (NOT BCTA) A 0B2H CP
Document: 04703A1L 0230 JAS 04703A1L 0245 JAS
< INTAKE AND OUTPUT >
Intake: 9
<< INTAKE >>
IVPB: 350
<< OUTPUT >>

Activity Date: 04/03/11 Time: 0230

191020 CLINICAL MONITORING+ A MD
Document: 04703A1L 0230 JAS 04703A1L 0245 JAS
Pulse: 133
Resp: 20
Non-Invasive BP-Systolic: 80
Non-Invasive BP-Diastolic: 39
Non-Invasive BP-Mean: 47
Ventricular Premature Beats: 13

Activity Date: 04/03/11 Time: 0245

191020 CLINICAL MONITORING+ A MD
Document: 04703A1L 0245 JAS 04703A1L 0300 JAS
Pulse: 126
Resp: 21

Age/Sex: 81 M Attending: Agraw,Venkatila MD
Admitted: 03/30/11 at 0245 Location: N.SSIC
Status: OIS INA Room/Bed: N.A539-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD MAR

Printed 04/12/11 at 1002

Problem/Intervention Description Sel Interaction Freq
Activity Occurred Recorded Documented Init
Date Time Date Time By Correct Value Change

Activity Date: 04/03/11 Time: 0115 Position: Semi-Fowler's

191020 CLINICAL MONITORING+ (continued)
Non-Invasive BP-Systolic: 70
Non-Invasive BP-Diastolic: 52
Non-Invasive BP-Mean: 56
Ventricular Premature Beats: 37

Activity Date: 04/03/11 Time: 0145

191020 CLINICAL MONITORING+ A MD
Document: 04/03/11 0145 04/03/11 0145
Pulse: 134
Resp: 20
Non-Invasive BP-Systolic: 63
Non-Invasive BP-Diastolic: 37
Non-Invasive BP-Mean: 43
Ventricular Premature Beats: 34

Activity Date: 04/03/11 Time: 0230

480015 RT: Respiratory Therapy Treatment+ A Per Order PS
Document: 04/03/11 0253 04/03/11 0253
- RESPIRATORY THERAPY TREATMENT -
Oxygen Therapy: Y
- RT INH TREATMENT -
Pre-treatment breath sounds
Post-treatment breath sounds
- RT INH TREATMENT -
Pre-treatment breath sounds
Post-treatment breath sounds
- OXYGEN FLOW SHEET -
O2 Flow: 12
l/mn
FiO2% 100
%
O2 Type: NON-REBREATHER MASK
Humidification? N
SpO2: 92%
- CPT TREATMENT/POSTURAL DRAINAGE -
Minutes
- OMITTED TREATMENT -
- SUCTIONING? -
< INCENTIVE SPIROMETRY >
-PULSE OXIMETRY -
F
F

Problem/Intervention Description Sel Interaction Freq
Activity Occurred Recorded Documented Init
Date Time Date Time By Correct Value Change

Activity Date: 04/03/11 Time: 0400

191020 CLINICAL MONITORING+ A MD
Document: 04/03/11 0400 04/03/11 0400
Pulse: 123
Resp: 20
Non-Invasive BP-Systolic: 69
Non-Invasive BP-Diastolic: 39
Non-Invasive BP-Mean: 48
Ventricular Premature Beats: 37

Activity Date: 04/03/11 Time: 0500

191020 CLINICAL MONITORING+ A MD
Document: 04/03/11 0500 04/03/11 0500
Pulse: 124
Pulse: 43
Resp: 20
Non-Invasive BP-Systolic: 66
Non-Invasive BP-Diastolic: 36
Non-Invasive BP-Mean: 42
Pulse Ox: 87
Ventricular Premature Beats: 37
210070 ADLs+ A Q12H CP
Document: 04/03/11 0500 04/03/11 0500
< ADL ASSISTANCE >
ACTIVITY
Assistance Required: Y
Assisted By: STAFF
Type: REPOSITIONING 2H OCD
TOILETING
ORAL CARE
Assistance Required: Y
Assisted By: STAFF
Type: SWAB MOUTH
LATEX
PERSONAL HYGIENE
Assistance Required: Y
Assisted By: STAFF
Type: PARTIAL BATH
LINEN CHANGED
Was Linen Changed: Y
Type: PARTIAL LINEN CHANGE
DRESSING
Was Patient Assisted With Changing Clothes: Y
191100 Shift Re-Eval Verification+ A Q2H CP
Document: 04/03/11 0500 04/03/11 0500
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have

[redacted] Attending: Agrwa, Yashitila MD
Acct#: [redacted] 15
Location: H.ESIC
Room/Bed: H.ASSB-1
Status: DIS INH

WINKLER, LOUIS

Brandon Regional Hospital Nursing *Live*
CLINICAL DOCUMENTATION RECORD MAR

Printed 04/18/11 at 1032

Problem/Goal/Intervention Description	Activity	Occurred	Recorded	Documented	Sub-Interaction	Freq
	Type	Date Time	by Date Time	by Comment	Units	Cancel

Activity Date: 04/03/11 Time Group: [illegible]

160100 Shift Re-Eval Verification* (continued)
notes changes and have documented said changes appropriately.
Nurse signature: SHIPLEY,JENNIFER A RN
191000 Vital Signs* (NOT BETA) A CSH CP
Document: [redacted]
<< VITAL SIGNS >>
Temp-F: 99.8
Temp Source: AXILLARY
Comment: PLACED ICE BAGS BILATERAL AXILLA

Activity Date: 04/03/11 Time: 0415

191020 CLINICAL MONITORING* A MD
Document: [redacted]
Pulse: 103
Resp: 18
Non-Invasive BP-Systolic: 64
Non-Invasive BP-Diastolic: 50
Non-Invasive BP-Mean: 53
Ventricular Premature Beats: 2

Activity Date: 04/03/11 Time: 0430

191020 CLINICAL MONITORING* A MD
Document: [redacted]
Pulse: 105
Pulse: 58
Resp: 10
Non-Invasive BP-Systolic: 58
Non-Invasive BP-Diastolic: 39
Non-Invasive BP-Mean: 42
Pulse Ox: 78
Ventricular Premature Beats: 2

Activity Date: 04/03/11 Time: 0445

191020 CLINICAL MONITORING* A MD
Document: [redacted]
Pulse: 99
Pulse: 58
Resp: 17
Non-Invasive BP-Systolic: 59
Non-Invasive BP-Diastolic: 33
Non-Invasive BP-Mean: 42
Pulse Ox: 82
Ventricular Premature Beats: 4

Problem/Goal/Intervention Description	Activity	Occurred	Recorded	Documented	Sub-Interaction	Freq
	Type	Date Time	by Date Time	by Comment	Units	Cancel

Activity Date: 04/03/11 Time: 0430

160206 Focused Care: Resp* A CP
Document: [redacted]
< RESPIRATORY EVALUATION >
O2 Therapy: Y
Breath Sounds Eval: Y
R Upper Anterior: COARSE
L Upper Anterior: COARSE
R Mid Anterior: COARSE
R Lower Anterior: COARSE
L Lower Anterior: COARSE
R Upper Posterior: COARSE
L Upper Posterior: COARSE
R Lower Posterior: COARSE
L Lower Posterior: COARSE
< RETRACTIONS >
< OXYGEN THERAPY >
O2 Device: NAB
O2 Flow (L/M): 15
FIO2 %: .80
< INCENTIVE SPIROMETRY >

Activity Date: 04/03/11 Time: 0445

191020 CLINICAL MONITORING* A MD
Document: [redacted]
Pulse: 139
Pulse: 38
Resp: 21
Non-Invasive BP-Systolic: 80
Non-Invasive BP-Diastolic: 27
Non-Invasive BP-Mean: 40
Pulse Ox: 61
Ventricular Premature Beats: 32
[redacted] IV Therapy: Medication Infusion A CSH/J CP
Document: [redacted]
< IV DRIP TITRATION >
IV Drip #1: .EVOPHED
Current Rate: 15
- MICROGRAM/MIN
< BLOOD SUGAR RESULTS >

Activity Date: 04/03/11 Time: 0445

Patient Notes: NURSES NOTES
Created: [redacted]
PT CONDITION DECLINING. FAMILY AT BEDSIDE. ORDER OBTAINED FOR DNR PER FAMILY WISHES.

WINKLER,LOUIS

Brandon Regional Hospital Nursing "Live"
CLINICAL DOCUMENTATION RECORD HPF

Page: 64

Printed 04/12/11 at 1802

Problem/Goal/Intervention Description

Activity Type | Ordered Date | Time | By | Recorded Date | Time | By | Comments | Documented Units | Charge

Activity Date: 04/07/11 Time: 0400 (continued)

Patient Notes: NURSES NOTES (continued)
Note Type Description
No Type None

Activity Date: 04/07/11 Time: 0400 (continued)

160200 Focused Care: Anuror (continued)
Document
< NEUROLOGICAL EVALUATION >
LOC: UNRESPONSIVE

Activity Date: 04/07/11

191020 CLINICAL MONITORING+ A MD
Document
Pulse: 133
Resp: 34
Non-Invasive BP-Systolic: 71
Non-Invasive BP-Diastolic: 48
Non-Invasive BP-Mean: 56
Ventricular Premature Beats: 31
200030 IV Therapy: Medication Infusion A Q8HIFT CP
Document
< IV DRIP TITRATION >
IV Drip #1: LEVOPHED
Current Rate: 15
- MICROGRAM/MIN
< BLOOD SUGAR RESULTS >

Activity Date: 04/07/11 Time: 0530

191020 CLINICAL MONITORING+ A MD
Document
Pulse: 134
Pulse: 137
Resp: 22
Non-Invasive BP-Systolic: 59
Non-Invasive BP-Diastolic: 37
Non-Invasive BP-Mean: 43
Pulse Ox: 100
Ventricular Premature Beats: 0

Activity Date: 04/07/11 Time: 0600

200030 IV Therapy: Medication Infusion A Q8HIFT CP
Document
< IV DRIP TITRATION >
IV Drip #1: LEVOPHED

Problem/Goal/Intervention Description

Activity Type | Ordered Date | Time | By | Recorded Date | Time | By | Comments | Documented Units | Charge

Activity Date: 04/07/11 Time: 0400 (continued)

200030 IV Therapy: Medication Infusion (continued)
Current Rate: 0
Comment: ALL FAMILY AT BEDSIDE, OFF PER FAMILY REQUEST, CMO
< BLOOD SUGAR RESULTS >

Activity Date: 04/07/11 Time: 0600

160100 Shift Re-Eval Verification+ A Q2H CP
Document
< SHIFT RE-EVALUATION >
By signing off on this intervention, I verify I have completed a Shift
Re-evaluation and have noted no change from my previous evaluation or have
noted changes and have documented said changes appropriately
Nurse signature: SHIPLEY, JENNIFER A, RN

Activity Date: 04/07/11 Time: 0600

191020 CLINICAL MONITORING+ A MD
Document
Pulse: 109
Pulse: 35
Resp: 17
Non-Invasive BP-Systolic: 62
Non-Invasive BP-Diastolic: 28
Non-Invasive BP-Mean: 34
Pulse Ox: 54
Ventricular Premature Beats: 0

Activity Date: 04/07/11 Time: 0730

191020 CLINICAL MONITORING+ A MD
Document
Pulse: 98
Pulse: 58
Resp: 14
Non-Invasive BP-Systolic: 48
Non-Invasive BP-Diastolic: 22
Non-Invasive BP-Mean: 27
Pulse Ox: 50
Ventricular Premature Beats: 0

Activity Date: 04/07/11 Time: 0800

191020 CLINICAL MONITORING+ A MD
Document
Pulse: 91
Pulse: 37
Resp: 7

[redacted] MD

WINKLER,LOUIS

Page: 65

Status: DIS Ibz Room/Bed: H.A539-L

Brandon Regional Hospital Nursing Flow
CLINICAL DOCUMENTATION RECORD PDF

Printed 04/12/11 at 1002

Problem/Goal/Intervention Description | SLP Interpreter | Time

Activity Type | Described Date | Recorded Time | By | Discontinued Date | Time | By | Comment | Outcome | Status

Activity Date: 04/03/11 (Time Ordered - Continued)

L71020 CLINICAL MONITORING (continued)
Pulse Ox: 46
Neurovascular Pressure Goals: N

Activity Date: 04/03/11 Time: 1139

Patient Notes: NURSES NOTES
Created 04/03/11 1203 EDT 04/03/11 1014 EDT

PT EXPIRED AT APPROX 0800 THIS MORNING. PT WAS EXTUBATED. SO AS AGGRESSIVE ACTIONS TAKEN. PT KEPT COMFORTABLE THROUGHOUT WITH 4 CHILDREN AND NEPHEW BY BEDSIDE. DR GRAVES ON FLOOR AT TIME OF DEATH. HE BRIEFLY TALKED WITH FAMILY AFTERWARDS. ALL POSSESSIONS TAKEN BY FAMILY AND THEY ARE TO CALL HOSPITAL WHEN FUNERAL HOME DETERMINED. UNTIL THAT TIME, PT TAKEN TO MORGUE

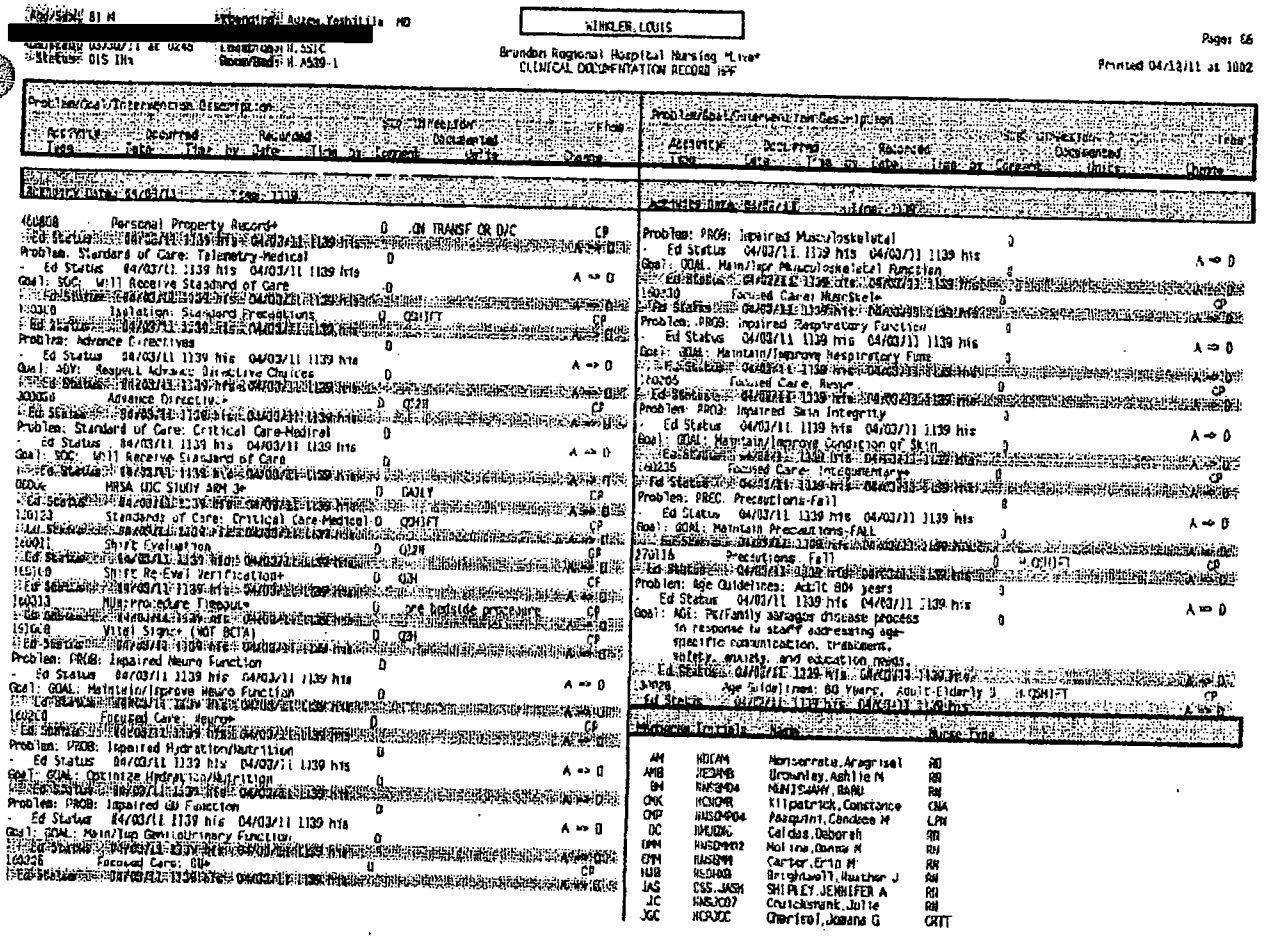
Note Type | Description
No Type | None

Activity Date: 04/03/11 Time: 1139

L00-E	EDM - MEDICATION HISTORY	C			AS
Ed Section	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
145000	Wound Care Evaluation	D	per standard		PS
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
191060	CLINICAL MONITORING	C			MD
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
960C0	BCTA: Transfusion Documentation	C	per standard		CF
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
140C3	OCTA: Blood Bank Product (BB)	D	per standard		PS
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
210035	Monitor: Blood Glucose*	D	QS		CF
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
330030	IV Therapy/ Medication Infusion	D	QSHIFT		CF
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
480010	RT: Respiratory Therapy Treatment*	D	per order		MS
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
91000	Nutrition: Assessment*	D	per standard		AE
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
540060	Patient Care Orders*	D	QSHIFT		DE
	4/1/11-BLOSIDE SWALLOW EVAL - IF PT PASSES MAY HAVE FULL LIQUID DIET				
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
540060	Patient Care Orders*	D	QSHIFT		DE
	4/1-STL CB, AM LABS, PORT CXR, STAT LACTIC ACID				
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active

Activity Date: 04/03/11 Time: 1139

540000	Patient Care Orders*	D	QSHIFT		DE
	4/1-TX TO ICU,PICC, NOTIFY MD OF PT STATUS,BLD CX X 2, SPUTUM CS IF ABLE, UA CS, IF PRN, KEEP SATS>90..CXR/LABS IN AM, 3RD.				
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
Problem: PSOS: Impaired Cardiovascular Function					3
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				A => D
Goal: GOal: Maintain/Adapt Cardiovascular Function					3
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
160210	Focused Care, Cardiac*	D			CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
Problem: Care Guidelines					9
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				A => D
Goal: SOC: Will Receive Care Per Guidelines					3
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
160105	Discharge Instructions*	D	on discharge		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
90020	Weight*	D	on admission and PRN		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
190060	Intake and Output* (IOP BCTA)	D	QL8H		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
210065	Eval: Venous Thromboembolism	D	on admission + QSHIFT		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
210070	ATLs*	D	QL8H		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
240020	Pain Management*	D	with VS and PRN		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
125005	CVC/PICC Insertion*	D	per standard		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
160010	Invasive Line Management*	D	QSHIFT+PRN		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
240020	Tubes & Drains Management*	D	Q SHIFT+PRN		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
940425	Special Equipment Management*	D	QSHIFT		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
240070	Interdisciplinary Team Conference*	D	on going		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
450100	Education: Interdisciplinary*	D	QSHIFT		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
450400	Education: Interdisciplinary Medi*	D	QSHIFT		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
480600	Plan of Care Review*	D	QSHIFT		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active
450700	Physician Notification/Response*	D	PRN		CP
Ed Status	04/03/11 1139 Hrs 04/03/11 1139 Hrs				Active



Age/Sex: 31 M
Unit #: [redacted]
Admitted: 03/30/11 at 0245
Status: DIS INI

Attending: Andrew Yeshitila MD
Account #: [redacted]
Location: M.SSIC
Room/Bed: M A539-1

WINKLER,LOUIS

Brandon Regional Hospital Nursing Unit
CLINICAL DOCUMENTATION RECORD MPF

Printed 04/12/11 at 1002

Nickname (Initial)	Name	Name Type
JPJ	HCPJPJ	Joseph,John P	CRTT
KAL	HCSKAL	Luke-Saul,Karina A	CNA
KAH	HNSKAH02	Morran,Kelly A	RN
KJY	HNSKJY	rost,Kami J.	RN
LS	HICLXS	SANDERS,LEIA	RN
MJB	HNSMJB02	Bisbee,Michelle J	US
MT	HCPMT	Thomas,Mary	CRTT
PAJ	HCNPAJ	Johnson,Patricia A	CNA
PCD	HNSPCD	Doriette,Philomene	RN
RCT	HCSRCT	Talley,Robert C	RRT
RP	HNSRP02	Price,Robert	RN
ZA	CSS.ZA	ACOSTA,ZAYDEE	RN
His		automatic by progress	

(1)

Room #: B318 Report sent by: Heather / Phone #: 6050
RAU. Arrival Time: 0710 Current Time: 0715 Transport Time:
Admitting Diagnosis: Cytopenia R/O Lymphoma Consulting: Loch Rodgers
Admitting Physician: Hazen MD on call:

- ☐ AM patient
- ☐ Pneumonia: Antibiotic ☐ Administered
- ☑ Pneumo/Influenza Vaccine screen completed ☐ Administered ☐ Refused
- ☑ Suicide / Elopement Initial Screening completed ☐ Precautions instituted ☐ N/A
- ☑ MRSA Screening ☐ Contact precaution instituted ☐ N/A
- ☐ Pressure ulcer(s) present ☐ Document POA ☐ Protocol in place ☐ N/A
- ☑ DVT Screening ☐ Prophylaxis ordered
- ☑ Fall Risk Assessment complete ☐ Fall precautions in place

ASA given? ☐ Administered ☐ Contraindicated
Blood Culture ? ☑ Yes ☐ No

Home Medication List Completed?: ☐ No ☑ Yes Allergies: NKMA
Language Barrier: ☑ No ☐ Yes Comment:
Code Status: ☑ Full Code ☐ DNR ☐ Advance Directive ☐ Copy in Chart
☑ IV # 1 Site LAC Size 18g Solution NS Rate 100 Placed by: ☐ ED ☑ EMS SCD's
☐ IV # 2 Site ____ Size ____ Solution ____ Rate ____ Placed by: ☐ ED ☐ EMS
☐ IV GTT Medication: ____ Rate ____
☑ O2 LPM 2 Device: ☑ N/C ☐ Venturi ☐ NRB Mask ☐ Trach tent
☑ Telemetry Ordered Cardiac Rhythm BCX 38 ST 108
☐ Foley: ☐ No ☑ Yes ☐ Needs ☐ NG Tube: ☑ No ☐ Yes ☐ Needs ☐ Suction: ☑ No ☐ Yes ☐ Needs
Vital Signs: Time 0720 BP 145/81 HR 109 RR 22 SpO2 95 Temp 99.3 Ax
Pain: On Arrival 0/10 (1-10 scale) Current 0/10 Location
Last dose of Pain Medication: Time ____ Medication ____ Effectiveness ____

Diagnostics:

	Done	Needs		Done	Needs		Done	Needs
CBC	☑	☐	Drug Screen	☐	☐	Urine Blood Culture	☑	☐
BMP/ CMP	☑	☐	ABG	☐	☐	Sputum Culture	☐	☐
PT/ PTT	☑	☐	Trop / Myog	☑ 0.05	☐	Wound Culture	☐	☐
UA	☑	☐						

Significant Abnormal Results: WBC-10.8 H-9.3, 29.9 PLT-95 UA ☑ RAN-38 Creat-1.5 GFR-48 AST-132 PT-17.7 INR-1.2 BNP-119
Antibiotics given: ☐ No ☐ Yes ☐ Needs
Current Assessment:

Mental Status	☐ Alert/oriented	☐ Anxious	☑ Confused	☐ Combative	☐ Drowsy
Skin Condition	☑ Warm/dry	☐ Flushed	☐ Diaphoretic	☐ Cool/clammy	☐ Pale/ashen
Respiratory Effort	☑ Even/unlabored	☐ Labored	☐ Shallow	☐ Rapid	☐ Agonal
Breath Sounds R	☐ Clear	☐ Wheezes	☐ Crackles	☐ Absent	Diminished
L	☐ Clear	☐ Wheezes	☐ Crackles	☐ Absent	Diminished

Valuables: ☐ Dentures ☐ Hearing Aides ☐ Glasses ☐ Prosthesis
Significant Medical History: fell 5 weeks ago & broke Rt arm Artificial Lt eye HTN dementia DM heart murmur
Comments:
RN Signature: Heather Hatfield Date: 3/30/11 Time: 0715

Rapid Admission Report

WINKLER, LOUIS [redacted] 81 M 03/29/11 0000 ER
Bennett, Roderick MD MRN H000747583
BRANDON REGIONAL HOSPITAL BRANDON, FL

"NNS" BRH00971 rev 08/10

Patient:WINKLER, LOUIS MRN:[redacted] Encounter:H00718392715 Page 1 of 1

M 001614

Louis Michael Winkler, Jr.

Vs.

State of South Carolina

Pleadings Binder-B

Index of Pleadings Binder-B

A. 2012 05 18 Subpoena of SLED Protocol
B. 2012 05 18 Subpoena to Horry County Police
C. 2012 05 23 Proposed Transportation Order
D. 2012 05 25 Ex Parte Transportation Order
E. 2012 05 30 Return Second Amended App. for PCR and Motion for More Definite Statement
F. 2012 06 01 Applicant's Supplemental Answers to Respondent's Interrogatories
G. 2012 06 01 Applicant's Supplemental Responses to Respondent's Request for Documents and Things
H. 2012 06 01 Respondent's Updated Responses to Applicants Request
I. 2012 06 04 Motion to Limit Scope of Cross-Examination
J. 2012 06 06 Notice of Intent to Rely on Affidavits
K. 2012 06 06 Order Regarding Applicant's Motion to Limit Scope of Cross Examination
L. 2012 06 07 Subpoena of Aaron Wilkes
M. 2012 06 07 Subpoena of Denise Bellamy
N. 2012 06 07 Subpoena of Paul Rathburn
O. 2012 06 07 Subpoena of Ralph Wilson
P. 2012 06 08 Subpoena of Kenneth Martinelli
Q. 2012 06 11 Return to Respondent's Objection to Applicant's reliance on Statements and Affidavits
R. 2012 06 11 Motion to Dismiss for Failure to State Facts Sufficient to Constitute a Cause of Action Pursuant to Rule 12(b)(6), SCRCP
S. 2012 06 12 Return to Respondent's Motion to Dismiss For Failure to State Facts Sufficient to Constitute A Cause of Action Pursuant Rule 12(b)(6)
T. 2012 06 14 Reply to Applicant's Return to Respondent's Motion to Dismiss for Failure to State Facts Sufficient to Constitute a Cause of Action Pursuant Rule 12(b)(6)
U. 2012 06 14 Reply to Applicant's Return to Respondent's Object to Applicant's Notice of Intent to Rely on Affidavits and Respondent's Motion to Exclude Statements and Affidavits
V. 2012 06 15 Ex Parte Medication Order

STATE OF SOUTH CAROLINA

ISSUED BY THE COMMON PLEAS COURT IN THE COUNTY OF HORRY

Louis Michael Winkler, Plaintiff

v.

SUBPOENA IN A CIVIL CASE

South Carolina, Defendant

Case Number: 2011-CP-26-03907

Pending in Horry County

TO: Margaret Knox; South Carolina Law Enforcement Division; 4400 Broad River Road, Columbia, SC 29210; P.O. Box 21398; Columbia, SC 29221.

☐ YOU ARE COMMANDED to appear in the above named court at the place, and time specified below to testify in the above case.

PLACE OF TESTIMONY	COURTROOM
	DATE AND TIME , AM

☐ YOU ARE COMMANDED to appear at the place, date, and time specified below to testify at the taking of a deposition in the above case.

PLACE OF DEPOSITION	DATE AND TIME , AM

☒ YOU ARE COMMANDED to produce and permit inspection and copying of the following documents or objects in your possession, custody or control at the place, date and time specified below (list documents of objects:

1. All manuals and documents describign the standard operating procedures associated with firearm and toolmark analysis and identification for the South Carolina Law Enforcement Division, including all standards for documentation of firearms and toolmark examiners' conclusions. The requested manuals and documents are to be provided in both their current versions and in the verions that were in effect in 2006 when the firearms and toolmark examinations in SLED Lab Number L06-4368 took place.

2. All proficiency results from January 1, 2006 to present for both the original examiner (Vello Paavel) and all peer reviewer(s) invovled in the analysis of toolmark and firearms analysis in SLED Lab Number L06-4368.

3. All records, documents, and materials regarding the accreditation by any accrediting agency of the South Carolina Law Enforcement Division firearms and toolmark identification unit from January 1, 2006 to present, including any attempts to gain accreditation, the results of such, any remedial measure suggested or imposed on the firearms and toolmark unit by any accrediting agency during this period, and the results of any remeidal measures taken.

4. The exact copies of the original photomicrographs associated with the firearms and toolmark examinations conducted in SLED Lab Number L06-4368.

5. All documents, reports and materials related to any intercomparison of the individual cartridge cases included in the firearms associated with SLED Lab Number L06-4368.

6. The curriculum vita for Mr. Paavel, all peer reviewers involved in the analysis of toolmark and firearms analysis in SLED Lab Number L06-4368.

PLACE	DATE AND TIME
Law Offices of John R. Mills; 201 W. Main Street; Suite 301; Durham, NC 27701.	May 28, 2012, 9:30 AM

SCCA 254 (05/2011)

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

☐ YOU ARE COMMANDED to permit inspection of the following premises at the date and time specified below.

PREMISES	DATE AND TIME , AM

ANY SUBPOENAED ORGANIZATION NOT A PARTY TO THIS IS HEREBY DIRECTED TO RULE 30(b)(6), SOUTH CAROLINA RULES OF CIVIL PROCEDURE, TO FILE A DESIGNATION WITH THE COURT SPECIFYING ONE OR MORE OFFICERS, DIRECTORS, OR MANAGING AGENTS, OR OTHER PERSONS WHO CONSENT TO TESTIFY ON ITS BEHALF, SHALL SET FORTH, FOR EACH PERSON DESIGNATED, THE MATTERS ON WHICH HE WILL TESTIFY OR PRODUCE DOCUMENTS OR THINGS. THE PERSON SO DESIGNATED TESTIFY AS TO MATTERS KNOWN OR REASONABLY AVAILABLE TO THE ORGANIZATION

I CERTIFY THAT THE SUBPOENA IS ISSUED IN COMPLIANCE WITH RULE 45(c)(1), AND THAT NOTICE AS REQUIRED BY RULE 45(b)(1) HAS BEEN GIVEN TO ALL PARTIES.

John R Miles — 5/18/2015 — John R. Miles

Attorney/Issuing Officer's Signature — Date — Print Name

Indicate if Attorney for Plaintiff or Defendant

Attorney's Address and Telephone Number :

919-251-6259

201 W. Main Street; Suite 301; Durham, NC 27701

Clerk of Court/Issuing Officer's Signature — Date — Print Name

Pro Se Litigant's Name, Address and Telephone Number :

PROOF OF SERVICE

SERVED	DATE 5/18/2012	FEES AND MILEAGE TENDERED TO WITNESS ☐YES ☒NO AMOUNT $
	PLACE Margaret Knox; South Carolina Law Enforcement Division; 4400 Broad River Road, Columbia, SC 29210; P.O. Box 21398; Columbia, SC 29221; Attorney General's Office; P.O. Box 1159; Columbia, SC 29211	

SERVED ON Margaret Knox; Al Simon	MANNER OF SERVICE Mail
SERVED BY John R. Mills	TITLE Attorney

DECLARATION OF SERVER

I certify that the foregoing information contained in the Proof of Service is true and correct.

Executed on 5/18/2012

John R. Mills
SIGNATURE OF SERVER

201 W. Main Street, Suite 301; Durham, NC 27701
ADDRESS OF SERVER

Rule 45, South Carolina Rules of Civil Procedures, Parts (c) and (d):

(c) Protection of Persons Subject to Subpoenas.

(1) A party or an attorney responsible for the issuance and service of a subpoena shall take reasonable steps to avoid imposing undue burden or expense on a person subject to that subpoena. The court on behalf of which the subpoena was issued shall enforce this duty and impose upon the party or attorney in breach of this duty an appropriate sanction, which may include, but is not limited to, lost earnings and a reasonable attorney's fee.

(2) (A) A person commanded to produce and permit inspection and copying of designated books, papers, documents or tangible things, or inspection of premises need not appear in person at the place of production or inspection unless commanded to appear for deposition, hearing or trial. A party or an attorney responsible for the issuance and service of a subpoena for production of books, papers and documents without a deposition shall provide to another party copies of documents so produced upon written request. The party requesting copies shall pay the reasonable costs of reproduction.

(B) Subject to paragraph (d) (2) of this rule, a person commanded to produce and permit inspection and copying may, within 14 days after service of the subpoena or before the time specified for compliance if such time is less than 14 days after service, serve upon the party or attorney designated in the subpoena written objection to inspection or copying of any or all of the designated materials or of the premises. If objection is made, the party serving the subpoena shall not be entitled to inspect and copy the materials or inspect the premises except pursuant to an order of the court by which the subpoena was issued. If objection has been made, the party serving the subpoena may, upon notice to the person commanded to produce, move at any time in the court that issued the subpoena for an order to compel the production. Such an order to compel production shall protect any person who is not a party or an officer of a party from significant expense resulting from the inspection and copying commanded.

(3) (A) On timely motion, the court by which a subpoena was issued, or regarding a subpoena commanding appearance at a deposition, or production or inspection directed to a non-party, the court in the county where the non-party resides, is employed or regularly transacts business in person, shall quash or modify the subpoena if it:

i. fails to allow reasonable time for compliance; or

ii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to travel more than 50 miles from the county where that person resides, is employed or regularly transacts business in person, except that, subject to the provisions of clause (c)(3)(B)(iii) of this rule, such a person may in order to attend trial be commanded to travel from any such place within the state in which the trial is held; or

iii. requires disclosure of privileged or otherwise protected matter and no exception or waiver applies; or

iv. subjects a person to undue burden.

(B) If a subpoena:

i. requires disclosure of a trade secret or other confidential research, development, or commercial information, or

ii. requires disclosure of an unretained expert's opinion or information not describing specific events or occurrences in dispute and resulting from the expert's study made not at the request of any party, or

iii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to incur substantial expense to travel from the county where that person resides, is employed or regularly transacts business in person,

the court may, to protect a person subject to or affected by the subpoena, quash or modify the subpoena or, if the party in whose behalf the subpoena is issued shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship and assures that the person to whom the subpoena is addressed will be reasonably compensated, the court may order appearance or production only upon specified conditions.

(d) Duties in Responding to Subpoena.

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

(1) A person responding to a subpoena to produce documents shall produce them as they are kept in the usual course of business or shall organize and label them to correspond with the categories in the demand.

(2) When information subject to a subpoena is withheld on a claim that it is privileged or subject to protection as trial preparation materials, the claim shall be made expressly and shall be supported by a description of the nature of the documents, communications, or things not produced that is sufficient to enable the demanding party to contest the claim.

STATE OF SOUTH CAROLINA

ISSUED BY THE COMMON PLEAS COURT IN THE COUNTY OF HORRY

Louis Michael Winkler, Plaintiff

v.

South Carolina, Defendant

SUBPOENA IN A CIVIL CASE

Case Number: 2011-CP-26-03907

Pending in Horry County

TO: Public Information Officer, Sgt. Robert Kegler, 2560 Main Street, Suite 7; Conway, SC 29526.

☐ YOU ARE COMMANDED to appear in the above named court at the place, and time specified below to testify in the above case.

PLACE OF TESTIMONY	COURTROOM
	DATE AND TIME , AM

☐ YOU ARE COMMANDED to appear at the place, date, and time specified below to testify at the taking of a deposition in the above case.

PLACE OF DEPOSITION	DATE AND TIME . AM

☒ YOU ARE COMMANDED to produce and permit inspection and copying of the following documents or objects in your possession, custody or control at the place, date and time specified below (list documents of objects:

All police reports, witness statements, and other materials related to an investigation related to a 911 call on August 6, 1994 related to Louis Michael Winkler Jr., DOB: 3/24/1960. Mr. Winkler was allegedly hit on the head with a beer bottle.

PLACE	DATE AND TIME
Law Offices of John R. Mills; 201 W. Main Street; Suite 301; Durham, NC 27701.	May 28, 2012, 9:30 AM

☐ YOU ARE COMMANDED to permit inspection of the following premises at the date and time specified below.

PREMISES	DATE AND TIME . AM

ANY SUBPOENAED ORGANIZATION NOT A PARTY TO THIS IS HEREBY DIRECTED TO RULE 30(b)(6), SOUTH CAROLINA RULES OF CIVIL PROCEDURE, TO FILE A DESIGNATION WITH THE COURT SPECIFYING ONE OR MORE OFFICERS, DIRECTORS, OR MANAGING AGENTS, OR OTHER PERSONS WHO CONSENT TO TESTIFY ON ITS BEHALF, SHALL SET FORTH, FOR EACH PERSON DESIGNATED, THE MATTERS ON WHICH HE WILL TESTIFY OR PRODUCE DOCUMENTS OR THINGS. THE PERSON SO DESIGNATED TESTIFY AS TO MATTERS KNOWN OR REASONABLY AVAILABLE TO THE ORGANIZATION

I CERTIFY THAT THE SUBPOENA IS ISSUED IN COMPLIANCE WITH RULE 45(c)(1), AND THAT NOTICE AS REQUIRED BY RULE 45(b)(1) HAS BEEN GIVEN TO ALL PARTIES.

John R. Mills — 5/18/2012 — John R. Mills

Attorney/Issuing Officer's Signature — Date — Print Name

Indicate if Attorney for Plaintiff or Defendant

Attorney's Address and Telephone Number

919-251-6259

201 W. Main Street; Suite 301; Durham, NC 27701

SCCA 254 (05/2011)

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

Clerk of Court/Issuing Officer's Signature | Date | Print Name

Pro Se Litigant's Name, Address and Telephone Number :

PROOF OF SERVICE

SERVED	DATE 5/18/2012	FEES AND MILEAGE TENDERED TO WITNESS
	PLACE Public Information Officer, Sgt. Robert Kegler, 2560 Main Street, Suite 7; Conway, SC 29526; Attorney General's Office; P.O. Box 1159; Columbia, SC 29211	☐YES ☒NO AMOUNT $
SERVED ON Robert Kegler; Al Simon		MANNER OF SERVICE Mail
SERVED BY John R. Mills		TITLE Attorney

DECLARATION OF SERVER

I certify that the foregoing information contained in the Proof of Service is true and correct.

Executed on 5/18/2012

John R. Mills
SIGNATURE OF SERVER

201 W. Main Street, Suite 301; Durham, NC 27701
ADDRESS OF SERVER

Rule 45, South Carolina Rules of Civil Procedures, Parts (c) and (d):

(c) Protection of Persons Subject to Subpoenas.

(1) A party or an attorney responsible for the issuance and service of a subpoena shall take reasonable steps to avoid imposing undue burden or expense on a person subject to that subpoena. The court on behalf of which the subpoena was issued shall enforce this duty and impose upon the party or attorney in breach of this duty an appropriate sanction, which may include, but is not limited to, lost earnings and a reasonable attorney's fee.

(2) (A) A person commanded to produce and permit inspection and copying of designated books, papers, documents or tangible things, or inspection of premises need not appear in person at the place of production or inspection unless commanded to appear for deposition, hearing or trial. A party or an attorney responsible for the issuance and service of a subpoena for production of books, papers and documents without a deposition shall provide to another party copies of documents so produced upon written request. The party requesting copies shall pay the reasonable costs of reproduction.

(B) Subject to paragraph (d) (2) of this rule, a person commanded to produce and permit inspection and copying may, within 14 days after service of the subpoena or before the time specified for compliance if such time is less than 14 days after service, serve upon the party or attorney designated in the subpoena written objection to inspection or copying of any or all of the designated materials or of the premises. If objection is made, the party serving the subpoena shall not be entitled to inspect and copy the materials or inspect the premises except pursuant to an order of the court by which the subpoena was issued. If objection has been made, the party serving the subpoena may, upon notice to the person commanded to produce, move at any time in the court that issued the subpoena for an order to compel the production. Such an order to compel production shall protect any person who is not a party or an officer of a party from significant expense resulting from the inspection and copying commanded.

(3) (A) On timely motion, the court by which a subpoena was issued, or regarding a subpoena commanding appearance at a deposition, or production or inspection directed to a non-party, the court in the county where the non-party resides, is employed or regularly transacts business in person, shall quash or modify the subpoena if it:

i. fails to allow reasonable time for compliance; or

ii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to travel more than 50 miles from the county where that person resides, is employed or regularly transacts business in person, except that, subject to the provisions of clause (c)(3)(B)(iii) of this rule, such a person may in order to attend trial be commanded to travel from any such place within the state in which the trial is held; or

iii. requires disclosure of privileged or otherwise protected matter and no exception or waiver applies; or

iv. subjects a person to undue burden.

(B) If a subpoena:

i. requires disclosure of a trade secret or other confidential research, development, or commercial information, or

ii. requires disclosure of an unretained expert's opinion or information not describing specific events or occurrences in dispute and resulting from the expert's study made not at the request of any party, or

iii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to incur substantial expense to travel from the county where that person resides, is employed or regularly transacts business in person,

the court may, to protect a person subject to or affected by the subpoena, quash or modify the subpoena or, if the party in whose behalf the subpoena is issued shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship and assures that the person to whom the subpoena is addressed will be reasonably compensated, the court may order appearance or production only upon specified conditions.

(d) Duties in Responding to Subpoena.

(1) A person responding to a subpoena to produce documents shall produce them as they are kept in the usual course of business or shall organize and label them to correspond with the categories in the demand.

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

(2) When information subject to a subpoena is withheld on a claim that it is privileged or subject to protection as trial preparation materials, the claim shall be made expressly and shall be supported by a description of the nature of the documents, communications, or things not produced that is sufficient to enable the demanding party to contest the claim.

STATE OF SOUTH CAROLINA)
COUNTY OF HORRY)

IN THE COURT OF COMMON PLEAS

CASE NO. 2011 - CP - 26 - 03907

Louis Michael Winkler, Jr.
[x] Plaintiff

v.

State of South Carolina
[ ] Defendant.

MOTION AND ORDER INFORMATION FORM AND COVER SHEET

Plaintiff's Attorney:	Defendant's Attorney:
John R. Mills, Bar No. 42301	Al Simon, Bar No.
Address: 201 W. Main Street, Suite 301 Durham, NC 27701	Address: P.O. Box 11549 Columbia, SC 29211
phone: 919-251-6259 fax: 919-237-9254	phone: 803-734-6307 fax:
e-mail: john@jrmillslaw.com her:	e-mail: her:

[ ] **MOTION HEARING REQUESTED (attach written motion and complete SECTIONS I and III)**
[x] **FORM MOTION, NO HEARING REQUESTED (complete SECTIONS II and III)**
[x] **PROPOSED ORDER/CONSENT ORDER (complete SECTIONS II and III)**

SECTION I: Hearing Information

Nature of Motion: Ex Parte Proposed Transportation Order
Estimated Time Needed: None Court Reporter Needed: [ ] YES / [x] NO

SECTION II: Motion/Order Type

[ ] Written motion attached
[x] Form Motion/Order

I hereby move for relief or action by the court as set forth in the attached proposed order.

John R. Mills
Signature of Attorney for [x] Plaintiff / [ ] Defendant

5/23/12
Date submitted

SECTION III: Motion Fee

[ ] PAID – AMOUNT:
[x] EXEMPT: (check reason)
- [ ] Rule to Show Cause in Child or Spousal Support
- [ ] Domestic Abuse or Abuse and Neglect
- [x] Indigent Status
- [ ] State Agency v. Indigent Party
- [ ] Sexually Violent Predator Act
- [ ] Post-Conviction Relief
- [ ] Motion for Stay in Bankruptcy
- [ ] Motion for Publication
- [ ] Motion for Execution (Rule 69, SCRCP)
- [ ] Proposed order submitted at request of the court; or, reduced to writing from motion made in open court per judge's instructions

Name of Court Reporter:
- [ ] Other:

JUDGE'S SECTION

[ ] Motion Fee to be paid upon filing of the attached order.
[ ] Other:

JUDGE

CODE: Date:

CLERK'S VERIFICATION

Collected by: Date Filed:

[ ] MOTION FEE COLLECTED:
[ ] CONTESTED – AMOUNT DUE:

SCCA/233 (11/03)

STATE OF SOUTH CAROLINA COUNTY OF HORRY Louis Michael Winkler Jr. Applicant, v. State of South Carolina, Respondent.	IN THE COURT OF COMMON PLEAS Case No. 2011-CP 26-03907 **EX PARTE** **TO BE FILED UNDER SEAL** **TRANSPROTATION ORDER**

This Court hereby orders the Department of Corrections to transport and deliver Mr. Louis Michael Winkler Jr., #6027 to the Medical University of South Carolina on June 6, 2012. At 9:00 a.m. he shall be at the 3rd Floor of the Main Hospital; 171 Ashley Avenue; Charleston, SC 29403. For the visit to the Main Hospital, the hospital has recommended taking Elevator D to get to the 3rd Floor. The hospital will conduct a positron emission tomography scan of Mr. Winkler's brain.

AND IT IS SO ORDERED.

Benjamin Culbertson
Circuit Judge

May _____, 2012

Respectfully submitted,

John R Mills 5/23/12

JOHN R. MILLS
Law Offices of John R. Mills, NPC
201 W. Main Street, Suite 301
Durham, NC 27701
919-251-6259

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
Post Office Box 11311
Columbia, SC 29211
803-765-1044

STATE OF SOUTH CAROLINA)
COUNTY OF HORRY)

IN THE COURT OF COMMON PLEAS

CASE NO. 2011 - CP - 26 - 03907

Louis Michael Winkler, Jr.
[x] Plaintiff

v.

State of South Carolina
[ ] Defendant.

MOTION AND ORDER INFORMATION FORM AND COVER SHEET

Plaintiff's Attorney:	Defendant's Attorney:
John R. Mills, Bar No. 42301	Al Simon, Bar No.
Address: 201 W. Main Street, Suite 301 Durham, NC 27701	Address: P.O. Box 11549 Columbia, SC 29211
phone: 919-251-6259 fax: 919-237-9254	phone: 803-734-6307 fax:
e-mail: john@jrmillslaw.com her:	e-mail: her:

[ ] **MOTION HEARING REQUESTED (attach written motion and complete SECTIONS I and III)**
[x] **FORM MOTION, NO HEARING REQUESTED (complete SECTIONS II and III)**
[x] **PROPOSED ORDER/CONSENT ORDER (complete SECTIONS II and III)**

SECTION I: Hearing Information

Nature of Motion: Ex Parte Proposed Transportation Order
Estimated Time Needed: None Court Reporter Needed: [ ] YES / [x] NO

SECTION II: Motion/Order Type

[ ] Written motion attached
[x] Form Motion/Order

I hereby move for relief or action by the court as set forth in the attached proposed order.

John R. Mills — Signature of Attorney for [x] Plaintiff / [ ] Defendant
5/23/12 — Date submitted

SECTION III: Motion Fee

[ ] PAID – AMOUNT:
[x] EXEMPT: (check reason)
- [ ] Rule to Show Cause in Child or Spousal Support
- [ ] Domestic Abuse or Abuse and Neglect
- [x] Indigent Status [ ] State Agency v. Indigent Party
- [ ] Sexually Violent Predator Act [ ] Post-Conviction Relief
- [ ] Motion for Stay in Bankruptcy
- [ ] Motion for Publication [ ] Motion for Execution (Rule 69, SCRCP)
- [ ] Proposed order submitted at request of the court; or, reduced to writing from motion made in open court per judge's instructions

Name of Court Reporter:
- [ ] Other:

JUDGE'S SECTION

[ ] Motion Fee to be paid upon filing of the attached order.
[ ] Other:

JUDGE

CODE: Date:

CLERK'S VERIFICATION

Date Filed:

Collected by:

[ ] MOTION FEE COLLECTED:
[ ] CONTESTED – AMOUNT DUE:

SCCA/233 (11/03)

STATE OF SOUTH CAROLINA)
) IN THE COURT OF COMMON PLEAS
COUNTY OF HORRY)
) Case No. 2011-CP 26-03907
Louis Michael Winkler Jr.)
Applicant,)
) **EX PARTE**
v.) **TO BE FILED UNDER SEAL**
) **TRANSPROTATION ORDER**
State of South Carolina,)
)
Respondent.)

This Court hereby orders the Department of Corrections to transport and deliver Mr. Louis Michael Winkler Jr., #6027 to the Medical University of South Carolina on June 6, 2012. At 9:00 a.m. he shall be at the 3rd Floor of the Main Hospital; 171 Ashley Avenue; Charleston, SC 29403. For the visit to the Main Hospital, the hospital has recommended taking Elevator D to get to the 3rd Floor. The hospital will conduct a positron emission tomography scan of Mr. Winkler's brain.

AND IT IS SO ORDERED.

Benjamin Culbertson
Circuit Judge

May 25, 2012

STATE OF SOUTH CAROLINA)	IN THE COURT OF COMMON PLEAS
)	
COUNTY OF HORRY)	
)	
Louis Michael Winkler, Jr., #6027,)	C/A No. 2011-CP-11-3907
)	
Applicant,)	
v.)	RETURN TO SECOND AMENDED APPLICATION FOR POST-CONVICTION RELIEF AND MOTION FOR MORE DEFINITE STATEMENT
)	(Capital Case)
The State of South Carolina,)	
)	
Respondent.)	
)	

Respondent, above-named, here by makes Return to the second amended application for post-conviction relief ("APCR"), served by Louis Michael Winkler, Jr. ("Applicant") on January 31, 2011. This APCR stems from a murder conviction, a first degree burglary conviction, an assault and battery of a high and aggravated nature conviction, and a death sentence.

Respondent respectfully moves for a more definite statement in regards to the allegations set forth in 10 & 11(b)(1) and 10 & 11(b)(2). Respondent submits that as submitted, those allegations are too vague for response.

I. Procedural History

During the May 2006 Term of the Horry County Court of General Sessions, Applicant Louis Michael Winkler was indicted by the Horry County Grand Jury for Murder, Burglary in the First Degree, Assault and Battery of a High and Aggravated Nature, and Escape. (R. 3458-60). The State had filed its Notice of Intent to Seek the Death Penalty on March 12, 2007. (R. 1976). In the Notice, the statutory aggravating circumstances asserted were that the murder was committed during the commission of

a burglary, S.C. Code Ann. Section 16-3-20(C)(a)(8); and that the murder was of a witness or potential witness committed at any time during the criminal process for the purpose of impeding or deterring prosecution of any crime under S.C. Code Ann. Section 16-3-20(C)(a)(11). (R. 1977).

On January 28 – February 8, 2008, ("Winkler") was tried by a jury for murder, first-degree burglary, and assault and battery of a high and aggravated nature.[1] He was tried in the Horry County Court of General Sessions before the Honorable James E. Lockemy, Circuit Court Judge. Ralph J. Wilson, Esquire, and Assistant Public Defender Paul Elbert Rathbun, Esquire, represented Winkler. Solicitor J. Gregory Hembree, Esquire, Deputy Solicitor Francis A. Humphries, Jr., Esquire, and Assistant Solicitor Scott R. Hixson, Esquire, all of the Fifteenth Judicial Circuit, represented the State. On February 2, 2008, Winkler was convicted on all three charges. (R. 1903).

On February 8, 2008, the jury found there was evidence of both asserted aggravating circumstances beyond a reasonable doubt. (R. 2940). The jury recommended that Winkler be sentenced to death. (R. 2940). Judge Lockemy sentenced Winkler to thirty years confinement on the burglary conviction, and ten years confinement on the ABHAN conviction, both to be served concurrently with a death sentence for the murder. (R. 2949).

A timely notice of appeal was filed and served on Applicant's behalf on February 11, 2008. On appeal, Applicant was represented by Robert M. Dudek, Chief Appellate Defender with the South Carolina Commission on Indigent Defense, Division of Appellate Defense, and Elizabeth A. Franklin-Best, Appellate Defender with the South

[1] The State withdrew the Escape charge before trial. (See R. 130).

Carolina Commission on Indigent Defense, Division of Appellate Defense. On April 5, 2010, Applicant perfected his direct appeal with the filing of a Final Brief of Appellant, in which they asserted the following issues:

1. Whether the trial court erred by admitting the audio tape recording as a prior consistent statement under Rule 801(b)(1)(B), SCRE, when defense counsel implicitly and explicitly asserted that J[redacted] G. fabricated his testimony when he stated he told Officer Knochs that it was his stepfather who shot his mother?

2. Whether the trial court erred in allowing the jury to review the transcript of the 911 tape when the jury was only allowed to see the transcript in the courtroom with the defendant and counsel present and only when the audio tape was played as requested by the jury?

3. Whether the trial court correctly held that it was within the court's discretion to grant or deny Appellant's Motion to proceed pro se when the motion was not timely made?

4. Whether the trial court abused its discretion when it denied Appellant's Motion to proceed pro se when the court determined that granting the motion would cause undue delay, the court had concerns regarding Appellant's ability to represent himself as the result of his preparedness and his anxiety condition, and there was the potential of jury confusion caused by the change in Appellant's representation?

5. Whether the trial court erred in not conducting a full Faretta inquiry when Appellant's request to proceed pro se was not governed by Faretta?

6. Whether the trial court erred in allowing defense counsel to present mitigation evidence to which Appellant objected when no timely objection to the testimony was made, and no argument regarding the allegation was presented on the record?

7. Whether the trial court erred in denying Appellant's motion for a directed verdict on the aggravating circumstance outlined in S.C. Code Ann. § 16-3-20(C)(a)(11) when there was substantial circumstantial evidence supporting the charge?

The State, through Assistant Attorney General Alphonso Simon Jr., filed its Final Brief of Respondent on April 14, 2010. Applicant, through Mr. Dudek and Ms. Franklin-Best, filed his Final Reply Brief of Appellant on April 4, 2010.

The Supreme Court of South Carolina heard oral arguments on the issue on June 24, 2010, and subsequently issued its opinion affirming the convictions and sentence on August 16, 2010. State v. Winkler, 388 S.C. 574, 698 S.E.2d 596 (2010). Applicant filed a timely petition for rehearing that was denied on September 22, 2010. The Remittitur was also issued on September 22, 2010.

On October 20, 2010, the South Carolina Supreme Court granted a stay of execution so that Applicant could pursue certiorari review before the United States Supreme Court. Applicant, through Mr. Dudek, filed a Petition for Writ of Certiorari with the United State Supreme Court dated February 11, 2011. The State, through Assistant Attorney General Simon, filed its Brief in Opposition to the Petition for Writ of Certiorari on March 28, 2011. Applicant filed a Reply Brief on April 12, 2011. The United States Supreme Court denied the petition for writ of certiorari by order dated April 25, 2011.

Applicant filed a second Petition for Stay of Execution on April 26, 2011. The State filed a response to the Petition for Stay of Execution on April 28, 2011. By Order filed May 25, 2011, the Supreme Court of South Carolina granted Applicant's Petition for Stay of Execution. In the Order, the South Carolina Supreme Court appointed the Honorable Benjamin H. Culbertson, Circuit Court Judge, to hear this post-conviction relief action. Applicant, through Mr. Dudek, filed his initial Application for Post-Conviction Relief on May 2, 2011. By Order filed June 24, 2011, this Court appointed Emily Paavola, Esquire, and John Mills, Esquire, to represent Applicant. On February 2, 2012, Applicant filed his first amended Application for Post-Conviction Relief. Applicant subsequently filed this second amended Application for Post-Conviction Relief.

Incorporated herein by reference are the following documents:[2]

(1) Notice of Appeal

(2) Record on Appeal, containing eight (8) volumes;

(3) Final Brief of Appellant;

(4) Final Brief of Respondent;

(5) Final Reply Brief of Appellant;

(6) State v. Louis Michael Winkler, Jr., SC S.Ct. Opinion No. 26857, filed August 16, 2010;

(7) Petition for Rehearing;

(8) Order Denying Petition for Rehearing;

(9) Petition for Writ of Certiorari to the Supreme Court of South Carolina;

(10) Brief in Opposition to the Petition for Writ of Certiorari to the Supreme Court of South Carolina;

(11) Reply Brief to Petition for Writ of Certiorari to the Supreme Court of South Carolina

(12) Letter acknowledging denial of Petition for Writ of Certiorari

II. Statement of Facts

On March 6, 2006, Applicant Louis Michael Winkler ("Winkler") broke into his estranged wife's condo in North Myrtle Beach, SC. (R. 1430-31, State's Exhibit 1, 51). He knocked her son, J[redacted] G., out of a stool and onto the ground. (R. 1431, 1433, State's Exhibit 1, 51). Winkler then shot the victim, Rebekah Grainger Winkler, once in the face at point blank range. (R. 1436, State's Exhibit 1, 51). According to Dr. Edward

[2] These documents were attached to Respondent's Return to the initial Application for Post-Conviction Relief.

Leroy Proctor, Jr., the forensic pathologist who conducted the victim's autopsy, the victim received a very close range gunshot wound that entered her left cheek, penetrated her brain stem, and exited through the rear right side of her brain. (R. 1634). Dr. Proctor noted that the shot was probably fired within a distance of 12 to 18 inches, and no more than 24 inches of the victim. (R. 1634). Dr. Proctor further testified there was stippling around the wound that caused by the burning gunpowder coming from the end of the gun. (R. 1634). Dr. Proctor testified that death would have been instant. (R.1637).

Winkler then walked over and pointed the gun at J[redacted]. (R. 1437, State's Exhibits 1, 51). Shortly thereafter, Winkler left the condo. (R. 1440, State's Exhibits 1, 51).

M[redacted] E[redacted] C., J[redacted] G.'s friend, testified that she was on the phone with him when she heard a loud pop noise, and a voice that was not J[redacted]'s say "I told you I'd be back. I'm not going to jail you stupid bitch, and I'm not -- I'm back, I'm back. I'm never going back to jail." (R. 1511-1512). She then heard a hit and the phone went to static. (R. 1512). She also heard someone curse a few times, and then the phone went dead. (R. 1512).

Andrew Cooper, a former crime scene technician for the Horry County Police Department, took a picture of the door jamb of the victim's condo door. (R. 1546, 1554). He testified that it appeared there had been a forced entry because the door jamb, the door frame, the lock mechanism, and other parts of the door had been busted. (R. 1554-55, See State's Exhibit 8). He also testified that a reddish colored liquid was collected from the kitchen countertop. (R. 1559, 1570-71). Kimberly Hahn, a former

SLED scientist, testified that she compared the blood swabs recovered from the counter of the victim's residence to Winkler's blood standard, and the blood from the counter matched Winkler's blood profile. (R. 1744, 1747). Cooper also photographed and collected a broken cordless phone. (R. 1562-63). Cooper also testified that a projectile was recovered from the baseboard of the wall behind the victim. (R. 1566-68). They did not locate a shell casing on the scene. (R. 1572).

Toby Boyd, a violent crime detective for the Horry County Police Department, testified that police were unable to find and arrest Winkler in the days after the homicide. (R. 1645-46). On March 13, 2006, they formed a task force to apprehend Winkler. (R. 1646). On March 20, 2006, two weeks after the homicide, Winkler was spotted in the wood line of a hole at the Eagle Nest Golf Course. (R. 1647). The police set up a perimeter around the area where Winkler was last seen on the golf course. (R. 1651). Boyd spotted Winkler moving inside the perimeter. (R. 1652). He testified that Winkler was wearing a dark pullover. Boyd requested that the helicopter assisting with the search scan the area. (R. 1652). The helicopter had to refuel. As the helicopter returned to the scene of the search, Boyd saw Winkler in the wood line. (R. 1653). Police were able to apprehend Winkler without any problems. (R. 1653). Boyd noted that Winkler appearance was consistent with someone who had been outside for a period of time. (R. 1657).

William Scott Rutherford, captain of the Horry County Police Department's Special Operations Division, testified that he and his team were called in to assist in the apprehension and arrest of Winkler. (R. 1682-83). On March 20, 2006, two of the individuals in the bloodhound tracking team screamed contact in the search of the area.

(R. 1685). He testified that he went to the sound of where the other officers indicated they had made contact with Winkler. (R. 1686). They were standing over Winkler with their guns drawn, and Winkler was laying face down with his hands behind his back. (R. 1686). Rutherford handcuffed Winkler and searched Winkler. (R. 1686). They recovered a Jennings .380 pistol from his right front pants pocket. (R. 1686-87). Five live rounds were in the pistol, but there was not a live round in the port. (R. 1687). During a full search of Winkler, they recovered eighteen rounds of .380 ammunition, a guard lock blade knife, and a brown bi-fold wallet. (R. 1689-91). In the wallet, there was a newspaper clipping about the shooting and Winkler's license. (R. 1691-92). Rutherford also testified that they recovered a green knit cap and a rolled up sweatshirt as part of search for Winkler. (R. 1692-93).

Ann Pitts, the lead detective in Winkler's investigation, testified that she went to Winkler's residence three days after the homicide. (R. 1710). Police found the victim's address on a piece of paper at the residence. (R. 1709-10).

Vello Paavel, a firearms and toolmark examiner for SLED,[3] testified that he received a Walther PPK pistol[4] .380 pistol, a Jennings Bryco .380 pistol, 1 fired projectile, and 18 unfired cartridges with the Jennings Bryco pistol. (R. 1757, 1760-61). He testified that there was dust, lint, and oil present in the bore of the Walther PPK, and that indicated it had not been fired since the last time it was cleaned. (R. 1769). He also noted that the magazine of the Walther PPK was full when he received it. (R. 1773). He also noted that the Bryco Jennings pistol's magazine held six cartridges, but

[3] Paavel was qualified as an expert in firearms and toolmark examination. (R. 1760).
[4] This pistol was recovered from underneath the bedroom pillow at the condo where the victim was shot.

only five were in the magazine when he received it. (R. 1777). Paavel concluded that the Jennings Bryco pistol fired the fired bullet. (R. 1787).

Sentencing Phase

Several witnesses testified on behalf of the State during the sentencing phase of Winkler's trial. The first witness to testify was Winkler's first ex-wife, Carla Kaiser. She testified that she first met Winkler when she was a freshman in high school and he was a senior. (R. 1992). She noted that they never had problems while she was in high school, but when she went to college, things started changing. (R. 1992). She testified that he was a jealous boyfriend, and at one point he called her five times in one night to ask her what she was doing. (R. 1993-94). Kaiser and Winkler dated for three years, and were then in an on-again, off-again relationship for another two years. (R. 1994). When they were broken up, Kaiser testified that if Winkler saw her talking with someone else, Winkler would harass that person. (R. 1994-95). She noted that Winkler was not always like that, but it was his jealousy that pushed her away. (R. 1995).

Kaiser related that on her 21st birthday, Winkler punched her square in the nose and knocked her out in front of a bar where her friends took her to celebrate her birthday. (R. 1996). She did not have direct contact with him after that. However, she did attempt to recover some coats and other items she had left at his apartment. (R. 1997). Kaiser testified that while she was there, Winkler forced himself on her sexually, and that was how she became pregnant with her daughter. (R. 1998). The two then married. (R. 1999). Kaiser testified that the marriage was good for the first few months. (R. 2000). However, she noted things changed when Winkler lost his job with an auto parts store and he started working construction with one of his friend's father's

construction company. (R. 2000-01). She noted that he would then start going to a bar right after work, and she would not see him until 1 or 2 a.m. (R. 2001). Winkler would come home drunk, and sometimes trouble would start. (R. 2001). She noted that Winkler would accuse her of being with someone else or doing something whenever she went out. (R. 2001). She testified that he would get very angry and would either kick her or throw her around. (R. 2001). Physical violence was a part of their relationship. (R. 2001). Sometimes Winkler would hit her; a lot of times he would throw her up against the wall or kick her while she was against the wall. (R. 2002). She also testified that the longer the drinking went on, the worse it got. (R. 2002). She testified that he kept a long gun next to the bed, and he would sometimes point it at her and ask her if she wanted to die that day. (R. 2002). He did that on three different occasions. (R. 2003). He would accuse her of being with someone else. (R. 2002). Kaiser also testified that girls who were not her friends would come to their apartment and ask Winkler to go to the bar with them. (R. 2003). Winkler would go with them. (R. 2003).

Kaiser testified that on the day her daughter was born, Winkler came home early, yelling at her. (R. 2004). She testified that he had her up against a wall, and he then kicked her in the stomach six times. (R. 2004). He then called her mother, told her mother that Kaiser was about to have the baby, and then told Kaiser to go to the hospital because her mother would be looking for her there. (R. 2004-05). Kaiser went to the hospital and went into labor while there. (R. 2005).

When she returned to the family apartment, everything was okay for a couple of weeks. (R. 2006). While Winkler did not want any of Kaiser's friends to see the baby or for Kaiser to have any visitors when he was not around, she did note that the violence

did initially slow down. (R. 2006). One day, he did come home and punched her in the face. (R. 2006). Kaiser testified that she talked with Winkler's mother about the violence, and she left the apartment for a little over a week. (R. 2007-08). When she did return, Winkler was nice and had stopped drinking. (R. 2008). However, the final straw in Winkler's and Kaiser's relationship came during Christmas Eve after the baby was born. (R. 2008). Kaiser testified that Winkler did not want to go to his mother's for Christmas. (R. 2009). Kaiser went to go pick up the baby, who was being kept by Kaiser's mother at the time. (R. 2009). When she got back, Winkler stated he did not want to go. (R. 2009). He left, but when he came back, he started throwing Kaiser up against the wall. (R. 2010). Kaiser testified that Winkler threw framed pictures at her, and her arms were cut by the frames and broken glass. (R. 2010). She testified that Winkler then took a gun out, cocked it, and said he would shoot her right then. (R. 2010). She testified that he accused her of cheating, then started beating on her. (R. 2010). After Winkler finished beating and kicking her, Kaiser wrapped her hands in towels because of the blood, grabbed her purse, and ran. (R. 2010-11). She went to Winkler's mother and showed her what Winkler had done. (R. 2011-12). Kaiser then went to the hospital. (R. 2012). She later pressed charges against Winkler. (R. 2013). She left with the baby and moved in with her parents in North Carolina. (R. 2015). She went back to Ohio for the court hearing on the assault charges. (R. 2017). She testified that he was found guilty. (R. 2017). They later got divorced. (R. 2019-20). She testified that Winkler somehow got her parents' phone number and he started calling and harassing them. (R. 2019).

Denise Ricketts, Winkler's second ex-wife, also testified at trial. (R. 2043). She testified that there were no problems when they were initially dating. (R. 2045). However, as time passed, the character of their relationship changed. (R. 2045). She noted that Winkler started being controlling, verbally abusive, and physically abusive. (R. 2045-46). Ricketts testified that the problems started about one year into the relationship. (R. 2046). The couple was invited to a Super Bowl party, but Ricketts did not want to go. (R. 2046). She testified that Winkler grabbed her by the neck and threw her to the floor; they ended up going to the party as a result of the fight. (R. 2046). She later forgave Winkler. She did note there were other instances of verbal abuse. (R. 2046). She also testified that Winkler was controlling, and he tried to keep her away from family and friends. (R. 2047). She testified that in April of 1997, before they were married, he came home one night and wanted to argue. She asserted that he kicked her in the legs and drug her around the house for a while, and then he threw her out the back door in her bedclothes and locked the door. (R. 2047-8). She reported this incident to police, and Winkler was later found guilty of criminal domestic violence as a result. (R. 2049-51).

Ricketts testified that she forgave Winkler after he later apologized. (R. 2052). She noted that things between them were fine for a while, but eventually, the same problems arose again. (R. 2052). Winkler started drinking a lot, and when he came home he would be mean to her. (R. 2052). They married in September 2001. (R. 2053). She testified that life was bad during the marriage. (R. 2053). He drank a lot, did not come home from work, and he was verbally abusive. (R. 2054). Ricketts also noted that Winkler was still controlling. (R. 2054). She later left Winkler, in part

because she was in fear he would become physically abusive. (R. 2054-55). She indicated that Winkler began to follow her, and he would leave notes in her car and would call her cell phone. (R. 2056). She later took out a restraining order on Winkler after he threatened to kill her when he saw a suitcase in the back of her truck. (R. 2057).

Jeff Cauble, a Patrolman First Class with the Horry County Police Department, testified that he responded to a call to a residence where Winkler was present. (R. 2067). He initially started to transport Winkler to the North Myrtle Beach Police Department, but he changed course after Winkler started gasping for air and complaining of chest pains. (R. 2068). Instead, he took Winkler to the Seacoast Medical Center. (R. 2068). At that time, Winkler was very angry with Patrolman Cauble, and it took a couple of people to get Winkler out of the vehicle. (R. 2068). Winkler spat on Cauble. (R. 2068). That led to a simple assault and battery conviction against Winkler. (R. 2069, 3468-69).

Kidnapping and Criminal Sexual Conduct Against Victim Rebekah Winkler

On October 10, 2005, Winkler kidnapped and sexually assaulted Rebekah Grainger Winkler, the murder victim. Allen Large, a detective with the Horry County Police Department, testified that on that evening, he received a page from dispatch regarding a missing person reference to a possible domestic incident. (R. 2077). The missing person was Rebekah Winkler. (R. 2077). Winkler's vehicle was first spotted behind the Seacoast Medical Center. (R. 2078). Another officer had moved the vehicle out of the roadway. (R. 2082). A floor mat, a shoe, and a cigarette butt were recovered from the vicinity of where the Winkler's vehicle was located. (R. 2082). The car was

towed. (R. 2085). Large testified that while the scene where Winkler's car was being processed, dispatch reported that the victim's car was located. Large left the scene where Winkler's car was found and went to scene where the victim's car was found. (R. 2086). Her vehicle was found off the road in some trees. (R. 2086). The Horry County Police Department activated its dog team to try to locate two missing persons at that point. (R. 2091). The victim was later found next to Stephen's Crossroads, which was where the magistrate's complex and library was located. (R. 2092).

Phyllis Richardson, who worked for the Horry County Probate Court on October 11, 2005, testified she was working at the satellite office located over by Stephen's Crossroads. (R. 2097). She testified that when she arrived at the parking lot that morning around 7:30am, she saw a woman walking in the lot being followed by a man. Richardson noted that the woman had on a long shirt, but the woman was not wearing any shoes. (R. 2099-2100). According to Richardson, the woman looked distraught and was acting confused. (R. 2100). Richardson did not recognize the woman. She also noted that the man was about thirty feet behind the woman, and he was wearing a pair of shorts but not shirt. (R. 2101). Richardson noted that his hands were in the air as if he was raging and irritated; however, she could not hear what he was saying. (R. 2101-02). Richardson later entered the office where she worked. She testified that shortly thereafter, she saw the woman from the parking lot in the room where the probate court performed ceremonies. (R. 2104). Richardson noted that the woman was on the phone, but she could not hear what she was saying on the phone. (R. 2104). Richardson testified that she did not recognize the woman that was making the call, but described the woman's hair as being very matted, tangled looking, with some

bald spots. (R. 2109). Richardson also indicated that the building became very active with police and emergency medical personnel later that morning. (R. 2109). Richardson later learned it was the victim, Rebekah Winkler, who was making the call in the other room. (R. 2110).

Curtis L. Thompson of the Horry County Police Department testified that he was the first officer to arrive at the building. (R. 2117). He found a white female who was very afraid in the building. (R. 2118). Thompson indicated that it appeared the victim had been in some sort of altercation, and she confirmed that she was Rebekah Winkler. (R. 2118). Thompson further testified that the left side of her hear looked like it had been ripped out, she had black eyes, abrasions, and other scratches. (R. 2118-19). After EMS transported the victim to the Seacoast Medical Center, Thompson assisted in the search for Winkler. He and Officer Hemingway located Winkler at a third person's residence. (R. 2124-25). They arrested Winkler, and Hemingway transported him to the M.L. Brown Building. (R. 2125-26, 2130).

Andrew Cooper testified that he processed both the Isuzu Rodeo and Land Rover that were connected to the kidnapping investigation. No evidence was collected from the Isuzu Rodeo. (R. 2137). Cooper testified that the Land Rover, which was registered to Rebekah Winkler, appeared to have been wrecked. (R. 2140). Cooper took pictures of the vehicle as he processed it. He testified there was blood on the driver side seat, and that the floor mat was missing from the driver's side of the car. (R. 2141). He also noted there was some blood around both seats and around the center console. (R. 2141). On the passenger's side, there were several blood smears and spots on the interior panel of the door. (R. 2142). Cooper collected blood from the door

handle of the interior driver's side door; swabs on the outside edge of the driver's side front seat, swabs from the exterior of the steering wheel; blood spots in the dash; blood spots from the back support; spots in the area between the center console and the edge of the driver's front seat; and blood on the passenger side front seat. (R. 2144-47). Cooper also took pictures of Winkler's face, arms, and legs. (R. 2150). Cooper transported the blood swabs and the victim's rape kit to SLED. (R. 2151).

Haley Grainger, the victim's younger daughter, testified that she first met Winkler at the house where the Rebekah, Haley's sister, and Haley's brother were staying. (R. 2162). She testified that during the early stages of Winkler's and the victim's relationship, Winkler seemed to be fine. (R. 2164). Haley testified that after Winkler and Rebekah had been married for a couple of years, Rebekah and J[redacted] G. moved out of Winkler's home and moved into Haley's condo. (R. 2165-66). The victim slept in the bedroom on the first floor, and J[redacted] slept on the couch. (R. 2166). When Haley was not there, J[redacted] slept in the bedroom upstairs. (R. 2166-67). On October 10, 2005, she and her sister became concerned about their mother's whereabouts. (R. 2167). Haley's sister had called. (R. 2167). That led Haley and her boyfriend to start looking for Rebekah. (R. 2168). Initially, they went to Winkler's home. (R. 2168). When they found his car was not there, they saw a Land Rover in the woods down the road. (R. 2168). It was later identified as her mother's Land Rover. (R. 2169).

Haley saw her mother the next morning at the Seacoast Medical Center. (R. 2170). Haley testified that Rebekah was in pretty bad shape: her face was really messed up, her hair was all tangled and looked horrible, and she had scratches all over.

(R. 2170). At first, Rebekah did not want her children to see her, but they talked her into it. (R. 2170). Haley testified that after the incident, her mother was very depressed and could not sleep. (R. 2172). She also observed that Rebekah was always scared, and she did not take any steps to change her outlook. Haley did note that Rebekah took steps to protect herself. Rebekah borrowed a gun from Haley's father (Rebekah's ex-husband Roger), and Rebekah received a can of mace from her mother (Haley's grandmother). (R. 2172).

Haley also identified a toe ring, an earring, a hair clip, shorts, and a shirt with a wad of hair in it that all belonged to Rebekah. (R. 2171). Jeff Gause, a police officer with the Horry County Police Department, testified that he recovered the shorts, a shirt with a wad of hair, a hair clip, and some underwear from a partly wooded area of the county that he had been informed was part of the area in which the assault took place. (R. 2176-80). Neil Livingston, a detective with the Horry County Police Department, testified that he recovered an earring and another piece of jewelry from the inside of a commercial building that was under construction in the Little River section of Horry County. (R. 2184-91).

Lisa Gore, a staff nurse at Seacoast Medical Center, treated the victim when she was brought in on October 11, 2005. (R. 2195-96). Gore testified that the victim had injuries to the left eye, some swelling to the jaw area, bruising around the neck, dried blood about the fact, a fractured nose, an upper lip injury, redness under her right eye, corneal abrasions, multiple bruises and contusions, and a bite mark to the face. (R. 2205-06). Gore also testified that the victim had a large amount of hair removed from her head, along with some matting and disarrangement of her hair with leaves and

debris mixed in. (R. 2206). Gore also indicated there were bruises to Rebekah's arms and wrists, the tops of her hands, her neck area, scrapes on her torso, belly, and back, and contusions and scrapes to her lower legs, thighs, and feet. (R. 2207-10). A sexual assault evidence kit was collected from Rebekah. (R. 2213-15).

Ann Pitts responded to the Stephen's Crossroads Complex. (R. 2220). She later responded to the Seacoast Medical Center to interview the victim. (R. 2221). Pitts testified that the victim seemed to be in shock, and was very afraid. (R. 2222). Rebekah did tell Pitts what happened and where it happened. (R. 2222). The victim also described the clothes she was wearing. (See R. 2226). While those clothes were not recovered when Pitts, the victim, and Detective Livingston initially went to the area, they were later recovered when members from the crime scene unit and dog team searched the area. (R. 2226). Pitts testified that Winkler was arrested for criminal sexual conduct, first degree, assault and battery with intent to kill, and kidnapping on October 11, 2005. (R. 2227). He was found at a friend's house. (R. 2227). When he was arrested, he was wearing blue jean shorts, a t-shirt with some type of printing on it, and some brown shoes. (R. 2228). Pitts was also present at Winkler's first bond hearing. (R. 2230). Bond was initially denied in his case. (R. 2231). At a second bond hearing, Winkler's bond was set at $150,000, and he was required to wear an electronic monitor while out on bond. (R. 2231-33). Pitts also testified that at Winkler's third bond hearing, his bond was amended to allow him to remove his electronic monitor for two hours so he could seek employment. (R. 2233-34). According to the bond, the monitor was to be off from 4pm to 6pm.

John Ortuno, a DNA analyst for SLED, testified that the DNA from the semen found in the rectal and vaginal swabs from the sexual assault evidence collection kit matched Winkler's DNA. (R. 2244-49). He also testified that the blood found in the Land Rover belonged to the victim, but there were mixtures with a secondary profile that could not be reliably interpreted. (R. 2249-51).

Tammy Cox was one of Rebekah's friends. (R. 2262-63). They first met when Rebekah trained Cox in medical transcription. (R. 2263-64). Cox testified that Rebekah was shy until you got to know her. (R. 2264). She also described Rebekah as a very sweet and caring person who worked all the time. (R. 2265). Cox indicated that Rebekah did not like having her picture taken. (R. 2266). Rebekah helped Cox with her work and with her illness during Cox's second pregnancy. (R. 2266-67). Cox testified that Rebekah was married to Roger Grainger before she married Winkler. (R. 2268-69). They split in 2001. (R. 2269). When Cox learned of Rebekah's relationship with Winkler, she never saw them out much. (R. 2269). After Rebekah married Winkler, Cox hardly ever saw her. (R. 2270). Cox testified that they only talked on the phone during the day when Winkler was at work. (R. 2269-70). Cox became aware that there were problems in Rebekah and Winkler's relationship in August or September. (R. 2270). She learned of the assault in October 2005. (R. 2271). Cox spent time with Rebekah between October 2005 and Rebekah's murder in March 2006. Cox noticed changes in Rebekah's personality. (R. 2271). Rebekah could not work any more and did not want to do anything any more. (R. 2272). Further, Rebekah did not go out, she lived in fear every day, and she could not sleep at night. (R. 2272). Cox stated that she was a totally different person, and that she was never the same person. (R. 2272-73).

Jill Shelley, Rebekah's older daughter, was the last witness to testify for the State during the sentencing phase. Shelley testified that she did not like her mother's relationship with Winkler or Winkler when it started to get more serious. (R. 2287). Shelley testified that it was just a few months after they started dating that Winkler was asking Rebekah to move in with him. (R. 2288). Shelley indicated that Winkler was not very friendly, and when she visited his home, she felt unwelcome. (R. 2288). After Shelley had her first child, Rebekah's first grandchild, Winkler did not really want them around his house. (R. 2289). Winkler also would not let Rebekah leave her house to come see Shelley's family. Shelley testified that she did not know that they had trouble, but she knew something was not right because before Rebekah married Winkler, Rebekah would do things with the rest of the family that she no longer could after they were married. (R. 2290).

Shelley relayed to the court an incident that occurred in September 2005 when Shelley went to take her mother shopping. She could not get Rebekah on the phone, so she drove over to Winkler's house. (R. 2291). When she got there, she found Rebekah was beat up and her arms were covered in bruises. She also noted that the phone was continually ringing. (R. 2291). It was Winkler calling the house because Rebekah had made him leave. (R. 2291). Some time thereafter, Winkler returned to the house and started kicking the side door. (R. 2292). Winkler was yelling and screaming until Rebekah let him into the house. (R. 2292). Shelley threatened to call the police. Winkler responded by warning Rebekah that she knew what would happen if they called the police. (R. 2292). Shelley testified that Rebekah moved out of Winkler's home as a result of this confrontation. (R. 2292).

Shelley also testified about the night of the kidnapping. (R. 2293). Shelley indicated she first became concerned when she found out from her brother that he was not picked up from a football game on October 10, 2005. (R. 2293-94). Shelley called the police when she first heard of the problem. (R. 2294). She noted that her mother's Land Rover was found that night, but there was no sign of either Rebekah or Winkler. (R. 2295). Shelley saw her mother the next morning at Seacoast hospital. (R. 2295). Shelley testified that her mother was very beat up and dirty. (R. 2295). Rebekah's eye was very swollen, and her hair was matted with sand spurs and twigs. (R. 2296). Rebekah was also nervous, and she wanted them to do something with Winkler to get him away from her. (R. 2296). Rebekah was very depressed. (R. 2296). Shelley testified that Rebekah lived in fear all the time and was scared. (R. 2296). Rebekah did not go anywhere or do anything. (R. 2297). She could no longer work, and she was never the same. (R. 2297-98). The final item of evidence presented by the State was a letter sent by Winkler to Jill Shelley while he was incarcerated. In the letter, Winkler asserted that had Shelley not gotten involved in he and Rebekah's business, Rebekah would still be alive. (R. 2300). He complained about Shelley's calling her mother to talk about Shelley's marriage, and he claimed that no one else in the family liked Shelley. (R. 2300-01). Winkler claimed that the victim slept with everyone, and he alleged that he had pornographic movies of him and the victim having sex. (R. 2301-02). He also threatened to post the video online. See (R. 2303). Winkler claimed that the victim saw him during the separation after the initial arrest, stated that Rebekah lied to police about the first set of charges, and blamed Shelley for her mother's death. (R. 2302-03).

During Winkler's mitigation case, the defense presented the testimony of several witnesses. First, Dr. Richard Frierson, a forensic psychiatrist, testified that he diagnosed Winkler with having depressive disorder not otherwise specified, anxiety, alcohol abuse, and having some paranoid personality traits. (R. 2338-39, 2343-46). During cross-examination, Frierson noted that Winkler did not have a history of childhood physical abuse, childhood sexual assault or child neglect. (R. 2347). Dr. Rikki Halanovich, another forensic psychiatrist, testified that she diagnosed Winkler with borderline personality disorder, major depressive disorder, alcohol dependence and cocaine abuse. (R. 2655-57, 2658-60). Dr. William Morton, Jr., who was qualified as an expert in psychopharmacology, also testified. (R. 2695-2743).

Te Anne Oehler, a social worker, testified that Winkler's father was very controlling of his mother. (R. 2752). When Winkler's parents were first married, they moved in with his father's parents. (R. 2752). Winkler's father made his mother quit her job, even before they had children. (R. 2752). Further, Oehler testified that Winkler's father worked at the family owned bar. Winkler's father would come home late at night, was very controlling of Winkler's mother, and he would not let her have any money of her won. (R. 2752). By the time the second Winkler child was born, Winkler's mother was emphatic that the new family move out into their own home. (R. 2752).

Oehler further testified that Winkler's mother was the primary caregiver because she was the person home during the day. (R. 2753). His mother was the person involved with Winkler's schoolwork. (R. 2753). Winkler's father did coach all of the boys on their sports teams. (R. 2753). However, Winkler's father would leave and go out after dinner, and he would not come back until 1 or 2 am. (R. 2753). Oehler noted

that Winkler's father had frequently been drinking a lot, and he was not always present at home. (R. 2753-54). She stated that Winkler's father was very controlling towards family members, and he had very poor parenting skills. (R. 2754). While Winkler denied his father ever beat him, both of the oldest Winkler children informed Oehler that their father had beaten them. (R. 2754). The only exception was when Winkler was a junior in high school, and his mother found marijuana in the bathroom. (R. 2754). Oehler testified that when she told Winkler's father that evening after work, Winkler's father grabbed Winkler by the throat and started choking him. (R. 2754). According to Oehler, Winkler's mother informed Oehler that she did not tell his father of any other transgressions out of fear that he might hurt Winkler worse. (R. 2754-55).

Oehler also testified that Winkler got his first drink from his father on a camping trip when Winkler was 13. (R. 2755). By the time Winkler graduated from high school, he was using alcohol and marijuana frequently. (R. 2755). At that point, if there was any problem with one of the Winkler children, Winkler's mother addressed it. (R. 2755). Winkler's father was out of the home working more with his insurance business. (R. 2755).

Oehler also testified about Winkler's personal history with women. She noted that Winkler tended to seek out women who had children. (R. 2758). She also noted that Winkler was a chronic drinker throughout the years, starting when he was a teenager. (R. 2760). She testified that the drinking affected his ability to hold down a job, and she noted that the longest tenure for Winkler at a job was his last one with the property management company. (R. 2760). Oehler asserted that Winkler did not immediately trust others, and he would remain suspicious of others until they proved

otherwise. (R. 2761). Winkler grew up in a strict Catholic home where his father was very rigid. (R. 2761-62). There was no physical abuse later in Winkler's upbringing. (R. 2762). Also, Winker's father controlled his wife and children through finances. (R. 2762). This was a source of conflict in the family among the older children because Winkler's father helped Winkler out financially every time. (R. 2762-63). Oehler indicated that Winkler lived a happy-go-lucky life growing up that he tried to replicate by seeking women with children. (R. 2763). She testified that Winkler had difficulty in relationships with peers because he sought to be the center of attention, and he wanted affirmation from others. (R. 2766). Some of his family relationships focused around holiday times, and he always seemed to be surrounded by children. (R. 2766-67).

After further testimony from Oehler, Rosemary Wolfe, a tenant in the Tillman property where Winkler worked testified on his behalf. (R. 2782-87). Counsel also presented the testimony of two of Applicant's sisters, one of Applicant's brothers, and Applicant's mother. They all testified about Applicant's upbringing and their interactions with Applicant as an adult. They all also requested the jury please spare Applicant's life. (R. 2790-2810). Counsel also presented the testimony of Sharon Myers, the lieutenant over the classifications division of the Horry County Sheriff's Department. (R. 2811-16). She testified that Applicant only had two infractions while being detained at the J. Reuben Long Detention Center. One was related to the fact Applicant was not wearing his ankle monitor when he was arrested. The second was for being out of his cell at an improper time on June 26, 2006. (R. 2813-14).

III. Allegations in the second Amended Application for Post-Conviction Relief

Applicant asserts as follows:

10 & 11(a) Applicant was denied the right to the effective assistance of counsel guaranteed by the Sixth and Fourteenth Amendments to the United States Constitution, Article I, §§ 3 and 14 of the South Carolina Constitution, and S.C. Code § 17-3-20 -- during the pre-trial and guilt-or-innocense phases of his capital trial – when trial counsel:

(1) failed to object to the trial court's pre-trial refusal to permit Applicant to discharge appointed counsel and allow him to proceed pro se. See Strickland v. Washington, 466 U.S. 668 (1994); Faretta v. California, 422 U.S. 806 (1975);

(2) failed to object to and/or adequately impeach the trial testimony of Mr. Vello Paavel, portions of which were improper, inaccurate, unreliable and inadmissible. See Strickland v. Washington, 466 U.S. 668 (1994); and,

(3) failed to impeach the State's witnesses with evidence that J[redacted] G[redacted] was not on the telephone with E[redacted] C[redacted] at the time of the crime. See Strickland v. Washington, 466 U.S. 668 (1994).

10 & 11(b) Applicant was denied the right to the effective assistance of counsel guaranteed by the Sixth and Fourteenth Amendments to the United States Constitution, Article I, §§ 3 and 14 of the South Carolina Constitution, and S.C. Code § 17-3-20 -- during the sentencing phase of his capital trial -- when trial counsel:

(1) failed to investigate and present evidence of Applicant's neurological and cognitive impairments and/or dysfunction; and

(2) failed to present mitigating evidence regarding applicant's change in demeanor and mental state before the crime and evidence that the victim harassed and taunted applicant while he was on house arrest;

(3) failed to object when the trial court: (a) repeatedly refused to answer the jurors' question about what would happen if they could not reach a unanimous sentencing verdict; and, (b) issued improper instructions to the jury under unduly coercive circumstances.

10 & 11(c) Applicant's right to self-representation, as guaranteed by the Sixth and Fourteenth Amendments to the United States Constitution and Article 1 § 14 of the South Carolina Constitution, was violated by the trial court's refusal to permit him to discharge appointed counsel and proceed pro se.

10 & 11(d) Applicant's right to a fair and impartial jury determination of his sentence – free from the influence of passion, prejudice, or any other arbitrary factor – guaranteed by the Sixth, Eighth and Fourteenth Amendments to the United States Constitution, Article 1 §§ 3,14 and 15 of the South Carolina Constitution, and S.C. Code § 16-3-25(C), was violated by the trial court's repeated refusal to answer the jurors' question about what would happen if they could not reach a unanimous sentencing verdict and the court's improper instructions to the jury under unduly coercive circumstances.

10 & 11(e) Applicant's right to a fair and impartial jury determination of his sentence – free from the influence of passion, prejudice, or any other arbitrary factor – guaranteed by the Sixth, Eighth and Fourteenth Amendments to the United States Constitution, Article 1 §§ 3, 14 and 15 of the South Carolina Constitution, and S.C. Code § 16-3-25(C), was violated when Juror Jeron Wallingford was coerced into voting for a death sentence by threat of physical harm and intimidation by his fellow jurors.

General Law on Ineffective Assistance Of Counsel.

Pursuant to the familiar doctrine in Strickland v. Washington, Applicant must first demonstrate that his trial counsel's performance fell below an objective standard of reasonableness. 466 U.S. 668 (1984). Judicial scrutiny of counsel's performance is highly deferential and not subject to the distorting effects of hindsight, and counsel may reasonably choose from a wide range of acceptable strategies. Strickland, 466 U.S. at 689; Burket v. Angelone, 208 F.3d 172 (4th Cir. 2000).

Competency is measured against what an objectively reasonable attorney would have done under circumstances existing at the time of the representation. Savino v. Murray, 82 F.3d 593, 598-99 (4th Cir. 1996). The Court should "decline to allow an ineffective assistance of counsel claim to create a situation where post-conviction attorneys stroll in with the full benefit of hindsight to second-guess trial lawyers who professionally discharge their duties to their clients under the manifold pressures of a state trial." Mazzell v. Evatt, 88 F.3d 263, 269 (4th Cir. 1996).

As the Supreme Court made clear in Strickland:

> . . . the reasonableness of counsel's actions may be determined or substantially influenced by the defendants own statements or actions. Counsel's actions are usually based, quite properly, on informed strategic choices made by the defendant and on information supplied by the defendant. In particular, what investigations are reasonable depends upon such information . . . [W]hen a defendant has given counsel reason to believe that pursuing certain investigations would be fruitless or even harmful, counsel's failure to pursue those investigations may not later be challenged as unreasonable.

Strickland, 466 U.S. at 691. Barnes v. Thompson, 58 F.3d 971, 979-80 (4th Cir. 1995); Matthews v. Evatt, 105 F.3d 907, 919-920 (4th Cir. 1997). The mere fact that trial counsel's strategy was unsuccessful does not render counsel's assistance unconstitutionally ineffective. Strickland, 466 U.S. at 689. Bell v. Evatt, 72 F.3d 421, 429 (4th Cir. 1995).

Next, Applicant must also establish prejudice by showing "a reasonable probability that, but for counsel's unprofessional errors, the result of the proceeding would have been different." Strickland, 466 U.S. 668, 694 (1984). "A reasonable probability is a probability sufficient to undermine confidence in the outcome." Id. It is insufficient to show only that the errors had some conceivable effect on the outcome of the proceeding, because virtually every act or omission of counsel would meet that test. Id. at 693. "The Petitioner bears the 'highly demanding' and 'heavy burden' in establishing actual prejudice." Williams v. Taylor, 529 U.S. 362, 394, 120 S.Ct. 1495, 1514 (2000).

In Jones v. State, 332 S.C. 329, 504 S.E.2d.822 (1998), the South Carolina Supreme Court restated the "prejudice" prong in a capital sentencing proceeding as being established when "there is a reasonable probability that, absent [counsel's] errors,

the sentencer – including an appellate court, to the extent it independently reweighs the evidence – would have concluded that the balance of aggravating and mitigating circumstances did not warrant death," citing Strickland. "A reasonable probability is a probability sufficient to undermine confidence in the outcome." Jones, 332 S.C. at 333, 504 S.E.2d at 823 (quoting Strickland). Accord, Plath v. Moore, 130 F.3d 595 (4th Cir. 1997) ("[g]iven the overwhelming aggravating factors, there is no reasonable probability that the omitted evidence would have changed the conclusion that the aggravating circumstances outweighed the mitigating circumstances and hence, the sentence imposed." Thus, in weighing the omitted evidence against that actually used to convict and sentence Plath, the mitigating evidence seems insufficient to shift the balance in Plath's favor.").

Finally, the Supreme Court of South Carolina has held that a hearing on an allegation is only required when factual allegations that lead to a Sixth Amendment deprivation are not conclusively refuted by the record. Norman v. State, 276 S.C. 278, 277 S.E.2d 707 (1981).

As a general matter, Respondent submits that the Record on Appeal from Applicant's trial and sentencing hearing conclusively demonstrate that appointed counsel were not deficient in their performance nor was Applicant prejudiced in any way by their performance. To the contrary, the Record from each proceeding demonstrates that Applicant's attorneys were diligent in their representation of Applicant, performed well within the wide range of competence and reasonable professional assistance demanded of attorneys in criminal matters. State v. Pendergrass, 270 S.C. 1, 239

S.E.2d 750 (1977); Marzullo v. Maryland, 561 F.2d 540 (4th Cir. 1977); Butler v. State, 286 S.C. 441, 34 S.E.2d 813 (1985); Hill v. Lockhart, 474 U.S. 52, 106 S.Ct. 366 (1985).

Ground 10(a): Ineffective Assistance of Counsel during pre-trial and guilt phase

Ground 10(a)(1): Counsel failed to object to the trial court's pre-trial refusal to permit Applicant to discharge appointed counsel and allow him to proceed pro se. See Strickland v. Washington, 466 U.S. 668 (1994); Faretta v. California, 422 U.S. 806 (1975)

Relevant Facts

At Applicant's first appearance, Ms. Orrie West, Esquire, a public defender for Horry County, was appointed to represent him. (R. 2984). One of Applicant's trial counsel, Mr. Thomas Rathbun, Esquire, also of the Horry County's Public Defender's Office, was assigned to help assist with the case. (R. 2985). At the appointment of counsel hearing on June 15, 2006, Ralph Wilson, Esquire, was appointed to serve as first chair in Applicant's defense. (R. 2993-94). At the hearing, Applicant indicated that he found the Public Defender's Office to be very inadequate. (R. 2991). He complained that Ms. West called him by the wrong first name. (R. 2991). Applicant also indicated that he had concerns about Mr. Rathbun because Rathbun told him he had not tried a murder case before. (R. 2992). When asked if he had any objections to Rathbun being appointed as second chair, Applicant indicated that he had an objection. (R. 2999). He indicated that he and Rathbun had argued more than anything. (R. 2999).

At the July 3, 2007 hearing, Applicant's trial counsel put on the record that Applicant was dissatisfied with Mr. Rathbun as counsel because of disagreements they had. (R. 3260). Wilson noted that a couple of weeks before the hearing, Rathbun went to see Applicant, and they had a conversation. (R. 3260). Rathbun and Wilson had

gone to see Applicant the Friday before, but they were not able to see Applicant because he had been taken to Charleston to meet with a psychiatrist. (R. 3260). Rathbun went to see Applicant the following Monday. (R. 3260). On Tuesday, Applicant was upset and irate. (R. 3260). Applicant told Wilson that Rathbun had said some things. (R. 3261). The Court indicated that Applicant needed to know that unless something regarding Rathbun reached the point of incompetence or something that would lead to a preliminary determination of ineffective assistance, it was improbable that the court would remove Rathbun unless it was something that would seriously prejudice Applicant's rights to receive a fair trial. (R. 3262). Wilson indicated that even when there have been disagreements between Rathbun and Applicant, Wilson has been able to sit down with Applicant and decide on the correct course of action with Applicant's consent. (R. 3262). Applicant was heard in this matter. (R. 3263-64). He informed the court that Rathbun was telling him to take a plea, plead guilty. (R. 3264). He told the court that when he sought counsel about the issue, Rathbun told him to plead guilty. (R. 3264). Applicant interpreted that to mean that Rathbun thought he was guilty. (R. 3264). Rathbun responded that he believed Applicant heard what he wanted to hear and didn't hear what counsel was saying. (R. 3265). Rathbun affirmed to the court that he would do his utmost to represent Applicant in a trial. (R. 3265).

During an ex parte hearing held before jury selection. Counsel indicated that during the telephonic conference on the Thursday before this hearing, Applicant started giving details about an incident that occurred between Applicant and Wilson. The Court allowed Applicant the opportunity to get the information on the record. Applicant told the court that he wanted Wilson to go forward as counsel. (R. 32). However, he no

longer wanted Rathbun to continue as counsel. He noted that eight months prior, he had requested Rathbun be relieved, and he was turned down. (R. 32). He informed the court that Rathbun got in his face, put his finger in Applicant's face, and touched his face. (R. 33). He then told the court that he gave Wilson his sister's pictures, and told Wilson that Wilson was calling her a liar. (R. 33). The court noted that it did not think that was enough to warrant counsel be relieved. (R. 33). Applicant asked, "how can I get a fair trial with guys that are against me? I mean, they've actually - -" (R. 34). Applicant informed the court that he did not believe they would do their best to get him acquitted. (R. 34).

In response, Wilson informed the court that he had done everything he knew to do to represent Applicant in the best fashion he knew. (R. 34). He also indicated that Applicant is antagonistic, and has been so since the first day. (R. 34). Wilson further noted that they had made every effort to protect every right, hired every expert they could think to hire, and have tried to talk with every witness they could possibly find. (R. 34). He informed the court they were prepared for trial. (R. 34). The fact that Applicant's personality got on Wilson's last nerve would not affect him and his ability to represent him in the fashion he was entitled to. (R. 34-5). Rathbun also stated he was ready for trial. (R. 35). Applicant complained that his attorneys did not find a witness. (R. 35-6). Wilson told the court that they had made an exhaustive effort to find the witness requested, and according to the witness' family, they did not know where he was. Applicant indicated he thought the witness was still in Horry County. Applicant indicated that his question regarding that witness was answered. He then noted that he was not sure if counsel had done their best efforts to find what he needed because he

was in lockup. (R. 37). He also complained that no one has gone out to the murder scene and measured couches and counters. (R. 39). Wilson noted that they could not because the unit belonged to the daughter of the victim, not the defendant. (R. 39).

Applicant continually complained that counsel was advising his family that Applicant was likely going to be convicted. (R. 41-2). The Court responded that it could not chastise counsel for giving him an honest opinion. (R. 42).

> Any event, we're going to proceed then. There's no request for you to represent yourself. You're requesting another attorney. Since that's the case, I will not grant your motion. Now, you always have that option to represent yourself, which would be very inadvisable at this stage, but we will continue on with the case.

(R. 42, ll 12-17).

Counsel later put on the record that it disagreed with Winkler's request to make a certain argument in the opening statement because counsel believed it would require Applicant testify in the guilt phase of trial. (R. 1376-81).

Argument

First, to the extent Applicant asserts that trial counsel was ineffective for not objecting to the trial judge denying a request for Applicant to represent himself, Respondent submits this claim should be denied and dismissed because it is not supported by the record. As was noted by the trial court and by the South Carolina Supreme Court in the opinion in Applicant's direct appeal, Applicant never made a request to represent himself pre-trial. (See R. 42; see also Winkler, 388 S.C. at 586, 698 S.E.2d at 602). Since a request was not made pretrial, and the trial court did not rule upon such a request pretrial, counsel had no opportunity to object to a denial of

such a request. Thus, counsel could not be deficient in this regard, and Applicant cannot show that he was prejudiced.

Second, to the extent Applicant contends trial counsel was ineffective for not objecting to the trial judge denial of Applicant's request for counsel to be relieved, Respondent submits this claim is without merit.

Applicant cannot show that counsel was deficient in this regard. In each instance in the record that Applicant indicated he wanted a new attorney, counsel ensured the issue was heard by the trial court. (See R. 32-42, 3260-65). The trial court heard from the Applicant and the attorneys at each instance, and the court denied the request to relieve counsel in both situations. Since counsel brought Applicant's concerns and requests to relieve counsel to the trial court's attention, and the trial court ruled on the matter both times, Respondent submits counsel was not deficient. Additional objection was not needed to preserve the issue for appeal. See generally State v. Rogers, 361 S.C. 178, 183, 603 S.E.2d 910, 912-13 (Ct. App. 2004) ("'There are four basic requirements to preserving issues at trial for appellate review. The issue must have been (1) raised to and ruled upon by the trial court, (2) raised by the appellant, (3) raised in a timely manner, and (4) raised to the trial court with sufficient specificity.'")(quoting Jean Hoefer Toal et al., Appellate Practice in South Carolina 57 (2d ed.2002)).

Applicant also cannot show that he was prejudiced by counsel not further objecting to the trial court's denial of Applicant's request to relieve counsel. First, as already noted, an additional objection was not needed to preserve any challenge to the denial of Applicant's motion to relieve counsel for appeal. Second, even if an additional

objection was needed to preserve the issue for appeal, Applicant was not entitled to relief upon a claim that the trial court improperly denied his requests to relieve counsel. "A motion to relieve counsel is addressed to the discretion of the trial judge and will not be disturbed absent an abuse of discretion." State v. Graddick, 345 S.C. 383, 385-86, 548 S.E.2d 210, 211 (2001)(citing State v. Hyman, 276 S.C. 559, 562, 281 S.E.2d 209, 211 (1981), overruled on other grounds, State v. Torrence, 305 S.C. 45, 406 S.E.2d 315 (1991)). The defendant has the burden of establishing satisfactory cause for removal. Graddick, 345 S.C. at 386, 548 S.E.2d at 211; Hyman, 276 S.C. at 562, 281 S.E.2d at 211. Respondent submits the record supports a finding that the trial court did not abuse its discretion in denying the requests to relieve counsel. Since the trial court did not abuse its discretion, Applicant was not entitled to relief upon the underlying claim. Thus, Applicant cannot establish that the result at his trial would have been different had counsel further objected to the trial court's denial of Applicant's request to relieve counsel. This claim should therefore be denied.

In the event this Court disagrees the issue should be dismissed as a matter of law based upon the record, Respondent submits any questions of fact in this claim can be resolved at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(a)(2): Counsel failed to object to and/or adequately impeach the trial testimony of Mr. Vello Paavel, portions of which were improper, inaccurate, unreliable and inadmissible. See Strickland v. Washington, 466 U.S. 668 (1994).

Relevant Facts

Vello Paavel is a firearms and toolmarks examiner with the State Law Enforcement Division. (R. 1757). He was qualified as an expert in firearms and

toolmarks examination at Applicant's criminal trial. (R. 1760). Agent Paavel testified that he received a Walther PPK .380 caliber pistol with a magazine with 7 unfired cartridges; a Jennings Bryco .380 caliber pistol with a magazine five unfired .380 caliber cartridges; one fired projectile; and 18 unfired cartridges. (R. 1760-61). Paavel testified that his examination of the Walther PPK pistol indicated the firearm had not been fired since the last time it was cleaned, or the last time the barrel was oiled. (R. 1769). Paavel determined the Walther pistol had not fired the projectile he examined. (R. 1770). Paavel also testified that the magazine for the Walther pistol was full when he received the weapon. (R. 1773).

Paavel further testified that he examined the Bryco pistol, and it had been fired at some point in time. (R. 1775). Paavel noted the magazine for the Bryco held six cartridges, and there five in the magazine he examined. (R. 1777). Paavel concluded the fired projectile he was provided was fired by the Bryco pistol. (R. 1787).

During the cross-examination, Paavel noted the bullet was definitely dented and damaged. (R. 1788). He further noted that he did not see anything on the bullet before he decontaminated it for his examination. (R. 1789). Paavel testified that he test fired the Bryco pistol four times, and he did not have any misfires. (R. 1791-92). He also noted that the Walther pistol had dust, lint, and oil, and he could not say when the oil was put in the pistol or when the lent got into the pistol. (R. 1792-93). Paavel also testified about elemental bullet lead analysis, which at one point in time was used by the FBI as a means to determine whether bullets had a common origin. (R. 1794-95). He noted that it was later determined that the interpretation of the results in elemental bullet

lead analyses was overstated. (R. 1795). During redirect, Paavel testified that no such elemental bullet lead analysis was performed in this case. (R. 1796).

Response

Respondent denies that counsel were deficient or that Applicant was prejudiced by counsel's handling of Agent Paavel as a witness. Applicant has not set forth any factual assertion regarding what was "inaccurate, unreliable and inadmissible" about Paavel's testimony. Respondent submits the record reflects that Agent Paavel's testimony was proper, and counsel had no basis for objecting to his testimony. Further, Applicant's claim that counsel failed to adequately impeach Agent Paavel is without merit. Again, Applicant does not set forth how Agent Paavel should have been impeached. "In hindsight, there are a few, if any, cross-examinations that could not be improved upon. If that were the standard of constitutional effectiveness, few would be the counsel whose performance would past muster." Willis v. United States, 87 F.3d 1004, 1006 (8th Cir. 1996). Counsel is not required to raise every conceivable issue or pursue every avenue of inquiry, but is required only to exercise normal skill, judgment, and diligence. Dyer v. Crisp, 613 F.2d 275 (10th Cir. 1980). Here, counsel vigorously cross-examined Paavel. Applicant cannot show that counsel's efforts were deficient. Nor can Applicant establish he was prejudiced. As a result, this claim for relief should be denied and dismissed with prejudice. In the event this Court disagrees any of these issues should be dismissed as a matter of law, Respondent requests an evidentiary hearing to resolve any questions of fact. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(a)(3): Counsel failed to impeach the State's witnesses with evidence that J[redacted] G. was not on the telephone with E[redacted] C. at the time of the crime. See Strickland v. Washington, 466 U.S. 668 (1994).

Relevant Facts

At trial, J[redacted] G., the victim's son, testified that on the afternoon of the shooting, he was eating supper and talking on the phone with his friend L[redacted]. (R. 1427-29). He noted that he was talking with her on his house phone. (R. 1430). While they were talking, he heard a loud noise at the door. (R. 1430). After hearing a second loud noise, the front door to the condo flew open. (R. 1430-31). He then saw the Applicant enter the condo yelling and cursing. (R. 1431). J[redacted] testified that the Applicant hit him and knocked him over. (R. 1431). J[redacted] indicated that the telephone was smashed and broken in the encounter. (R. 1434). A photograph of the broken telephone was entered into evidence as State's Exhibit 25. (R. 1435).

After Applicant killed the victim and left, J[redacted] got his cell phone and called the police. (R. 1440). A copy of the 911 call was entered into evidence as State's Exhibit 1 (R. 1409). J[redacted] further testified that he spoke with L[redacted] again after the police arrived at the condo. (R. 1443). He noted that he thought she called him. (R. 1443). J[redacted] also indicated that he thought he called both of his sisters. (R. 1443). During cross-examination, J[redacted] testified that he also called his father, Roger Grainger, that night. (R. 1446). He also noted that it was approximately 5:30 p.m. when he was talking with L[redacted] on the phone. (R. 1448). J[redacted] recounted that when the Applicant entered the condo, he walked over to J[redacted] and knocked the phone out of his hand. (R. 1451).

M[redacted] E[redacted] C. (L[redacted]), J[redacted] G.'s friend, testified that she called J[redacted] on the afternoon of the shooting. (See R. 1510-12). L[redacted] testified that she initially called J[redacted]'s house phone around 5 p.m. (R. 1510, 1511). She noted that the victim was on the phone, and the victim told L[redacted] to call back later. (R. 1510). L[redacted] testified that she called back around 5:25 or 5:30. (R. 1511). She noted that she called from her house phone to J[redacted]'s house phone. (R. 1511). L[redacted] was on the phone with J[redacted] when she heard a loud pop noise, and a voice that was not J[redacted]'s say "I told you I'd be back. I'm not going to jail you stupid bitch, and I'm not -- I'm back, I'm back. I'm never going back to jail." (R. 1511-1512). She then heard a hit and the phone went to static. (R. 1512). She also heard someone curse a few times, and then the phone went dead. (R. 1512). L[redacted] tried calling back to J[redacted]'s house phone a few times to no avail. (R. 1512). She noted that she called J[redacted]'s cell phone at around 5:56 or 5:57. (R. 1512-13). L[redacted] later clarified that J[redacted] had called her on her cell phone around 5:56 or 5:57, and not vice versa. (R. 1518, see 1521-22). L[redacted] also noted that she could not check the times for the phone calls from the house phone, but she could check the records from her cell phone. (R. 1519, see R. 1521).

Response

Respondent submits the Applicant cannot show that he is entitled to relief upon this claim. Respondent submits that counsel acted reasonably in not attempting to impeach either witness to the phone conversation by asserting they were not on the phone at the time. Respondent further submits that trial counsel's decision not to impeach the witnesses with such an assertion would have been the result of a

reasonable strategic decision by counsel. However, this claim cannot be resolved solely on the trial court record. Thus, Respondent requests that any questions of fact regarding this issue be heard at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(b): Ineffective Assistance of Counsel during the sentencing phase of his capital trial

Ground 10(b)(1): Counsel failed to investigate and present evidence of Applicant's neurological and cognitive impairments and/or dysfunction

Pursuant to Rule 12(e) of the South Carolina Rules of Civil Procedure, Respondent moves for a more definite statement because the allegation as stated is too vague for a response to be framed. In this claim, Applicant asserts that counsel failed to investigate and present evidence of alleged neurological and cognitive impairments and/or dysfunction. However, Applicant does not set forth what evidence, if any, counsel should have uncovered and presented. Respondent requests that Applicant indicate what evidence of neurological and cognitive impairment and/or dysfunction Applicant should have uncovered.[5]

[5] Respondent would note that in the first Amended application, the Applicant raised this same claim. Respondent moved for a more definite statement in response, and this Court granted the motion for a more definite statement. The Applicant, in response, did file a more definite statement asserting as follows:

> Applicant was denied the right to the effective assistance of counsel guaranteed by the Sixth and Fourteenth Amendments to the United States Constitution, Article I, sections 3 and 14 of the South Carolina Constitution and S.C. Code section 17-3-20---during the sentencing phase of his capital trial-when trial counsel failed to investigate and present evidence of Applicant's neurological and cognitive impairments and/or dysfunction, including a history of head injuries and exposure to trauma resulting in neurological damage, impaired brain functioning, and compromised judgment complicated by a family history of progressive neurological conditions, including dementia and Alzheimer's disease.

Respondent further submits Applicant cannot show that counsel was deficient in this regard, and further cannot show that Applicant was prejudiced. Respondent further submits that this issue raises questions of fact that cannot be resolved solely on the record below. Thus, Respondent requests that any questions of fact regarding this issue be heard at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(b)(2): Counsel failed to present mitigating evidence regarding applicant's change in demeanor and mental state before the crime and evidence that the victim harassed and taunted applicant while he was on house arrest.

Relevant facts

During the sentencing phase, the Applicant testified. During the course of his testimony, the Applicant made several allegations that the victim was visiting his home while they both had restraining orders against one another. (R. 2438-39, 2497, 2579). Applicant asserted he saw the victim in his driveway three times. (R. 2439). He claimed that when he saw her, he would not leave his home. (R. 2440-41). He further claimed that other individuals also witnessed her appearances in his neighborhood. In fact, Applicant asserted some of his friends from Raleigh photographed and videotaped

---

It is not clear from the second amended Application whether the Applicant intends to raise the claim as asserted in the more definite statement. Thus, Respondent moves for a more definite statement in this claim. To the extent the Applicant is asserting the claim raised in the more definite statement, Respondent submits Applicant could not show counsel was deficient in this regard. See Wiggins v. Smith, 123 S.Ct. 2527 (2003) ("In assessing the reasonableness of an attorney's presentation, a court must consider not only the quantum of evidence already known to counsel, but also whether the known evidence would lead a reasonable attorney to investigate further"). Furthermore, Respondent submits the Applicant will not be able to show that he was prejudiced. Inasmuch as these claims raise factual issues as to counsel's investigation, preparation, and representation, Respondent requests an evidentiary hearing to resolve any questions of fact. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

her. (R. 2441). Applicant also asserted that he told Aaron Wilkes of the Horry County Police Department. (R. 2441-42). Applicant also claimed that the victim would call his house and hang up. (R. 2497, 2579). A diary that Applicant kept between October 10, 2005 and the murder was introduced into evidence by the State as State's Exhibit 162. (R. 2584-85, 2633-36).

Response

First, Respondent moves for a more definite statement in regards to the first allegation within this claim, i.e., counsel failed to present mitigating evidence regarding applicant's change in demeanor and mental state before the crime. It is unclear from the allegations set forth what constitutes the period "before the crime." Further, it is unclear from the allegations what Applicant asserts was his demeanor and mental state "before the crime." Without more specific details regarding these allegations, Respondent cannot properly respond to the allegation.

As to the allegation that counsel failed to present evidence the victim allegedly harassed and taunted Applicant while he was on house arrest, Respondent submits Applicant cannot show that counsel was deficient in this regard, and further cannot show that Applicant was prejudiced. Counsel did present evidence of the alleged harassment through Applicant's testimony. Thus, the presentation of any additional evidence would have been cumulative to Applicant's testimony. Since the presentation of additional evidence would have been cumulative, Applicant cannot show counsel was ineffective in not presenting such additional evidence. Edwards v. State, 392 S.C. 449, 459, 710 S.E.2d 60, 66 (2011). Furthermore, Applicant has neither identified what additional evidence could have been presented nor shown that such additional evidence

would have been admissible at trial. Respondent submits that the overall mitigation presentation made by trial counsel was proper and effective, and the decision to present the mitigation case in the way presented at trial was the result of reasonable trial strategy. Thus, Applicant is not entitled to relief upon this claim. See generally Meyer v. Branker, 506 F.3d 358, 371 (4th Cir. 2007). Finally, Respondent submits Applicant cannot show that he was prejudiced in light of the strength of the State's case in aggravation and the limited, if any, mitigating value this alleged evidence may have had. See generally Jones v. State, 332 S.C. 329, 333, 504 S.E.2d 822, 824 (1998). Respondent further submits that this issue raises questions of fact that cannot be resolved solely on the record below. Thus, Respondent requests that any questions of fact regarding this issue be heard at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(b)(3)(a): Counsel failed to object when the trial court repeatedly refused to answer the jurors' question about what would happen if they could not reach a unanimous sentencing verdict.

Relevant facts

During the jury deliberations, the jurors sent the trial judge a note asking the following question: "Could you please explain what happens if we're not able to reach a unanimous decision?" (R. 2921, ll 23-4). The trial judge then indicated that he had shared the question with both counsel for the State and counsel for Applicant. (R. 2921-22). There was agreement amongst the attorneys and the trial judge that the jurors were not indicating they were deadlocked, and all were concerned about the ramifications of responding to the question. (R. 2922). In light of those concerns, the

trial judge sent a response stating, "I cannot answer the question the way you phrased it. Please let me know if you have any other questions." (R. 2923, ll 5-7).

After receiving no response from the jury, the trial judge indicated on the record that the attorneys for both sides expressed concern regarding whether the jury did have a question. (R. 2923-24). As a result, the trial judge sent a second note to the jury, asking, "Mr. Foreman and members of the jury, do you have any questions or messages for the court?" (R. 2924, ll 13-4). In response, the judge received the following question from the jurors: "What is the law state when a jury does not reach any unanimous decision at this stage of the trial?" (R. 2925, ll 3-5).

The trial judge indicated that he believed the question was a hypothetical question. (R. 2925). After discussing the matter further with the attorneys, the trial judge sent the jury another note. In this note, the judge stated, "I cannot answer hypothetical questions. Do you have any specific questions to ask or comments that you would like to make about your jury?" (R. 2925 l 23- 2926 l 1). Shortly thereafter, the jury sent another note to the trial judge. (R. 2926, Ct. Exh. 25). Both sides agreed that the last message from the jury indicated they were deadlocked. (R. 2926).

Argument

Applicant asserts trial counsel was ineffective in not objecting to the trial court not answering the jurors' questions regarding what would happen if the jury could not come to a unanimous verdict. This contention is without merit.

Trial counsel was not deficient when they did not object to the trial judge's decision not to answer the questions. The trial court was well within its discretion in

refusing to answer the initial questions asked by the jury, and, as a result, counsel had no basis for objecting. S.C. Code Ann. § 16-3-20(C) states:

> If members of the jury after a reasonable deliberation cannot agree on a recommendation as to whether or not the death sentence should be imposed on a defendant found guilty of murder, the trial judge shall dismiss such jury and shall sentence the defendant to life imprisonment as provided in subsection (A).

The South Carolina Supreme Court has held that this sentencing portion of the subsection (C) does not need to be shared with the jury.

> The language of the statute provides that where a sentence of death is not recommended by the jury, a life sentence must be given. The situation implicitly envisioned here is that normally the jury will unanimously either recommend life or death. The undecided jury is the exception. That portion of the statute addressing the legal effect given to the existence of an unalterably divided jury is addressed to the trial judge only and need not be divulged to the jury.

State v. Adams, 277 S.C. 115, 124, 283 S.E.2d 582, 587 (1981) overruled on other grounds by State v. Torrence, 305 S.C. 45, 406 S.E.2d 315 (1991); State v. Copeland, 278 S.C. 572, 584-85, 300 S.E.2d 63, 70 (1982); see State v. Spann, 279 S.C. 399, 404, 308 S.E.2d 518, 521 (1983)(finding harmless error when judge instructed jury that any sentence for life imprisonment must be unanimous because jury need not be instructed of legal effect of unalterable divided jury). "[T]he Eighth Amendment does not require that the jurors be instructed as to the consequences of their failure to agree." Jones v. United States, 527 U.S. 373, 381 (1999).

> We have never suggested, for example, that the Eighth Amendment requires a jury be instructed as to the consequences of a breakdown in the deliberative process. On the contrary, we have long been of the view that "[t]he very object of the jury system is to secure unanimity by a comparison of views, and by arguments among the jurors themselves." Allen v. United States, 164 U.S. 492, 501, 17 S.Ct. 154, 41 L.Ed. 528 (1896). We further have recognized that in a capital sentencing

> proceeding, the Government has "a strong interest in having the jury express the conscience of the community on the ultimate question of life or death." Lowenfield v. Phelps, 484 U.S. 231, 238, 108 S.Ct. 546, 98 L.Ed.2d 568 (1988) (citation and internal quotation marks omitted). We are of the view that a charge to the jury of the sort proposed by petitioner might well have the effect of undermining this strong governmental interest.

Jones, 527 U.S. at 382 (footnote omitted).

The questions posed by the jurors specifically asked what would happen if they did not reach a unanimous verdict. In light of the longstanding precedent against informing jurors of what would occur if they did not reach a unanimous verdict, it was proper for the trial court to not respond to the jurors' questions on that subject. Thus, trial counsel had no basis for objecting to the trial court's refusal to answer the questions. As a result, counsel was not deficient.

Applicant cannot show that he was prejudiced by counsel not objecting to the trial court's refusal to answer those questions from the jury. First, as already noted, the trial court's refusal to answer the questions was proper. Thus, any objection would have been without merit. See, e.g., Werts v. Vaughn, 228 F.3d 178, 203 (3rd Cir. 2000) ("counsel cannot be ineffective for failing to raise a meritless claim"); see also Almon v. U.S., 302 F.Supp.2d 575, 586 (D.S.C.,2004) ("There can be no ineffective assistance of counsel for failing to raise a claim which is not legally viable."). Second, Respondent submits Applicant cannot show that the result at his sentencing hearing would have been different but for the fact counsel did not object to the trial court's refusal to answer the jurors' questions regarding the result of a hung jury. Thus, this claim for relief should be denied.

In the event this Court disagrees the issue should be dismissed as a matter of law based on the record below, Respondent submits any questions of fact in this claim can be resolved at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(b)(3)(b): Counsel failed to object when the trial court issued improper instructions to the jury under unduly coercive circumstances.

Relevant facts

After receiving the jury's last note, the trial judge proposed that he would bring the jury out, give them an Allen charge, and then give them the option of either continuing deliberations that evening or returning the next day to continue deliberations. (R. 2926-27). Both the attorneys for the State and Applicant's trial counsel agreed with the suggestion. (R. 2927). The judge then charged the jury as follows:

> Ladies and gentlemen, I have your comment. Let me reply to you in this fashion and in this way.
>
> Mr. Foreman, ladies and gentlemen of the jury, you stated that you've been unable to unanimously agree on the decision in this case. As I instructed you earlier, the decision of the jury must be unanimous.
>
> When a matter is in dispute, it isn't always easy for even two people to agree. So, when twelve people must agree, it's even more difficult. In most cases, absolute certainty cannot be reached or expected. However, you have a duty to make every reasonable effort to reach a unanimous decision.
>
> In doing so, you should consult with one another, express your own views, listen to the opinions of your fellow jurors, tell each other how you feel, and why you feel that way. Discuss your differences with open minds. Although the decision of the jury must be unanimous, every one of you has a right to your own opinion. The verdict, the decision you agree to must be your own decision, the result of your own convictions, and you should not give up your firmly-held beliefs merely to be in agreement with a fellow juror.

> The majority should consider the minority's position, and the minority should consider the majority's position. You should carefully consider and respect the opinion of each other and reevaluate your position for reasonableness, correctness, and impartiality. You must lay aside all outside matters and reexamine the questions before you based on the law and the evidence in this case.
>
> Now, ladies and gentlemen of the jury, I'm going to give you an option at this time. I'm going to ask you to return and continue deliberations with the hope that you can arrive at a decision, a unanimous decision within a reasonable time. If you wish to do so, to continue deliberations tonight to see if you can come to a unanimous decision within a reasonable time, then I'll be glad to let you do so. I'll let you make the decision. If you'd rather go back to the hotel room, come back tomorrow to see if you can reach a unanimous decision in a reasonable time, you can do that. I will let you make the decision.
>
> So, return to the jury room. If you wish to continue deliberations tonight to see if you can reach a unanimous decision, that's fine. That's your choice, and we'll wait with you. Or if you feel you'd rather return to the hotel rooms and come back tomorrow to continue deliberations, see if you can reach a unanimous decision within a reasonable time, then we'll do that.

(R. 2928, l 2 – 2929, l 23). No exceptions were taken to the instruction. (R. 2930). The jury subsequently decided to end deliberations for the evening and start again in the morning. (R. 2930).

When the jury returned the next morning, and after the trial court asked if any of the jurors needed to hear the charge again, jurors requested that the judge give the charge again. (R. 2931-33, 2934-35). After discussion with counsel for both Applicant and the State, the trial court repeated the charge to the jury. The court charged the jury as follows:

> Ladies and gentlemen, take no emphasis on me repeating it. What I take from you all is that it was after midnight last night and maybe because of the length of the day, you didn't listen carefully or could not listen as carefully as maybe you can after some rest, and you really want me to charge it, but no emphasis about anything other than the fact that

you may not heard what I said last night. That's what I assume, so please don't take any, any meaning of about me doing. This is like the first time charging this.

Ladies and gentlemen of the jury and Mr. Foreman, you stated that you've been unable to unanimously agree on the decision in this case. As I instructed you earlier, the decision of the jury must be unanimous. When a matter is in dispute, it isn't always easy for even two people to agree. So, when twelve people must agree, it becomes even more difficult.

In most cases, absolute certainty cannot be reached or expected. However, you have a duty to make every reasonable effort to reach a unanimous decision. In doing this, you should consult with one another, express your own views, and listen to the opinions of your fellow jurors. Tell each other how you feel and why you feel that way; discuss your differences with open minds.

Although the decision of the jury must be unanimous, everyone of you has the right to your own opinion. The decision you agree to must be your own decision, the result of your own convictions, and you should not give up your firmly-held beliefs merely to be in agreement with your fellow jurors.

The majority should consider the minority's position, and the minority should consider the majority's position. You should carefully consider and respect the opinions of each other and reevaluate your position for reasonableness, correctness, and impartiality. You must lay aside all outside matters and reexamine the questions before you based on the law and the evidence in this case.

I therefore, ladies and gentlemen, ask you to return to your deliberations with the hope that you can arrive at a verdict within a reasonable time.

Now, ladies and gentlemen, I told you not to deliberate last night after I charged you in this, and I told you not to deliberate this morning until after you I came in and saw you. So, now at this time with that additional charge then, if you would please step to the jury room. You may begin deliberations until you reach a decision within a reasonable time. You may return to your jury room.

(R. 2936, l 22 – 2938, l 19).

Argument

Applicant asserts trial counsel should have objected to this charge because they were improper and were given in unduly coercive circumstances. Respondent submits this contention is without merit.

> Neither the Due Process clause nor the Eighth Amendment forbid the giving of an Allen charge in the sentencing phase of a capital proceeding. Lowenfield v. Phelps, 484 U.S. 231, 108 S.Ct. 546, 98 L.Ed.2d 568 (1988); see also Jones v. United States, 527 U.S. 373, 119 S.Ct. 2090 (1999) (no constitutional requirement that capital jury be informed of consequences of its failure to agree). Whether an Allen charge is unconstitutionally coercive must be judged "in its context and under all the circumstances." Lowenfield, supra.

Tucker v. Catoe, 346 S.C. 483, 490-91, 552 S.E.2d 712, 716 (2001).

> In South Carolina state courts, an Allen charge cannot be directed to the minority voters on the jury panel. Instead, an Allen charge should be even-handed, directing both the majority and the minority to consider the other's views. A trial judge has a duty to urge, but not coerce, a jury to reach a verdict. It is not coercion to charge every juror has a right to his own opinion and need not give up the opinion merely to reach a verdict.

Green v. State, 351 S.C. 184, 194, 569 S.E.2d 318, 323 (2002) (citations omitted).

In determining whether an Allen charge is unconstitutionally coercive, a court should look to whether (1) the charge spoke specifically to the minority juror(s); (2) the judge included in his charge any language such as "You have got to reach a decision in this case;" (3) there was an inquiry into the jury's numerical division, which is generally coercive; and (4) whether the jury returned a verdict shortly after the supplemental charge, which suggests a possibility of coercion; and if so, whether the fact that trial counsel did not object either to the inquiry into whether the jurors believed further deliberation would result in a verdict, nor to the supplemental charge. Tucker, 346 S.C. at 492, 552 S.E.2d at 716 (citing Lowenfield, 484 U.S. at 237, 108 S.Ct. 546); see State

v. Williams, 386 S.C. 503, 512, 690 S.E.2d 62, 66-67 (2010), cert. denied, 131 S. Ct. 230, 178 L. Ed. 2d 153 (2010).

Respondent submits the Allen charge given in Applicant's case was not coercive. The language utilized in the charge was similar to the language upheld in Lowenfield and to the charge upheld in Williams. Further, the charge did not speak directly to the minority jurors. The trial court never intimated that the jury had to reach a verdict. The trial court never inquired into the jury's numerical division. And while the jury returned its verdict approximately one hour after hearing the charge, there is no indication in the record that such coercion was readily apparent. Since the Allen charge was not coercive, counsel was not deficient in not objecting to the charge.

Applicant also cannot show that he was prejudiced by counsel not objecting to the Allen charge. First, such an objection would have been without merit because the charge was not coercive. Thus, any objection would have been dismissed. Respondent submits Applicant cannot show that he was otherwise prejudiced by counsel not objecting. Respondent also asserts that trial counsel decision not to object was reasonable trial strategy.

In the event this Court disagrees the issue should be dismissed as a matter of law based upon the record, Respondent submits any questions of fact in this claim can be resolved at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(c): Applicant's right to self-representation, as guaranteed by the Sixth and Fourteenth Amendments to the United States Constitution and Article 1 § 14 of the South Carolina Constitution, was violated by the trial court's refusal to permit him to discharge appointed counsel and proceed pro se.

These allegations are procedurally barred because they could have been raised at trial and on direct appeal.

S.C. Code Ann. § 17-27-20(b) (1986) specifically provides that the remedy of Post-Conviction Relief "is not a substitute for nor does it affect any remedy incident to the proceedings in the trial court, or of direct review of the sentence or conviction." The South Carolina Supreme Court has consistently and repeatedly held that issues that either were or could have been raised at trial and on direct appeal may not be raised in PCR. Drayton v. Evatt, 312 S.C. 4, 8-9, 430 S.E.2d 517, 520 (1993) (issues that could have been raised at trial or in direct appeal cannot be asserted in PCR application absent a claim of ineffective assistance of counsel); Hyman v. State, 278 S.C. 501, 299 S.E.2d 330 (1983) (same); Cummings v. State, 274 S.C. 26, 260 S.E.2d 187 (1979). Therefore, this ground is not appropriate for PCR.

Second, Respondent submits this claim has essentially been ruled upon by the South Carolina Supreme Court in Applicant's direct appeal. In its opinion, the Supreme Court wrote:

> Appellant argues the trial court abused its discretion by refusing to allow Appellant to represent himself during the sentencing phase of the trial. We disagree.
>
> An accused may waive the right to counsel and proceed pro se. Faretta v. California, 422 U.S. 806, 95 S.Ct. 2525, 45 L.Ed.2d 562 (1975). However, "[a] defendant's right to waive the assistance of counsel is not unlimited." State v. Fuller, 337 S.C. 236, 241, 523 S.E.2d 168, 170 (1999). "The request to proceed pro se must be clearly asserted by the defendant prior to trial." Id. (citation omitted). "If the request to proceed

> pro se is made after trial has begun, the grant or denial of the right to proceed pro se rests within the sound discretion of the trial judge." Id. (citing United States v. Singleton, 107 F.3d 1091 (4th Cir.1997); United States v. Lawrence, 605 F.2d 1321 (4th Cir.1979)). "Once trial commences, that right [to proceed pro se] is subject to the trial court's discretion which requires a balancing of the defendant's legitimate interests in representing himself and the potential disruption and possible delay of proceedings already in progress." U.S. v. Wesley, 798 F.2d 1155, 1155–56 (8th Cir.1986) (citations omitted); see also U.S. v. Stevens, 83 F.3d 60, 66–67 (2d Cir.1996) ("[O]nce a trial has begun, a defendant's right to represent himself 'is sharply curtailed,' and the judge considering the motion must weigh 'the prejudice to the legitimate interests of the defendant' against the 'potential disruption of proceedings already in progress.' "). The sentencing phase of a capital trial does not constitute a separate trial. See S.C. Code Ann. § 16–3–20(B) (2003); see also State v. Stewart, 288 S.C. 232, 235, 341 S.E.2d 789, 791 (1986).
>
> Appellant did not make his request to proceed pro se at the beginning of trial. Appellant made his request to proceed pro se at the beginning of the sentencing phase, which is not a separate trial. Thus, review of this issue is governed by the abuse of discretion standard outlined above and Appellant's right to represent himself was sharply curtailed by his failure to exercise this right prior to trial.
>
> The trial court did not abuse its discretion in denying Appellant's request to proceed pro se at the sentencing phase of the trial. First, the trial court noted it was concerned that Appellant's medication would affect his ability to properly and fully function as his own counsel. Second, the trial court was concerned that allowing Appellant to represent himself during the sentencing phase would require some delay for Appellant to fully prepare. Third, the trial court was concerned the jury may be confused to have the first half of the case tried by counsel and the second half tried without counsel, especially if the jury could see counsel at Appellant's counsel table. For these reasons, the trial court properly considered the legitimate interests of Appellant and the potential disruption of the proceedings already in progress. Hence, the trial court's decision to not allow Appellant to proceed pro se during the sentencing phase of trial was not an abuse of discretion and, therefore, nor error.

Winkler, 388 S.C. at 585-87, 698 S.E.2d at 602-03. Since this issue has already been resolved by the South Carolina Supreme Court, and there have been no intervening changes in the law that would require re-examination of this issue, Respondent submits

it cannot be re-examined in this post-conviction relief action. As a result, this claim for relief should be denied.

In the event this Court disagrees the issue should be dismissed as a matter of law based on the record below, Respondent submits any questions of fact in this claim can be resolved at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(d) Applicant's right to a fair and impartial jury determination of his sentence –free from the influence of passion, prejudice, or any other arbitrary factor – guaranteed by the Sixth, Eighth and Fourteenth Amendments to the United States Constitution, Article 1 §§ 3,14 and 15 of the South Carolina Constitution, and S.C. Code § 16-3-25(C), was violated by the trial court's repeated refusal to answer the jurors' question about what would happen if they could not reach a unanimous sentencing verdict and the court's improper instructions to the jury under unduly coercive circumstances.

These allegations are procedurally barred because they could have been raised at trial and on direct appeal.

S.C. Code Ann. § 17-27-20(b) (1986) specifically provides that the remedy of Post-Conviction Relief "is not a substitute for nor does it affect any remedy incident to the proceedings in the trial court, or of direct review of the sentence or conviction." The South Carolina Supreme Court has consistently and repeatedly held that issues that either were or could have been raised at trial and on direct appeal may not be raised in PCR. Drayton v. Evatt, 312 S.C. 4, 8-9, 430 S.E.2d 517, 520 (1993) (issues that could have been raised at trial or in direct appeal cannot be asserted in PCR application absent a claim of ineffective assistance of counsel); Hyman v. State, 278 S.C. 501, 299 S.E.2d 330 (1983) (same); Cummings v. State, 274 S.C. 26, 260 S.E.2d 187 (1979). Therefore, this ground is not appropriate for PCR.

Furthermore, for the reasons underlying Respondent's response to Ground 10(b)(2), Respondent submits these claims are without merit. As a result, this ground should be denied and dismissed. In the event this Court disagrees the issue should be dismissed as a matter of law, Respondent submits any questions of fact in this claim can be resolved at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

Ground 10(e): Applicant's right to a fair and impartial jury determination of his sentence – free from the influence of passion, prejudice, or any other arbitrary factor – guaranteed by the Sixth, Eighth and Fourteenth Amendments to the United States Constitution, Article 1 §§ 3, 14 and 15 of the South Carolina Constitution, and S.C. Code § 16-3-25(C), was violated when Juror Jeron Wallingford was coerced into voting for a death sentence by threat of physical harm and intimidation by his fellow jurors.

"The Sixth and Fourteenth Amendments of the United States Constitution guarantee a defendant a fair trial by a panel of impartial and indifferent jurors." State v. Kelly, 331 S.C. 132, 141, 502 S.E.2d 99, 104 (1998) (citing Estelle v. Williams, 425 U.S. 501, 96 S.Ct. 1691, 48 L.Ed.2d 126 (1976); Irvin v. Dowd, 366 U.S. 717, 81 S.Ct. 1639, 6 L.Ed.2d 751 (1961); S.C. Const. art I, §§ 3 & 14). The general test for evaluating alleged juror misconduct is whether there in fact was misconduct and, if so, whether any harm resulted to the defendant as a consequence. State v. Zeigler, 364 S.C. 94, 108, 610 S.E.2d 859, 866 (Ct. App. 2005); State v. Smith, 338 S.C. 66, 525 S.E.2d 263 (Ct.App.1999). Where a defendant seeks a new trial on the basis of juror misconduct, he is required to prove both the alleged misconduct and the resulting prejudice. Zeigler, supra; State v. Galbreath, 359 S.C. 398, 597 S.E.2d 845 (Ct.App.2004); see also State v. Aldret, 333 S.C. 307, 509 S.E.2d 811 (1999) (a defendant must demonstrate

prejudice from jury misconduct in order to be entitled to a new trial). Misconduct of a juror is a fact to be determined by the trial judge from the circumstances of each case. Smith, 338 S.C. at 71, 525 S.E.2d at 266.

"As a general rule, juror testimony may not be the basis for impeaching a jury verdict. Normally, courts should not intrude into the privacy of the jury room to scrutinize how jurors reached their verdict." State v. Hunter, 320 S.C. 85, 88, 463 S.E.2d 314, 316 (1995). Rule 606(b), SCRE states:

> Upon an inquiry into the validity of a verdict or indictment, a juror may not testify as to any matter or statement occurring during the course of the jury's deliberations or to the effect of anything upon that or any other juror's mind or emotions as influencing the juror to assent to or dissent from the verdict or indictment or concerning the juror's mental processes in connection therewith, except that a juror may testify on the question whether extraneous prejudicial information was improperly brought to the jury's attention or whether any outside influence was improperly brought to bear upon any juror. Nor may a juror's affidavit or evidence of any statement by the juror concerning a matter about which the juror would be precluded from testifying be received for these purposes.

"[J]uror testimony involving internal misconduct is competent only when necessary to ensure due process, i.e. fundamental fairness." Id.

> [T]he exception to the general rule against review of internal jury deliberations carved out in Hunter is a narrow one, limited by our supreme court to those few situations which implicate due process raising a question of fundamental fairness.
>
> ...
>
> But the integrity of the jury system is jeopardized any time a court finds it necessary to intrude into the internal deliberation process. Such an inquiry should not be lightly made.

State v. Franklin, 341 S.C. 555, 562, 534 S.E.2d 716, 720 (Ct. App. 2000), "The occurrence of a significant degree of jury misconduct calling for the admission of juror testimony has proved to be quite rare." Shumpert v. State, 378 S.C. 62, 69, 661 S.E.2d

369, 372 (2008) (citing State v. Pittman, 373 S.C. at 554-55, 647 S.E.2d at 158 (suggesting that the mine-run of prejudicial jury misconduct cases involve internal coercion based on race or gender bias)). In Shumpert, the Supreme Court warned that trial courts should exercise a degree of caution before entertaining juror testimony presented in an attack on a jury's verdict. Shumpert, 378 S.C. at 69, 661 S.E.2d at 372.

In Franklin, the South Carolina Court of Appeals found no error in the trial court's denial of the appellant's request for a factual inquiry into allegations of undue coercion and gender bias raised in a juror's affidavit post-trial. Franklin, 341 S.C. at 561, 534 S.E.2d at 719. In the affidavit at issue in Franklin, the juror alleged that several other jurors called her derogatory names and blamed her for wasting other jurors' time. Id. at 559, 534 S.E.2d at 718. The juror further alleged that during a discussion about how an alternate could get involved in the deliberations, one juror stated that "'someone would have to die,'" and everyone laughed when the juror providing the affidavit said it would have to be her. Id. at 559-60, 534 S.E.2d at 718. The Court of Appeals found that the allegations of gender bias were not borne out by the affidavit, and the remaining allegations did not indicate internal misconduct sufficient to raise a due process concern. Id. at 561, 534 S.E.2d at 719. Similarly, in Shumpert, the South Carolina Supreme Court found that a juror affidavit that alleged misconduct in the form of other jurors allegedly ignoring the trial judge's instructions regarding the defendant's exercise of his right to remain silent and the burden of proof did "not measure up to the high bar that precedent sets for the seriousness of allegations that juror testimony must raise before it may be admitted." Shumpert, 378 S.C. at 64-5, 68, 661 S.E.2d at 370, 372.

Even in those cases where an issue of fundamental fairness was found to warrant consideration of a juror's testimony or affidavit, relief upon the underlying claim has been consistently denied when the underlying facts did not support a finding of fundamental unfairness or prejudice. See Hunter, 337 S.C. 307, 509 S.E.2d 811 (finding juror testimony regarding use of racial slur and claim that juror was touched on the shoulders by another juror did not warrant a new trial); Pittman, 373 S.C. 527, 647 S.E.2d 144 (affirming denial of relief upon juror misconduct claim based upon juror testimony that they felt they were coerced and that they only found the defendant guilty based upon information other jurors provided).

Respondent submits that Applicant has not set forth sufficient allegations in this claim in the application to warrant review. The allegation does not set forth any facts that would implicate due process by raising a question of fundamental fairness. The allegations set forth in this claim do not fall within the parameters of those cases in which fundamental fairness has warranted further review. Thus, Respondent submits this claim for relief should be denied and dismissed with prejudice.

Furthermore, Respondent submits Applicant cannot show there was a due process violation that impinges on fundamental fairness in the jury's deliberations. Respondent further submits Applicant cannot show that he was prejudiced. This claim is without merit. In the event this Court disagrees the issue should be dismissed as a matter of law, Respondent submits any questions of fact in this claim can be resolved at the evidentiary hearing. See Sharper v. State, 279 S.C. 264, 305 S.E.2d 247 (1983).

CONCLUSION

Each and every allegation in the Application that is not hereinabove expressly admitted, denied, qualified or explained is hereby denied.

WHEREFORE, Respondent submits that the Application for Post-Conviction Relief should be denied and dismissed.

Respectfully submitted,

ALAN WILSON
Attorney General

JOHN W. McINTOSH
Chief Deputy Attorney General

DONALD J. ZELENKA
Senior Assistant Deputy Attorney General

ALPHONSO SIMON, JR.
Assistant Attorney General
(Counsel of Record)

Post Office Box 11549
Columbia, South Carolina 29211
(803) 734-6305

By: _____
ATTORNEYS FOR RESPONDENT

May 30, 2012.

CERTIFICATE OF SERVICE

I, Alphonso Simon, Jr., counsel for the Respondent, certify that I have served the Respondent's **Return to Second Amended Application for Post-Conviction Relief and Motion for More Definite Statement** via U.S. mail, first class, postage pre-paid, addressed to:

Emily C. Paavola, Esquire
Death Penalty and Defense Center
900 Elmwood Ave., Suite #101
Columbia, SC 29201

John R. Mills, Esq.
201 West Main St., Ste. #301
Durham, NC 27701

This 30th day of May, 2012.

ALPHONSO SIMON, JR.

STATE OF SOUTH CAROLINA	)	
	)	IN THE COURT OF COMMON PLEAS
County of Horry	)	
	)	
Louis Michael Winkler, Jr.,	)	Case No. 2011-CP-26-03907
Applicant,	)	
	)	
v.	)	**APPLICANT'S SUPPLEMENTAL ANSWERS TO RESPONDENT'S INTERROGATORIES**
	)	
State of South Carolina,	)	
Respondent.	)	

TO: Alphonso Simon, Jr.
Assistant Attorney General
P.O. Box 11549
Columbia, SC 29211

Applicant received service of Respondent's First Set of Interrogatories on January 3, 2012. Applicant provided an initial response on February 8, 2012. Pursuant to Rules 26 and 33 of the South Carolina Rules of Civil Procedure, Applicant, Louis M. Winkler, Jr., submits the following supplemental responses. The answers set forth herein are subject to the following reservations and qualifications:

a) Applicant does not waive any objection to any interrogatory that seeks information in excess of Rule 33(b), SCRCP.

b) Applicant does not waive the right to assert privileges, *i.e.*, the attorney-client privilege, the work-product doctrine, the physician-patient privilege, or any other confidentiality privileges, notwithstanding the submission of these answers.

c) Applicant is continuing with trial preparation and will supplement these responses as required and allowed by the Rules and court orders.

d) Applicant's answers are in some instances over-inclusive and some persons who are listed may have information relevant to the proceedings but may not be called as witnesses.

ANSWERS TO INTERROGATORIES

1. **Give the names and addresses of the persons known to the parties or counsel to be witnesses concerning the facts of the case [i.e., the post-conviction relief case], and indicate whether or not written or recorded statements have been taken from the witnesses and indicate who has possession of such statements.**

Answer: . Applicant directs Respondent's attention to the official transcript of record of applicant's trial and direct appeal for a complete list of fact witnesses, participating attorneys, and court personnel. This information is readily available to respondent and the burden of deriving it or ascertaining the answer to this interrogatory from these records is substantially the same for Respondent as it is for Applicant. *See* Rule 33(c), SCRCP. Applicant would also identify the additional witnesses who have given written statements, which have been disclosed to Respondent:

1. Pat White, [redacted]
2. Frank Patterson, [redacted]
3. Benjamin Hege, located in [redacted]. Address unknown.
4. Carolyn Samuels, [redacted]
5. Jeannie Walker, [redacted]
6. John Burch, [redacted]
7. Chuck Webster, [redacted]
8. Dickie Caines, [redacted]
9. Stephen Fitzwater, located in [redacted] Address unknown.
10. Jeron Wallingford, [redacted]
11. Lauren Roughton, [redacted]
12. Philip Randall, [redacted]

13. Thomas Hardwick; [redacted]

14. Louis Michael Winkler Jr.; [redacted]

15. Te Anne Oehler; [redacted]

16. Carolyn Graham, [redacted]

17. Vicki Childs, [redacted]

18. Ed Genet, [redacted]

Applicant also identifies the following witnesses who have not given written or recorded statements:

1. Jody McDougal, [redacted]
2. Karen Reeves, [redacted]
3. Jeff Winkler, [redacted]. Address unknown.
4. Rick Winkler, [redacted]
5. Ralph Wilson, [redacted]
6. Paul Rathbon, [redacted]
7. Jeff Naylor, [redacted]
8. Aaron Wilkes, [redacted]
9. Jerry Pol, [redacted]
10. Kenneth Martinelli, [redacted]

In the event that Applicant becomes aware additional witnesses and/or takes a written or recorded statement from such witnesses, he will provide a supplemental response to this interrogatory.

2. **Set forth a list of photographs, plats, sketches or other prepared documents in possession of the party that relate to any claim or defense in the case [i.e., the post-conviction relief case].**

Answer: Applicant would direct Respondent to his Supplemental Production of Documents and Things.

3. **[Standard interrogatory referencing personal injury cases not applicable].**

Answer: No response required.

4. **[Standard interrogatory referencing liability insurance not applicable].**

Answer: No response required.

5. **[Standard interrogatory regarding itemized statement of damages not applicable].**

Answer: No response required.

6. **List the names and addresses of any expert witnesses whom the party proposes to use as a witness at the trial of the case [i.e., the post-conviction relief case].**

11. *Answer*: Adina Schwartz, John Jay College of Criminal Justice; 899 Tenth Avenue; New York, NY

7. **For each person known to the party or counsel to be a witness concerning the facts of the case [i.e., the post-conviction relief case], set forth either a summary sufficient to inform the other party of the important facts known to or observed by such witness, or provide a copy of any written or recorded statements taken from such witnesses.**

Answer: Applicant directs respondent's attention to the official transcript of record of Applicant's trial and direct appeal for a complete list of fact witnesses, participating attorneys, and court personnel. This information is readily available to respondent and the burden of deriving it or ascertaining the answer to this interrogatory from these records is substantially the same for respondent as it is for applicant. *See* Rule 33(c), SCRCP. Applicant has provided Respondent with all written statements responsive to this interrogatory.

Respectfully submitted,

By: _____

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
900 Elmwood Avenue
Suite 101
Columbia, South Carolina 29201
(803) 765-1044

JOHN R. MILLS
Attorney at Law
201 W. Main Street
Suite 301
Durham, NC 27701
(919) 251-6259

Counsel for applicant.

June 1, 2012

STATE OF SOUTH CAROLINA	)	
	)	IN THE COURT OF COMMON PLEAS
County of Horry	)	
	)	
Louis Michael Winkler, Jr.,	)	Case No. 2011-CP-26-03907
Applicant,	)	
	)	
v.	)	**APPLICANT'S SUPPLEMETNAL RESPONSES TO RESPONDENT'S REQUEST FOR DOCUMENTS AND THINGS**
	)	
State of South Carolina,	)	
Respondent.	)	

TO: Alphonso Simon, Jr.
Assistant Attorney General
P.O. Box 11549
Columbia, SC 29211

Applicant received service of Respondent's Request for Production of Documents and Things on January 3, 2012. Applicant provided an initial response on February 8, 2012. Pursuant to Rules 26 and 34 of the South Carolina Rules of Civil Procedure, Applicant, Louis M. Winkler, Jr., submits the following supplemental responses.

1. **Any and all documents, affidavits, statements, or any other information provided to Applicant which relate to a claim or defense which has been raised or will be raised in this case. Documents or correspondence which have been provided to Applicant from the Office of the Attorney General are excluded from this request.**

Response: Applicant objects to this request to the extent that it seeks the discovery of privileged attorney/client communications and attorney work product. Applicant further objects to this request to the extent that it is overbroad and seeks irrelevant information related to claims that "will be raised in this case" or to the state's "defenses," of which Applicant is not aware. Subject to these objections, Applicant responds that he will produce any non-privileged documents in his possession that relate to a claim raised in this PCR. Applicant is producing all responsive documents in his possession at this time, concurrently with these written responses.

These documents are enclosed in electronic format and are numbered LMW D00311-LMW D01411.

2. **Any and all documents and/or correspondence provided pursuant to a Freedom of Information Act or similar request made by Applicant of any government agency, subdivision, or political entity whether state or federal.**

Response: Applicant objects to this request to the extent that it is overbroad and seeks irrelevant information not related to any claim in this PCR. Subject to this objection, Applicant responds that he will produce responsive documents related to any claim in this PCR. *See* Applicant's Response to Request for Production No. 1.

3. **The reports and/or summaries of the experts retained and consulted in preparation for Applicant's capital trial or his post-conviction relief case, who are expected to testify at the post-conviction relief hearing, and any all [*sic*] documents, notes, files, reports, tests and/or other written or recorded materials upon which the expert has relied in reaching his or her opinion.**

Response: Applicant objects to this request to the extent that it is overbroad and seeks irrelevant information not related to any claim in this PCR. Subject to this objection, Applicant responds that he has produced any documents on which the expert he intends to call at the PCR hearing in reaching her opinion. *See* Applicant's Response to Request for Production No. 1.

4. **A current *curriculum vitae* of all experts expected to testify at the post-conviction relief hearing.**

Response: Applicant has provided the *curriculum vitae* of Prof. Adina Schwartz. *See* Applicant's Response to Request for Production No. 1.

5. **Any and all documents, correspondence, reports, affidavits, statements, or any other information which has been provided to any expert that the Applicant intends to call as a witness at the PCR hearing.**

Response: Applicant directs Respondent's attention to his answer to Request for Production No. 3.

6. **Any and all documents, correspondence, reports, affidavits, statements, or any other information that was supposedly withheld from any mental health professional, investigator, social worker, or mitigation specialist during the preparation for Petitioner's trials, both during the guilt phase and sentencing phase.**

Response: Applicant objects to this request to the extent it amounts to a request for attorney work-product. That is, it calls for production of material designated—in the opinion of Applicant's counsel—as related to specific deficiencies at trial. Subject to this objection, Applicant responds that he will produce responsive documents in his possession related to any claim in this PCR. See Applicant's Response to Request for Production No. 1.

7. **Any and all evidence, whether testimonial, documentary, photographic, recorded, physical, or otherwise, which Applicant contends should have but was not disclosed by the State at trial.**

Response: Applicant objects to this request to the extent it amounts to a request for attorney work-product. That is, it calls for production of material designated—in the opinion of Applicant's counsel—as related to specific deficiencies at trial. Subject to this objection, Applicant responds that he will produce responsive documents in his possession related to any claim in this PCR. *See* Applicant's Response to Request for Production No. 1.

8. **Any and all written or recorded statements that have been taken from any potential witnesses.**

Response: Applicant directs Respondent's attention to his answer to Request for Production No. 1.

9. **Any and all photographs, plats, sketches, or other prepared documents in possession of the party or the party's attorneys that relate to any claim or defense in the case.**

Response: Applicant directs Respondent's attention to his answer to Request for Production No. 1.

10. **Any and all documents created and/or used by physicians, psychologists, psychiatrists, mental health providers, social workers, mitigation specialists, or any health**

care providers who have treated, evaluated, or visited the Applicant, and all hospitals or mental health institutions to which the party has been committed (this includes voluntary and involuntary treatment or evaluation) in connection with this Post-Conviction Relief action and the underlying criminal offenses which gave rise to it.

Response: Applicant objects to this request to the extent that it is overbroad and seeks irrelevant information not related to any claim in this PCR. Subject to this objection, Applicant responds that he will produce responsive documents in his possession related to any claim in this PCR. *See* Applicant's Response to Request for Production No. 1.

11. **Any and all documents, correspondence, reports, affidavits, statements, or any other information which has been provided to any expert that the Applicant intends to call as a witness at the PCR hearing.**

Response: Applicant directs Respondent's attention to his answer to Request for Production No. 3.

12. **Any and all documents, correspondence, reports, affidavits, statements, photographs, diagrams, and drawings obtained from persons known to the parties or counsel that Applicant intends to call at the PCR hearing or depose for substantive admission into evidence in this matter, who have information or knowledge of unpresented or allegedly improperly presented evidence that would be relevant to the guilt or innocence phase of a capital trial, regardless of whether Applicant intends to call the person at the PCR hearing or depose the person for substantive admission into evidence in this matter. This includes any persons or sources relied on by a social worker, investigator, mitigation specialist, or mental health expert whom Applicant intends to call at the PCR hearing or depose for substantive admission into evidence in this matter.**

Response: Applicant objects to this request because it is unreasonably vague and ambiguous.

13. **Any and all documents, correspondence, reports, affidavits, statements, photographs, diagrams, and drawings obtained from persons known to the parties or counsel that Applicant intends to call at the PCR hearing or depose for substantive admission into evidence in this matter, who have information or knowledge of unpresented or allegedly improperly presented evidence that would be mitigating in a capital sentencing phase, regardless of whether Applicant intends to call the person at the PCR hearing or depose the person for substantive admission into evidence in this matter. This includes any persons or sources relied on by a social worker, investigator, mitigation specialist, or mental health expert whom Applicant intends to call at the PCR hearing or depose for substantive admission into evidence in this matter.**

Response: Applicant objects to this request because it is unreasonably vague and ambiguous.

14. **Any and all documents, correspondence, reports, affidavits, statements, photographs, or any other documentary or physical evidence or information obtained from persons known to the parties or counsel who have information or knowledge of evidence that the State suppressed evidence that was material and exculpatory or impeaching, regardless of whether Applicant intends to call the person at the PCR hearing or depose the person for substantive admission into evidence in this matter. This includes any persons or sources relied on by a social worker, investigator, mitigation specialist, or mental health expert whom Applicant intends to call at the PCR hearing or depose for substantive admission into evidence in this matter.**

Response: Applicant objects to this request to the extent that it is vague and overbroad and seeks irrelevant documents not related to any claim in the PCR. Subject to this objection, Applicant directs Respondent to his answer to Request for Production Nos. 1 and 3.

Respectfully submitted,

By: John R. Mills

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
900 Elmwood Avenue
Suite 101
Columbia, South Carolina 29201
(803) 765-1044

JOHN R. MILLS
Attorney at Law
201 W. Main Street
Suite 301
Durham, NC 27701
(919) 251-6259

Counsel for applicant.

June 1, 2012

STATE OF SOUTH CAROLINA COUNTY OF HORRY Louis Michael Winkler, Jr., #6027, Applicant, v. State of South Carolina, Respondent.	IN THE COURT OF COMMON PLEAS *Case No. 2011-CP-11-3907* **Respondent's Updated Responses to Applicant's Request for Production of Documents**

To: Emily C. Paavola, Esquire, Death Penalty Resource & Defense Center, 900 Elmwood Ave., Ste. #101, Columbia, SC 29201

John R. Mills, Esquire, 201 West Main St., Ste. # 301, Durham, NC 27701

Pursuant to Rule 26 and 34, SCRCP, Respondent, through undersigned counsel, hereby responds to Applicant's Request for Production of Documents:

1. **Any and all documents or correspondence provided to Respondent which relate to a claim that has been raised in this case or a defense that respondent intends to make to any of applicant's claims. Documents that have been provided to Respondent by the Applicant are excluded from this request.**

Documents obtained from the Fifteenth Circuit Solicitor's Office are enclosed. Counsel for Respondent is still awaiting documents that are currently being reviewed by trial counsel. If Respondent is provided with documents or correspondence in the future that relate to a claim or defense in this case, Respondent will supplement this response accordingly.

2. **The reports and/or summaries of any experts who are expected to testify for Respondent at the post-conviction relief hearing, and any documents, notes, files, reports, tests and or other written or recorded materials upon which the expert has relied in reaching his or her opinion.**

The reports/summaries and written materials that were created by and relied upon by Mr. Paavel were those provided by SLED in response to Applicant's subpoena served on January 27, 2012. To date, Mr. Paavel has not indicated there are any additional materials. If Mr. Paavel provides any additional materials, Respondent will provide it to Applicant when Respondent receives it from Mr. Paavel. Respondent is also awaiting documents that are currently being reviewed by trial counsel. If Respondent is provided with documents requested by this request from trial counsel, Respondent will supplement this response accordingly.

3. **A current *curriculum vitae* of all experts expected to testify for Respondent at the post-conviction relief hearing.**

As of the date of this response, Respondent does not have a current curriculum vitae for Mr. Paavel. However, he testified to his qualifications during Applicant's criminal trial. (See R. 1757-60). If Respondent determines any other expert needs to testify in relation to any allegations raised after the date of this response, Respondent will supplement this response accordingly.

Respectfully submitted,

ALAN WILSON
Attorney General

JOHN W. MCINTOSH
Chief Deputy Attorney General

DONALD J. ZELENKA
Senior Assistant Deputy Attorney General

ALPHONSO SIMON JR.
Assistant Attorney General

P. O. Box 11549
Columbia, South Carolina 29211
(803) 734-6305

BY: _____
ALPHONSO SIMON JR.
ATTORNEYS FOR RESPONDENT

June 1, 2012
Columbia, South Carolina

STATE OF SOUTH CAROLINA COUNTY OF HORRY Louis Michael Winkler, Jr., #6027, Applicant, v. State of South Carolina, Respondent.	IN THE COURT OF COMMON PLEAS Case No. 2011-CP-11-3907 **CERTIFICATE OF SERVICE**

I, Alphonso Simon, Jr., counsel for the Respondent, certify that I have served the Respondent's Responses to Applicant's Request for Production of Documents and Respondent's Responses to Applicant's Interrogatories by U.S. mail, first class, postage prepaid, addressed to:

Emily C. Paavola, Esq.
Death Penalty Resource & Defense Center
900 Elmwood Ave., Ste. #101
Columbia, SC 29201

John R. Mills, Esq.
201 West Main St., Ste. # 301
Durham, NC 27701

This 1st day of June, 2012.

ALPHONSO SIMON, JR.

STATE OF SOUTH CAROLINA	IN THE COURT OF COMMON PLEAS
COUNTY OF HORRY	Case No. 2011-CP-26-03907
Louis Michael Winkler, Jr. Applicant, vs. State of South Carolina, Respondent.	**APPLICANT'S MOTION TO LIMIT SCOPE OF CROSS-EXAMINATION**

Applicant, Louis Michael Winkler, Jr., (hereafter, "Winkler") offers his attached affidavit as his direct testimony and moves this Court to limit any cross-examination to the subject matters contained in the affidavit. In support of this motion, Winkler apprizes this Court of the following relevant facts and points of law.

RELEVANT FACTS

This case is scheduled for an evidentiary hearing to begin on June 18, 2012. Winkler seeks post-conviction relief from his capital convictions and sentence. His Second Amended Application for Post-Conviction Relief asserts that his trial attorneys, Ralph Wilson and Paul Rathbun, provided ineffective assistance of counsel for, among other things, failing to protect his Sixth Amendment right to proceed *pro se* at trial. *See* Second Amended Application, Ground 10 & 11(a)(1). Moreover, the Application alleges that the trial court violated Winkler's constitutional right to self-representation by refusing to permit him to discharge Wilson and Rathburn after Winkler made a pre-trial request to discharge appointed counsel and proceed *pro se*. *See id.* at Ground 10 & 11(c). On at least two occasions prior to trial, Winkler informed the trial judge that he wished to exercise his constitutional right to self-representation. These discussions were not recorded. The trial judge neither denied these particular requests on the

record nor made any findings on the record regarding these requests. Thus, Winkler seeks to introduce his own testimony for the limited purpose of establishing that these conversations occurred and that his requests to proceed *pro se* went unheeded. Winkler now moves, *in limine*, that this Court limit any cross-examination of him to this this particular subject area.

ARGUMENT

I. THE FIFTH AMENDMENT PRIVILEGE AGAINST SELF-INCRIMINATION APPLIES IN POST-CONVICTION.

The Fifth Amendment, which is applied to the states through the Fourteenth Amendment, *Mallow v. Hogan*, 378 U.S. 1, 6 (1964), commands that "[n]o person . . . shall be compelled in any criminal case to be a witness against himself." U.S. Const. amend. V. This amendment grants individuals the privilege of refusing to answer any official questions in any civil or criminal, formal or informal proceeding where the answer might incriminate the individual in future proceedings. *Lefkowitz v. Turley*, 414 U.S. 70, 77 (1973). Generally, a defendant who is convicted of and receives a sentence for a crime no longer has a Fifth Amendment privilege when he can no longer be incriminated by testimony related to that crime. *See Reina v. United States*, 364 U.S. 507, 513 (1960) (noting that there is "weighty authority" for the proposition that "once a person is convicted of a crime, he no longer has the privilege against self-incrimination"). The privilege does apply, however, when a defendant exercises a right to appeal the conviction and still risks potential self-incrimination that could be used against him at a retrial or a resentencing. *See Taylor v. Best*, 746 F. 2d 220, 222 (4th Cir. 1984) (noting that in the situation in which post-conviction incriminating evidence could possibly be used against a convicted defendant who was in the midst of an appeal, the *Reina* rule does not apply). The likelihood that an incriminating statement will be suppressed at a later proceeding does not

negate the State's violation of a defendant's Fifth Amendment privilege in the original course of questioning. *Id.* at 224.

Because Winkler risks providing testimony at the evidentiary hearing that could be used against him in a subsequent retrial or resentencing, and because the State does not have an alternative legitimate interest in asking Winkler questions about the facts underlying his conviction, this Court should recognize Winkler's Fifth Amendment privilege during the evidentiary hearing. A defendant is constitutionally entitled to remain silent during his appeals process when he might provide incriminating statements that could be used against him after a successful appeal and when the State does not offer specific, direct, and narrow questions related to a legitimate alternative purpose other than determining whether the defendant did or did not commit the criminal act. *See Taylor*, 746 F. 2d at 222-226; *Uniformed Sanitation Men Ass'n v. Commissioner of Sanitation of New York*, 392 U.S. 280, 285 (1968). In *Taylor*, the Fourth Circuit addressed the actions of a prison disciplinary committee that had punished Taylor for refusing to answer a prison psychologist's questions about the crime Taylor had been convicted of committing. The psychologist asked Taylor the questions while Taylor was in the midst of his appeal. The Fourth Circuit Court of Appeals found that Taylor retained a Fifth Amendment privilege in such a situation. *Taylor*, 746 F. 2d at 222. However, because the State had the clear alternative purpose of discovering Taylor's custodial and rehabilitative needs, the court found that Taylor's Fifth Amendment privilege would only arise if and when the State tried to use the psychologist's evaluation in a subsequent criminal proceeding. *Id.* at 224. In *Uniformed Sanitation Men v. Ass'n v. Commissioner of Sanitation of New York*, however, the Court found that New York sanitation workers had refused to answer questions that could expose them to criminal prosecution and that were not otherwise "specifically, directly, and narrowly" related to

the workers' job duties. 392 U.S. 280, at 284. The court held that the workers could not be discharged for refusing to answer the questions regardless of whether the statements would have actually been used against them in a subsequent criminal proceeding. *Id.* at 284. As in *Taylor*, Winkler's participation in answering state inquiries about the crime puts him at risk of providing self-incriminating material that can be used against him in his ongoing criminal matter. Unlike the State psychologist in *Taylor*, in this case the State has no alternative purpose in questioning Winkler about the facts underlying the crime he was convicted of committing. Instead, the State's only purpose in questioning Winkler about the facts underlying the crime, as in *Uniformed Sanitation*, would be to attempt to further develop a criminal case against him that could be used at a retrial or resentencing.

II. THIS COURT SHOULD LIMIT ANY CROSS-EXAMINATION TO THE SCOPE OF WINKLER'S DIRECT EXAMINATION TO PROTECT WINKLER'S RIGHT TO TESTIFY ON COLLATERAL MATTERS WITHOUT FULLY WAIVING HIS PRIVILEGE AGAINST SELF-INCRIMINATION.

An individual does not completely waive a Fifth Amendment privilege by testifying solely on collateral or preliminary matters. *See Simmons v. United States*, 390 U.S. 377, 394 (1968) (holding that a defendant's testimony at a Fourth Amendment suppression hearing could not be used against him at trial unless he did not object). A defendant's limited testimony that is necessary to guarantee that he is afforded the other benefits of the Bill of Rights does not fully waive his Fifth Amendment privilege against self-incrimination. *See Id.* at 392 (finding that it was intolerable that when the trial court could have limited cross-examination to the issues of the suppression hearing that "one constitutional right should have to be surrendered in order to assert another").

Winkler does not waive his Fifth Amendment privilege against self-incrimination regarding the facts underlying his conviction by providing testimony strictly limited to his

attempts to exercise his Sixth Amendment right to represent himself at trial. Courts, whenever possible, should not force a defendant to sacrifice one constitutional right in order to assert another. *Id.*

For example, the Supreme Court has protected a defendant's Fifth Amendment privilege when the defendant testified for the limited purpose of asserting his Fourth Amendment right to be free from unreasonable search and seizures. In *Simmons v. United States*, the defendant gave pretrial testimony in an attempt to assert a Fourth Amendment claim that certain State evidence was the inadmissible product of an illegal search and seizure. *Id.* at 389. The State then used this testimony against the defendant at trial. *Id.* The Supreme Court held that the prosecution could not use the defendant's testimony, which was limited to the Fourth Amendment claim, against the defendant at trial unless the defendant did not object, because it created an "undeniable tension" between the defendant's exercise of his Fourth and Fifth Amendment rights. *Id.* at 393.

The Second Circuit has recognized that a defendant does not fully waive his Fifth Amendment privilege by attempting to exercise a Sixth Amendment right to appointed counsel. In *United States v. Branker*, the government introduced testimony that the defendant had given at a preliminary hearing for the purpose of establishing a right to appointed counsel. 418 F. 2d 378, at 380 (2nd Cir. 1969). The court held that the State impermissibly used the testimony against the defendant, and it noted that the defendant should "enjoy his constitutional rights to counsel . . . without running the risk that thereby he may be incriminating himself." *Id.* at 380.

Multiple states have also recognized that a court commits error when it allows the prosecution to cross-examine a defendant about the underlying facts of a case when the defendant testifies at a pretrial hearing for the limited purpose of establishing that a confession

was involuntary and not in accord with Due Process under the Fourteenth Amendment. For example, in *McCain v. State*, the Texas Court of Appeals held that the trial court committed an error when, at a hearing on a motion to suppress, the court allowed the prosecutor to ask the defendant whether he was in a car and whether he pulled up alongside and shot at another car. 995 S.W.2d 229, 235-42 (Tex. App. 1999) (holding that the error committed by the trial court was harmless). In *Marshall v. State*, the Georgia Supreme Court recognized that the trial court erred by not limiting cross-examination during a *Jackson v. Denno* hearing (a pretrial hearing to determine the issue of voluntariness of a confession). *See* 266 Ga. 304, 305-306 (1996). The Supreme Court of Mississippi, in *Powell v. State,* noted that the extensive cross-examination of the defendant at a *Jackson v. Denno* hearing concerning the truthfulness of the defendant's out of court statement was impermissible. 540 So. 2d 13, 15-16 (Miss. 1989). The Supreme Court of Kansas, in *Kansas v. Bogguess*, found that a defendant may take the stand for the limited purpose of testifying about whether a statement was voluntarily made while still maintaining a Fifth Amendment privilege in regards to questions that go to the substance of the out of court statement. 268 P.3d 481 (Kan. 2012) (finding that the trial court erred when the court struck the defendant's testimony at the suppression hearing after the defendant refused to answer questions about events that were the bases of the charged crimes). There is no material distinction between a defendant's testimony at a suppression hearing and the testimony applicant intends to present in this case. In both instances, the testimony is unrelated to the facts of the crime and it is offered to demonstrate the denial of a constitutional right.

Tennessee is an example of a state that recognizes this principle and has adopted a clear rule that gives a defendant the right to testify at a post-conviction evidentiary hearing without being forced to face cross examination regarding the facts underlying the crime for which a

defendant has been convicted. In *Keough v. State*, the Tennessee Supreme Court addressed its post-conviction Rule 28 §8(C)(1)(d), which states, "[u]nder no circumstances shall petitioner be required to testify regarding the facts of the conviction which the petition attacks unless necessary to establish the allegation of the petition or necessary to the state's attempt to rebut the allegations of the petition." 356 S.W.3d 366, 366 (Tenn. 2011). Applying this Rule, the Tennessee Supreme Court vacated a decision and remanded a case for a hearing with limited cross-examination after the hearing judge denied the defendant's motion to limit cross-examination at the evidentiary hearing to the issue of ineffective assistance of counsel and the defendant subsequently chose not take the stand. *Id.* at 368, 373.

Winkler faces a situation that is similar to those faced by the defendants in the previously mentioned cases: in order to assert his constitutional claim, Winkler must offer testimony related to a particular fact-bound experience that is entirely separate from any of the facts of the crime he was convicted of committing. Specifically, Winkler seeks to offer testimony about his prior, unrecorded requests to the trial judge that he be allowed to represent himself. If the Court allows the State to cross-examine Winkler beyond the scope of this testimony, then the Court will force him to abandon his Fifth Amendment privilege in order to attempt to exercise the protections of the Sixth Amendment. If Winkler must avoid testifying in order to maintain his Fifth Amendment Privilege, he cannot prove his Sixth Amendment claim, because his requests and the judge's denials are not reflected by the record. This is the same "undeniable tension" that the Court in *Simmons* avoided by limiting the State's ability to undermine a defendant's Fifth Amendment privilege when the defendant attempts to claim another constitutional protection.

Therefore, the Court should limit the State's cross-examination to the scope of Winkler's affidavit, the factual circumstances regarding his requests to represent himself at trial, in order to protect Winkler's access to all of his constitutional rights.

CONCLUSION

For all of the reasons stated above, Winker respectfully requests that the Court limit any cross-examination by the State at the evidentiary hearing to the scope of Winkler's direct testimony, offered in his affidavit, in order to allow him to assert his Sixth Amendment claim while maintaining his Fifth Amendment privilege against self-incrimination.

Respectfully submitted,

6/4/2012
DATE

Emily C. Paavola

JOHN R. MILLS
Law Offices of John R. Mills, NPC
201 W. Main Street, Suite 301
Durham, NC 27701
919-251-6259

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
900 Elmwood Ave., Suite 101
Columbia, SC 29201
803-765-1044

ATTACHMENT A

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF DORCHESTER)

Louis Michael Winkler, who appeared personally before me, affirms and states the following:

1. I was represented by Paul Rathbun and Ralph Wilson in connection with my 2008 capital trial.

2. As we prepared for trial over the course of 2006 and 2007, my lawyers and I attended several pre-trial meetings and hearings with the judge. At several of these meetings, I informed the trial judge that I wished to represent myself. I specifically remember telling the trial judge that if he would not appoint new attorneys for me, then I wanted to represent myself.

3. When I first made this request, the trial judge was dismissive and suggested that this was an issue that could be addressed at a later date. When I continued to say that I wanted to represent myself at later meetings, the trial judge simply said that he had already considered that, and we had already been through it, and my request was denied.

4. Prior to trial, the judge never advised me that I had a right to represent myself. He did not explain that it was my decision to make, and he did not discuss with me the pros and cons of self-representation.

5. I told the trial judge that I wanted to represent myself on several occasions. I do not remember the dates of all of these occasions, but I specifically remember telling him this at a hearing in Conway, South Carolina on July 3, 2007, after the trial judge denied my request to remove Paul Rathbun as my attorney. I also specifically remember telling the judge that I wanted to represent myself at a hearing in Dillon, South Carolina on December 13, 2007.

I affirm, under the penalty of perjury, that the foregoing is true and correct to the best of my knowledge. Further affiant sayeth naught

Louis M. Winkler
LOUIS MICHAEL WINKLER

Sworn to and subscribed before me
This 25th day of May, 2012

John R Mills
Notary Public for the State of South Carolina
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

STATE OF SOUTH CAROLINA	)	
	)	IN THE COURT OF COMMON PLEAS
COUNTY OF HORRY	)	11-CP-26-03907
	)	
LOUIS MICHAEL WINKLER, JR. SK6027	)	
Applicant,	)	
vs.	)	**CERTIFICATE OF SERVICE**
STATE OF SOUTH CAROLINA,	)	
Respondent.	)	
	)	

The undersigned certifies that a copy of the foregoing Applicant's Motion to Limit Scope of Cross-Examination, was served by first class United States mail, postage prepaid, this 4th day of June, 2012, upon the following:

Alphonso Simon, Jr.
Assistant Attorney General
P.O. Box 11549
Columbia, SC 29211

Jill A. Rider

Jill A. Rider

STATE OF SOUTH CAROLINA COUNTY OF HORRY Louis Michael Winkler, Jr. Applicant, vs. State of South Carolina, Respondent.	IN THE COURT OF COMMON PLEAS Case No. 2011-CP-26-03907 **APPLICANT'S NOTICE OF INTENT TO RELY ON AFFIDAVITS**

Applicant, Louis Michael Winkler, Jr., hereby informs the Court and opposing counsel that he intends to offer proof in support of his post-conviction relief claims through affidavits of certain defense witnesses in lieu of direct examination of those witnesses at trial. In support of this notification, applicant apprizes this Court of the following relevant facts:

1. Applicant is an indigent, death-sentenced inmate in South Carolina. He was convicted and sentenced to death in Horry County. *State v. Winkler*, 388 S.C. 574, 698 S.E.2d 596 (2011). He is currently seeking post-conviction relief.

2. In support of his application for post-conviction relief, applicant intends to rely upon affidavits provided by certain defense witnesses in lieu of conducting direct examination of those witnesses at trial. This procedure is authorized pursuant to S.C. Code § 17-27-80, which provides that, in a hearing on an application for post-conviction relief, "[a]ll rules and statutes applicable in civil proceedings are available to the parties. The court may receive proof by affidavits, depositions, oral testimony or other evidence and may order the applicant brought before it for hearing." Furthermore, this procedure has been used in numerous capital post-conviction cases. *See, e.g., Herman Lee Hughes v. Michael Moore*, 98-CP-09-101 (Calhoun County); *Joseph M. L. Gardner v. Michael Moore*, 98-CP-18-453 (Dorchester County); *Keith L.*

Simpson v. Michael Moore, 97-CP-42-1911 (Spartanburg County); *Kenneth Simmons v. State*, 05-CP-18-1368 (Dorchester County); *Kevin Mercer v. State*, 09-CP-32-5465 (Lexington County). The South Carolina Supreme Court has specifically approved this process. *See Simpson v. Moore*, 367 S.C. 587, 607-08, 627 S.E.2d 701, 712 (2006) (finding that the PCR court did not err in allowing the applicant to introduce over forty depositions and approximately twenty-two affidavits into evidence in lieu of live testimony); *see also, Beckett v. State*, 278 S.C. 223, 224, 294 S.E.2d 46, 47 (1982).

3. Moreover, this process is in no way prejudicial to the State's case. By employing this procedure, applicant seeks to expedite the hearing and eliminate the need for live testimony – or at least live direct testimony – from a number of relatively minor witnesses. By being provided with their direct testimony weeks in advance of the hearing, the Attorney General will, in fact, have an improved opportunity to consider the witnesses' direct testimony and make an informed decision about whether to cross-examine those witnesses than if the witnesses were called for direct examination at the evidentiary hearing.

4. Undersigned counsel have previously provided counsel for respondent with photocopies of all of the affidavits they currently intend to admit. Applicant hereby provides both counsel for the respondent and the Court with copies of all of the affidavits presently in his possession that he intends to admit, attached cumulatively hereto as Attachment A.

5. Of course, applicant acknowledges that the Attorney General has the prerogative to call any or all witnesses who have provided affidavits or other documentary evidence for purposes of cross-examination. Whether to do so is completely within the Attorney General's discretion.

WHEREFORE, applicant requests that the Court accept the affidavits and other documentary evidence provided by certain defense witnesses in lieu of a direct examination of those witnesses at trial.

6/4/2012
DATE

Emily C. Paavola

JOHN R. MILLS
Law Offices of John R. Mills, NPC
201 W. Main Street, Suite 301
Durham, NC 27701
919-251-6259

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
900 Elmwood Ave., Suite 101
Columbia, SC 29201
803-765-1044

ATTACHMENT A

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Philip Randall, who appeared personally before me, affirms and states the following:

1. I was a juror in Mr. Louis Michael Winkler's trial.

2. During the penalty phase, deliberations were slow. We were initially split eight to four. Three women and the African American man were in the minority. I was in the majority along with seven others.

3. As part of the deliberations we discussed the facts of the crime, including whether Mr. Winkler intended to kill J[redacted] G[redacted], the only eyewitness. Chris Trout, the jury foreman, and one other juror explained to us that each of them had some prior knowledge and experience with guns. Based on that, he knew that the gun in question was cheap and given to jamming. He called it a piece of junk.

4. During deliberations we also discussed the prospect of Mr. Winkler getting out of prison. The deliberations were taking a long time, and the two sides were somewhat entrenched. One of our concerns was that if we did not reach a unanimous decision in the sentencing phase we did not know whether he would go free. This concern motivated us to reach a unanimous verdict.

5. As deliberations wound down, it was clear that there was one hold out, the short African American man. It seemed that nothing would change his mind. I wandered if the comfort of the nice meals and the jury service paycheck led to him sticking to his guns. We were frustrated that the verdict might not be unanimous and were determined that it not end as a hung jury. We felt like we had to turn up the heat. The foreman of the jury and I stood on either side of him and made him look at the autopsy photos. It was

PR

important to us for him to see what Mr. Winkler had done. The hold out kept saying that he wanted the killing to end and, therefore, did not want to give death. We reminded the him man that he had told the judge that he was willing to give death and that, therefore, his objection did not make sense. When the judge polled the jury, there was almost a sigh of relief when he said that he supported verdict.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

PHILIP RANDALL

Sworn to and subscribed before me
This 14th day of January, 2011

Notary Public for the State of North Carolina John R. Mills
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

PR

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

TeAnne Oehler, who appeared personally before me, affirms and states the following:

1. My name is TeAnne Oehler. I am a clinical social worker and psychotherapist. I have a Masters Degree in Social Work from the University of North Carolina at Chapel Hill. My business address is 1601 Oak Street, Myrtle Beach, SC 29577.

2. I was retained in the Louis Michael Winkler case by his attorney, Ralph Wilson. My role was to prepare a psycho-social evaluation and testify about my findings. I testified in the penalty phase of Mr. Winkler's 2008 capital trial.

3. No specific penalty-phase theory was ever articulated to me from anyone on the defense team. My instructions were basically to just let them know if I found any mitigation.

4. I told Mr. Winkler's attorneys that they should get a neuropsychologist to evaluate Mr. Winkler because he has a history of head injury with loss of consciousness. It is my normal practice to recommend such an evaluation in any case where there is evidence of a possible head injury. Mr. Winkler's attorneys thought that I could testify about those issues myself, but I explained to them that brain damage is not my area of expertise. To my knowledge, no neuropsychological evaluation was ever performed on Mr. Winkler.

I affirm, under the penalty of perjury, that the foregoing is true and correct to the best of my knowledge. Further affiant sayeth naught

TEANNE OEHLER, LISW

Sworn to and subscribed before me
This 31 day of May, 2012

Notary Public for the State of South Carolina
My commission expires: 2/1/2021

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF CHARLESTON)

Vicki Childs, who appeared personally before me, affirms and states the following:

1. My name is Vicki Childs. My work address is P.O. Box 21297, Charleston, South Carolina 29413. I was retained to work as a private investigator on Louis Michael ("Mick") Winkler's case. My role was to serve as a fact investigator only. I was not serving as a mitigation investigator.

2. I primarily did fact interviews relating to the guilt-or-innocence phase of the case, collected documents, and other miscellaneous tasks. I did whatever I was directed to do by the trial attorneys. I was not asked to talk to witnesses about the possibility that Mick was suicidal near the time of the crime. I was not asked to investigate anything related to mental illness or Mick's mental state. These tasks would have been more appropriate for a mitigation investigator to do, which was not my role in the case.

I affirm, under the penalty of perjury, that the foregoing is true and correct to the best of my knowledge. Further affiant sayeth naught

VICKI CHILDS

Sworn to and subscribed before me
This 30 day of May, 2012

Notary Public for the State of South Carolina
My commission expires: 9-21-20

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Stephen Fitzwater, who appeared personally before me, affirms and states the following:

1. Mick Winkler lived across the street from me when I lived with my foster sister, foster mother, and foster ~~stepfather~~ brother-in-law - S.F. Frank Paterson.

2. I did not know Mick well until after he was confined to his house on home detention. During that time he was very depressed. He would make insinuations about committing suicide. He would refer to ending it. My step-brother and a couple of my friend's would try to get him to play basketball since it was about the only thing he could do without leaving the area his ankle monitor would require him to stay in. We played with him mostly because we felt sorry for him.

3. His ex-wife would sometimes come around, and this would be very upsetting to Mick. He got me to video her. It was weird to video her, but it was also weird that she would come by and park just outside of Mick's allowed area.

4. Prior to trial, I was not contacted by anyone from Mick's defense team. If I had been asked by Mick's trial attorneys, I would have been willing to testify to the information in this statement.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

Stephen Fitzwater
STEPHEN FITZWATER

Sworn to and subscribed before me
This 24th day of May, 2012

John R Mills
Notary Public for the State of North Carolina
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Pat White, who appeared personally before me, affirms and states the following:

1. Mick Winkler and I have known each other since the early 1990s. I moved to Myrtle Beach in 1989.

2. I first met Mick at a New Year's party in the early 1990s. Mick lived in North Carolina at the time, and we exchanged phone numbers. We called each other a couple times each week and became friends.

3. Mick was interested in moving to Myrtle Beach, and I helped him find a job at Kingston Plantation, where I worked putting together golf packages.

4. Mick needed help getting on his feet, and I was like a mother to him. I allowed Mick to live with me while he was getting settled. Mick could not manage money for ten minutes. I was always on him to do better with it. He didn't even have a bank account. Mick would often end up giving away a lot of what little money he had by hosting friends. He was a great cook, and he loved to have friends over, even if he barely knew the people. He was desperate for affirmation and he would take it from anyone who gave it to him.

5. The two houses Mick eventually got and lived in on his own were both purchased by his father. The same is true of Mick's truck. Mick was proud of his house. He added a deck and pool to the house he and Becky shared. Even so, if it weren't for his father, Mick would not have had a thing in the world.

6. While Mick lived at my place, he was very helpful. He made significant renovations, helped around the house, and did anything I asked of him. He planted

PW

flowers that are in my garden even today. He also put up the gutters on my house and put the siding and roof on the shed in my back yard.

6. In the summer of 1994 Mick was still living with me. He had gone out with some of his friends from Kingston Plantations, where he worked. Mick got hit hard in the head with a bottle, and it knocked him out. I got a call very late, around 2:00 a.m. When I saw Mick he had his head totally split open on the front of his forehead. He tried to get up off the table in the hospital room, but he slumped all the way down to the floor. The doctors said to keep him from sleeping, but he was groggy and sleepy for several days after it happened. He was very embarrassed over the injury, and he would hide in the passenger seat of my car when I took him places. He didn't want people to see the bandages. I don't know if it gave him long-term damage, but getting hit in the head like that really did a number on Mick.

7. Sometime after Mick moved out, he gave me his dog, Buster, as a gift. Buster was the puppy of Mick's prior dog. Mick took to Buster in particular because Buster was smaller than the other puppies in the litter, and he wanted to look after him and protect him. Mick enjoyed playing ball with Buster. He also had a cat named Mariah. She would lie on the back of his sofa and rule the roost. When I went out of town, Mick would look after my dog. I would do the same for the dog he and Becky shared. Mick loved animals and enjoyed looking after them.

8. Mick was a hard worker. He would go in to work even when he was sick. He was proud of his job, and he wanted to do well at it. He loved the job at Tilghman Lakes, and the people at Tilghman loved him. He would help the condo owners who couldn't do things for themselves. He did repair work and painted decks and balconies, even though

PW

none of that was his job as the maintenance man. He was just responsible for the grass and the pool. The condo owners really liked him and gave him Christmas gifts. He also liked the work. If he were sick, he would insist on going to work. He was adamant about going to work every day. He also sought out additional responsibilities at work. When he started at Tilghman, it was only his job to mow the grass and take care of the pools. But he sought out, and obtained, responsibility for treating the property for pests. He took pride in his work.

9. When Mick was on house arrest, I would stop by to check in on him. I was worried about him. He did not have any money, and he was pretty depressed. Sometimes when I went by, the refrigerator would be totally empty. I would buy him groceries and share the fish I caught with him because I wanted him to have something to eat.

10. Another time he called and was very down in the dumps. I thought seeing his old dog, Buster, might make him feel better. Buster was getting older, and she was having some problems with her legs. I had been giving her some medication. Somehow Buster got injured as I was putting her in the car to take her to Mick's. When Mick saw Buster, he was thrilled. That night, the dog got up, and as she was walking around, she fell over and could not get up. Mick called me first thing the next morning and—because he was on home detention—asked me to take Buster to the vet. I took Buster to Kind Care, and they had to put Buster down. When Mick found out, he was devastated. He cried and cried. He wondered what else could go wrong in his life.

11. Around Christmas, while he was still on home detention, Mick called and asked me to come over and bake my Christmas cookies with him. He was very down, and he

PW

was seeking company so he might feel better. I had made Christmas cookies every year when we lived together, and they were something he liked. They were simple to make, and I was happy to bring over the ingredients. It was fun to show him how to make the cookies and try to get Mick back to his old self.

11. But Mick was in tough shape. For a while, he did not have access to a phone. When I visited Mick, he would be pacing up and down the floor and moving the whole time we talked. Mick normally kept a clean house, but while he was on home detention, he took it to the next level. He had washed the walls, the woodworks, the floors, and every inch of the house. The house was spotless. I had never seen anything like it. Mick was not well. He had lost his job, his car, his family, and even his dog. He had no money and his friends had abandoned him. He seemed to be going further downhill every day. He was pitiful and was trying to maintain control over what little he still had, a clean house. He might have been suicidal. I visited Mick because I was very worried about him.

12. Becky did not make things any easier for Mick while he was on home detention. She would come by his house with her mother. She was taunting Mick. It got him really upset. Mick even showed me photos of Becky in her car that her neighbor had taken. She was running around, and he was stuck at home and could not go anywhere.

13. Becky also tried to manipulate me. She called me and tried to turn me against Mick. I do not understand why she would have done that because she did not even know me. It was like she was trying to further isolate him.

14. Mick was losing at every turn. I know how catastrophic that can be and make you feel. I believe he went crazy that day.

PW

15. Before Mick's trial, I talked with Ralph Wilson on the phone, and I met with Carolyn Graham. They did not explain how a death penalty trial works or that if I had been called to testify, how the information in this affidavit would have been helpful. They did not explain that the penalty phase was not about whether Mick had committed a death penalty eligible crime, only what the appropriate punishment was, including whether there is a reason to show him mercy. If Mick's trial attorneys had explained this to me, I would have been willing to testify in the penalty phase to the information in this statement. Even if they had not explained the process to me, I would have been willing to sign an affidavit to the information contained in this affidavit.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

Pat White
PAT WHITE

Sworn to and subscribed before me
This 29th day of May, 2012

Notary Public for the State of North Carolina
My commission expires: 5/30/2016

PW

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Frank Patterson, who appeared personally before me, affirms and states the following:

1. I lived across the street from Mick Winkler when he lived on [redacted] in Little River, SC. At first I was just neighbors with Mick, but we became friends.

2. My wife at the time and I would go over to Mick's place, and Mick and his wife, Becky, would come over to ours. My ex-wife and I enjoyed spending time with them.

3. Becky moved out of Mick's place in September, but she still came to the neighborhood pretty often to see Mick. I assumed they were in the process of working out their differences.

4. After the incident in October, Mick was in tough shape. Many of his neighbors stopped socializing with him. My stepson and foster brother-in-law and a couple of their friends felt sorry for him, so they would play basketball with him close enough to his house that his ankle monitor would not go off. I would periodically go by his house just to see if he was alright. He would run out of money and at times go a day or two without eating. I told him that if he was without food, he should just join my family and me. We happily provided him with a plate of food when we realized he did not have any. Mick was depressed and trapped.

5. I was surprised when I saw Becky start showing up in the neighborhood again after the October incident. Instead of going to Mick's house though, she would drive around the neighborhood and then park just outside the range of the ankle monitor. I do not know why she did this, but it tore Mick up when she did. At some point, my ex-wife's mother had my stepson video Becky's driving around. Nothing excuses what

FP

Mick did, but it just did not seem right that she behaved that way.

6. When I visited Mick, we would talk about his situation. He was shocked by the allegations related to the October charge, and he professed his love for Becky. At times he would be mad, but he never spoke of violence. He was mostly depressed. He talked about killing himself. I did not know he had a gun, but I would have assumed he would have used it on himself if he did. Mick was very depressed.

7. If I had been asked by Mick's trial attorneys, I would have been willing to testify to the information in this statement.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

FRANK PATTERSON

Sworn to and subscribed before me
This 1st day of May, 2012

Notary Public for the State of North Carolina
My commission expires: 5/30/2012

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

FP

STATE OF OHIO)
) AFFIDAVIT
COUNTY OF WAYNE)

Edward Genet, who appeared personally before me, affirms and states the following:

1. I currently reside at [redacted].

2. I am a childhood friend of Louis ("Mick") Winkler. We attended school together at St. Peter and St. Paul's Catholic School from kindergarten through eighth grade. We also played football together for all four years at Chippawa High School.

3. Mick was a great kid who loved the outdoors. We spent a lot of time together doing outdoor activities like hiking and biking. My parents were also good friends with Mick's parents and we did family activities together.

4. Mick was always very polite and respectful to people. Even as a kid, he would make a point to say hello to my parents and ask how they were doing when he came over. Mick has always been very meticulous about being clean. His closet was always neat and orderly. Even when he was very young, he would play with a toy and then put it back in the box and clean up afterwards.

5. Mick is very family oriented. He has always loved holidays and birthdays. Spending time with his family is very important to him. He is very close to his family and he loves them a lot. Mick seemed very troubled by his parents' divorce. I think he took it especially hard because family was so important to him.

6. I kept in touch with Mick after he moved away from Ohio. He would call me a couple of times each year. He always made a point to call me on my birthday. I would take my family on vacation to South Carolina and visit Mick.

7. I visited Mick in South Carolina once when he was married to Denise. Mick seemed very involved with Denise's son. He spent a lot of time with him doing outdoor stuff. Mick was also very good with my two kids. They called him "Uncle Mick."

8. I met Becky on a couple of occasions. Mick seemed very proud of his life with her. Mick is a hard worker and he enjoyed his job working at the condos. I last saw Mick when he and Becky came to Ohio to visit during the Christmas holidays in 2004.

I affirm that the foregoing is true and correct to the best of my knowledge. Further affiant sayeth naught

EDWARD GENET

Sworn to and subscribed before me
This 29 day of May, 2012

Notary Public for the State of Ohio
My commission expires: March 25, 2017

NOTARIAL SEAL
STATE OF OHIO

SHIRLEY A. BLAGG
NOTARY PUBLIC
STATE OF OHIO
STARK COUNTY
My Comm. Expires March 25, 2017

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Dickie Caines, who appeared personally before me, affirms and states the following:

1. I lived at Tilghman Lakes condo complex throughout Mick Winkler's time there as the maintenance man and grounds keeper.

2. Mick was a good employee and was well liked by the residents. I was on the Board of Directors while Mick was there, and we approved several raises for him. When Mick got engaged to Denise, a number of the condo owners put together some money to help pay for their marriage. Some of us paid for the limo, and others helped pay for the flowers. We went to their wedding out on the beach. That is not something we would have done for just any employee. I have stood up at board meetings and said that Mick is someone who deserves a raise. Mick was well liked.

3. Mick was someone who the condo owners trusted. He had keys to many of our places, and when storms would come, he put the furniture away for us. He would do all sorts of odd jobs.

4. Mick was kind to me. I liked gardening, and the two of us would work together planting things around the premises. He was nice to work with.

5. Towards the end of Mick's time at Tilghman Lakes, something changed in Mick. He was no longer the diligent, polite, and helpful person he had been for his first eight years of employment. He once kind of snapped at me when I made a request of him. He would be late and not show. Mick was eventually let go because of the change. I was very surprised because that kind of behavior was very uncharacteristic of Mick.

6. If I had been asked by a member of Mick's trial team, I would have been willing

DC

to provide them the information in this affidavit.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

D Caines

DICKIE CAINES

Sworn to and subscribed before me
This 29th day of May, 2012

John R Mills

Notary Public for the State of North Carolina
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

DC

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Chuck Webster, who appeared personally before me, affirms and states the following:

1. I was a tenant at Tilghman Lakes while Mick Winkler worked here on our landscaping. It was his job to maintain the grass, bushes, shrubs, and the pool.

2. For most of his tenure here, everyone liked him. Most people here are absentee landlords, and to them, no news was good news. Mick would show up, and he did his work. Some of the owners would have him do personal work, like fix screen doors.

3. My parents would spend a couple of weeks out of the year here, and they liked him. When I spoke with Mick, it was usually pretty casual. We talked about fishing, and things were fine.

4. As a board member, I voted a couple times for him to receive a raise. He had been here a while and provided satisfactory work.

5. Towards the end of his time here at Tilghman, I had an odd confrontation with him. He came to my place and accused me of letting my dog toilet in the yard. He was being very confrontational and it was if he was ready to get into a physical fight over the dog poop. He was eventually fired over a similar blow-up with another condo owner. These blow-ups were wholly inconsistent with the Mick we had known for years prior.

6. No one from Mick's defense team talked to me before Mick's trial. Had they done so, I would have been willing to provide them with the information in this affidavit and to testify to it in court.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the

CW

foregoing is true and correct.

CHUCK WEBSTER

Sworn to and subscribed before me
This 29th day of May, 2015

Notary Public for the State of North Carolina
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

CW

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF LEXINGTON)

Carolyn Graham, who appeared personally before me, affirms and states the following:

1. I was hired as the mitigation specialist on Mick Winkler's case. Ralph Wilson contacted me and asked that I get involved. Paige Tarr had previously been on the case, but she had barely done any work. We did not have a lot of time left before trial. We had to do the best with the time we had. I also worked with Dorian Hall, who was hired to do investigation in Ohio. There was not enough time for one person to do the entire investigation alone. Dorian and I were responsible for working with TeAnne Oehler.

2. Mick's case presented some challenges for me. Paul Rathbun was the other attorney on the case. I had very limited contact with him. He and Mick did not get along.

3. Communication on the team was also difficult. We mostly communicated via e-mail, but all e-mails had to go through Danielle, Ralph Wilson's paralegal. It was as if she was running the show. This was an odd procedure and it slowed down our communication. I did not spend much time talking with either of the attorneys about exactly what they were hoping to present. I have conducted many mitigation investigations, but it is my expectation and preference to work with the team to develop penalty phase themes that are coherent and consistent with the guilt phase presentation. That did not happen in Mick's case. Trial counsel got me appointed, and left it up to me to develop the mitigation presentation. I did not receive guidance about what the theory of the penalty phase would be or about how that theory might fit into the guilt phase presentation.

CG

4. Mick's relationship with trial counsel was very strained. Mick did not trust that they were doing a good job on his case. His conversations with trial counsel were often very contentious, and trial counsel did little to address his concerns. Mick was always upset with both Paul Rathbun and Ralph Wilson.

5. Things came to a head with trial counsel shortly before the hearing. Mick was not doing well. The stress of the pending trial was wearing on him. He was very anxious about the trial. Making matters worse, Paul and Ralph decided to do a mock trial exercise where they cross-examined Mick on the stand. The cross-examination was extremely upsetting for Mick, and he felt that his lawyers were against him rather than on his side. Apparently, Mick and Ralph Wilson had some kind of blow up shortly after the mock cross-examination. I had been with the team during the cross, but I stepped out to speak to a security guard afterward. When I came back, Mick was being led away by a guard. A couple of days later, I was asked to attend a meeting where Paul and Ralph talked to Mick about why they did not want him to testify at trial. They brought a court reporter to this meeting and had it recorded. This was very unusual. I have never worked on a case where the trial lawyers recorded a conversation like that with their client. Again, this event was extremely upsetting for Mick. His relationship with trial counsel deteriorated even further after these two events.

6. During the trial, the judge asked that I sit with Mick. It was because his relationship with his attorneys was so strained. Mick and his attorneys did not get along.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

CG

Carolyn Graham

CAROLYN GRAHAM

Sworn to and subscribed before me
This 1st day of June, 2012

STATE OF NORTH CAROLINA)
) AFFIDAVIT
COUNTY OF LEE)

John Burch, who appeared personally before me, affirms and states the following:

1. I have known Mickey Winkler since the early 1990s. We had a mutual friend in Henry Yates, and that is how I met him.

2. We lived in Apex in when we met Mick, but we frequently go to the Lumberton area, where we met Mickey, because both my wife's family and my family live in Lumberton.

3. Early in our relationship, Mickey took us to a Bruce Springsteen concert at the Dean Dome in Chapel Hill. He drove us there, and he paid for the tickets. It was a generous gesture, especially because he did not have a lot for himself.

4. When we went to visit our families, we would often stay with Mickey. He was always happy to host and generous with whatever he had. Mickey would cook us delicious Spanish omelets for breakfast. He was always an immaculate housekeeper. Everything was very clean and in its place, even if he did not have a lot of space to live in. Because he was working construction, he sometimes would not have much, but he was always happy to share.

5. Sometimes people from his work would come by the house to see him. He was willing to give them whatever he had. He would give you the shirt off of his back. There was no pretentiousness.

6. I attended Mickey and Denise's wedding. We were treated like family. Most of the guests were not on the family tab, but Mick put us on it. He was generous with us.

JAB
JAB

7. At the wedding Rick gave Mick a one thousand dollar bill. He asked me if there really was such a thing. It spoke volumes about their relationship that he was not sure if his brother would give him a fake bill as a wedding present.

8. Mickey was always a hard worker. He worked construction jobs, and he was always the sort of person who would show up to work every day. The work was often physically demanding, but he would always show. He was a reliable worker.

9. Mickey was willing to work hard and to share his construction skills. I built the garage at our house, and Mickey helped out. My father-in-law was also willing to help, and Mickey rode with my father-in-law from Lumberton to Apex, where I live. I have some basic carpentry skills, but Mickey was the project manager. He led and I followed. The project was supposed to be finished early on Sunday, but we were not done. Instead of quitting as planned, Mickey insisted that he wanted to help work until the job was done. We worked through the weekend and up until sundown on Sunday. We finished the job. I offered to pay him for the work, but he insisted the meal we bought him the night before was more than enough. I was impressed that he volunteered and worked so hard on that project. Mickey was a generous friend.

10. After Mickey got charged with the rape and kidnap, my wife and I were worried about him. His friends in Myrtle had abandoned him, and he was by himself. We took two trips down to check on him, one in November and one in February. He was not doing well, especially in February. He had lost his car and he could not leave his house. His lawyer had given him evidence from the charge, including the statement of Becky from the kidnapping charge. Mickey narrated the statement and responded to the allegations. It was a weird thing to share with his friends and an odd experience. It was

clear though that he was obsessing about the charge. His world was crashing down around him, and he was in bad sorts. It was not the Mick we had known for many years.

11. While we were there Mick pointed out that the same car drove by several times. When he pointed it out, I realized too that it had been by several times before. He explained that it was someone from Becky's family. He explained that they drove by all the time. I don't know if they drove by all the time or not, but in the state Mick was in, he thought they did. Nothing excuses what Mick is accused of doing, but he was very agitated by them coming by, and it drove him further down his downward spiral.

12. If I had been asked, I would have been willing to provide the information in this statement to Mickey's defense team.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

John A. Burch

JOHN A. BURCH

Sworn to and subscribed before me
This 25th day of MARCH, 2012

Notary Public for the State of North Carolina
My commission expires: 3/2/16

JAB

JAB

STATE OF NORTH CAROLINA)
) AFFIDAVIT
COUNTY OF LEE)

John Burch, who appeared personally before me, affirms and states the following:

1. I have known Mickey Winkler since the early 1990s. We had a mutual friend in Henry Yates, and that is how I met him.

2. We lived in Apex in when we met Mick, but we frequently go to the Lumberton area, where we met Mickey, because both my wife's family and my family live in Lumberton.

3. Early in our relationship, Mickey took us to a Bruce Springsteen concert at the Dean Dome in Chapel Hill. He drove us there, and he paid for the tickets. It was a generous gesture, especially because he did not have a lot for himself.

4. When we went to visit our families, we would often stay with Mickey. He was always happy to host and generous with whatever he had. Mickey would cook us delicious Spanish omelets for breakfast. He was always an immaculate housekeeper. Everything was very clean and in its place, even if he did not have a lot of space to live in. Because he was working construction, he sometimes would not have much, but he was always happy to share.

5. Sometimes people from his work would come by the house to see him. He was willing to give them whatever he had. He would give you the shirt off of his back. There was no pretentiousness.

6. I attended Mickey and Denise's wedding. We were treated like family. Most of the guests were not on the family tab, but Mick put us on it. He was generous with us.

7. At the wedding Rick gave Mick a one thousand dollar bill. He asked me if there really was such a thing. It spoke volumes about their relationship that he was not sure if his brother would give him a fake bill as a wedding present.

8. Mickey was always a hard worker. He worked construction jobs, and he was always the sort of person who would show up to work every day. The work was often physically demanding, but he would always show. He was a reliable worker.

9. Mickey was willing to work hard and to share his construction skills. I built the garage at our house, and Mickey helped out. My father-in-law was also willing to help, and Mickey rode with my father-in-law from Lumberton to Apex, where I live. I have some basic carpentry skills, but Mickey was the project manager. He led and I followed. The project was supposed to be finished early on Sunday, but we were not done. Instead of quitting as planned, Mickey insisted that he wanted to help work until the job was done. We worked through the weekend and up until sundown on Sunday. We finished the job. I offered to pay him for the work, but he insisted the meal we bought him the night before was more than enough. I was impressed that he volunteered and worked so hard on that project. Mickey was a generous friend.

10. After Mickey got charged with the rape and kidnap, my wife and I were worried about him. His friends in Myrtle had abandoned him, and he was by himself. We took two trips down to check on him, one in November and one in February. He was not doing well, especially in February. He had lost his car and he could not leave his house. His lawyer had given him evidence from the charge, including the statement of Becky from the kidnapping charge. Mickey narrated the statement and responded to the allegations. It was a weird thing to share with his friends and an odd experience. It was

clear though that he was obsessing about the charge. His world was crashing down around him, and he was in bad sorts. It was not the Mick we had known for many years.

11. While we were there Mick pointed out that the same car drove by several times. When he pointed it out, I realized too that it had been by several times before. He explained that it was someone from Becky's family. He explained that they drove by all the time. I don't know if they drove by all the time or not, but in the state Mick was in, he thought they did. Nothing excuses what Mick is accused of doing, but he was very agitated by them coming by, and it drove him further down his downward spiral.

12. If I had been asked, I would have been willing to provide the information in this statement to Mickey's defense team.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

JOHN A. BURCH

Sworn to and subscribed before me
This ____ day of ____, 20__

MARCH 2 2016

Notary Public for the State of North Carolina
My commission expires ____

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Jeannie Walker, who appeared personally before me, affirms and states the following:

1. I know Louis "Mick" Winkler from his time working at Tilghman Lakes in North Myrtle Beach. My daughter lived there, and Mick worked maintenance. I lived in the condo complex next door.

2. Mick was a hard worker at Tilghman. He would answer maintenance calls at all hours of the day, every day of the week. He helped my daughter on several occasions.

3. Mick was willing to go above and beyond the call of duty. He would help people carry up their groceries, and do odd jobs for them. He fixed the light on my daughter's car, repaired her deck, and helped her move things into storage. When we'd offer to pay him, he would always decline. Mick took pride in his work.

4. After Mick was fired, there were rumors about him not doing his work and a change in his work ethic. Any lapse in his work would have been a big change because he loved that job.

5. I invited Mick to the open houses that I would host for my friends and neighbors. Mick would compliment my fried chicken and be grateful for the invitation. Mick was pleasant to have around.

6. Prior to trial no one asked me to provide the information in this affidavit to the court. Had they asked me to do so, I would have been willing to do so.

JW JW

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

Jeanie Walker
JEANNIE WALKER

Sworn to and subscribed before me
This 25 day of May, 2016

John R. Mills
Notary Public for the State of North Carolina
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

JW
JW

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Carolyn Samuels, who appeared personally before me, affirms and states the following:

1. I lived at Tilghman Lakes by the Sea in North Myrtle Beach from 1990 until 2007. My mother lived in the condo complex next door to Tilghman. During my time there Mick Winkler worked maintenance.

2. I appreciated Mick's hard work at Tilghman. For many years he would reliably clean the grounds, address maintenance issues on the property, and would respond day or night, seven days a week to maintenance calls.

3. In addition to taking care of his responsibilities, he made a point of taking care of the residents. Mick helped fix my deck and the taillight on my car. He would often help the residents carry in their groceries and do odd jobs that were well outside of his job's responsibilities. Mick was always willing to help out, and he never expected—or accepted—money for his services.

4. Mick was generally well liked at Tilghman. We included him in the annual golf tournament, and he consistently received raises though his time there.

5. Towards the end of his time there, there were rumors that he was not working hard and addressing his responsibilities. If that is true, it would have been very much out of character for Mick. He was a good worker who cared about his job.

6. Prior to the trial I was interviewed by an investigator from the Defense Team. I provided her with the same information contained in this affidavit. I also told her I was willing to testify. After speaking with the investigator, I never heard from the Defense Team again.

CS

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

Carolyn Samuels
CAROLYN SAMUELS

Sworn to and subscribed before me
This 15 day of May, 2015

John A Mills
Notary Public for the State of North Carolina
My commission expires: 5/30/2016

John A Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

CS

STATE OF NORTH CAROLINA)
) AFFIDAVIT
COUNTY OF COLUMBUS)

Ben Hege, who appeared personally before me, affirms and states the following:

1. I met Louis "Mick" Winkler when he was the maintenance person at Tilghman Lakes by the Sea in North Myrtle Beach, South Carolina. My father owns a condo there, and I met Mick when I visited.

2. Mick had a reputation for doing a good job and being generous. I barely knew him, but on one of my visits there he let me store my boat over night at his house. Nothing about his job required him to do something like that, and I thought it was a generous gesture.

3. I was shocked to learn about this crime happening.

4. Prior to Mick's trial no one from Mick's trial team contacted me or asked me to provide the information in this affidavit. Had they asked me to do so, I would have been willing to testify to the information contained in it.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

BEN HEGE

Sworn to and subscribed before me
This 29 day of May, 2012

Notary Public for the State of North Carolina
My commission expires: July 2, 2014

CHRISTINA SIAKI-RANDOLPH NOTARY PUBLIC BRUNSWICK COUNTY, N.C.

BH

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Lauren Roughton, who appeared personally before me, affirms and states the following:

1. I was a juror in Louis Michael Winkler's death penalty case.

2. The deliberations in Mr. Winkler's case, in the penalty phase, were ugly. After the initial vote, it was clear that three people were voting for life. It was me, an older white woman, and an African American man.

3. There was a lot of pressure to change my vote. Many of those pushing for death were concerned that if we did not give him death, that he would one day have the opportunity to be a free man. Part of the concern was that if we did not reach a unanimous decision, then there may have been no punishment inflicted. I was not sure if that was the case, but I thought that the death penalty was not appropriate in this case. We even sent a note to the judge about what would happen, but the judge refused to answer our question. because of the way we worded it.

4. I held out through the end of the first day of deliberations. We went late that night, and we were all tired by the end. When we left that evening, it was still nine to three, with three of us voting for life.

5. When we got back the next day, the people who wanted a death verdict made it clear that they were ready to get this over with and to go home. They did not respect the life-voters' positions, and it was clear that there was no chance that any of those voting for death would switch to life.

6. I eventually gave in to the majority. I thought I was a stronger person than to have given up on my convictions. I had prayed to God for strength, but in the end I

LR

failed. I gave in when the majority did not respect my feelings and beliefs. To this day, I regret my vote.

7. The young African American man held out the longest. Once he was the lone holdout, things got heated. Two men and one woman were particularly intense about trying to make him switch. One of the men was the foreman. The other was the person who was quoted in the newspaper. The woman was younger and had straight black hair.

8. The two men stood on either side of the holdout. With their voices raised they were swearing and pounding on the table. The juror was not particularly well-spoken, but he was entitled to his opinion. The other jurors did not respect that. They kept yelling, "Why? Why? Why?," trying to force him to explain himself.

9. I felt bad for him because I also felt railroaded into changing my vote. I consider myself smart, but unlike the people who yelled at the juror, I do not talk a lot. I'm not very verbal. The last holdout seemed the same way. He could not explain how he felt, so he got pushed into voting the way everyone else did.

I NEVER DOUBTED MR. WINKLER'S GUILT, BUT LR

10. I never truly wished for Mr. Winkler to get the death penalty. I only changed my vote because I felt pressured to do so by the majority. It must have been all the more difficult for the last holdout. To this day I regret my vote.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

LAUREN ROUGHTEN LR

LR

Sworn to and subscribed before me
This 30th day of March, 2016

John R. Mills
Notary Public for the State of North Carolina
My commission expires: 5/30/2016

LR

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Thomas Hardwick, who appeared personally before me, affirms and states the following:

1. I was a juror in Mr. Louis Michael Winkler's trial.

2. I do not have much of a memory for the trial or the deliberations, but I remember there being a great deal of discussion during deliberations about whether Mr. Winkler would ever get out of prison. We weren't sure, if we didn't reach a death sentence, whether Mr. Winkler might ever get out of prison.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

Thomas Hardwick
THOMAS HARDWICK

Sworn to and subscribed before me
This 11th day of January, 2011

John R. Mills
Notary Public for the State of North Carolina
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

TH
TH

STATE OF SOUTH CAROLINA)
) AFFIDAVIT
COUNTY OF HORRY)

Jeron Wallingford, who appeared personally before me, affirms and states the following:

1. I served as a juror in Louis Michael Winkler's trial in 2008. I was the only African American on the jury.

2. On Saturday, when we began deliberations, there was a vote. It was around nine to three. There were at least two women, in addition to myself, who wanted to vote for life. ~~One of the women who wanted to vote for life used to be a parole officer.~~

3. We deliberated for a long time on Saturday. It was very late, well after midnight, before we left.

4. When we arrived the next morning, we were all tired and it seemed like some of the jurors just wanted to go home. The two other votes for life and I still wanted to give Mr. Winkler a life sentence.

5. I felt, and feel, that the killing needed to stop. Mr. Winkler deserved punishment, but not the death penalty.

6. The other jurors would not listen when I tried to explain my position. I told them that I felt for Mr. Winkler's family, especially his mother, but they would not listen.

7. The other jurors became belligerent and threatening. They suggested that something bad might happen to my daughter if Mr. Winkler did not get death. At one point two or three of the male jurors stood over me and forced me to look at autopsy photos of Rebecca Winkler. They were shouting threats at me and were trying to physically intimidate me into voting for death. They swore, yelled, and pounded on the

JW

table. Things did not get physical, but I thought they could. And one of the men in particular was pretty large.

8. Over the course of the deliberations, the other two jurors voting for life changed their votes. Because of the threats and yelling, I felt hopeless to change their minds, and I gave in. I voted for death.

9. Death for Mr. Winkler was not my choice, and I regret that I let the other jurors make me change my vote.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

Jeron Wallingford
JERON WALLINGFORD

Sworn to and subscribed before me
This 10th day of May, 2012

John R. Mills
Notary Public for the State of North Carolina
My commission expires: 5/30/2016

John R Mills
Notary Public
Durham County
North Carolina
My Commission Expires 5/30/2016

J.W.
JW

STATE OF SOUTH CAROLINA	)	
	)	IN THE COURT OF COMMON PLEAS
COUNTY OF HORRY	)	11-CP-26-03907
	)	
LOUIS MICHAEL WINKLER, JR. SK6027	)	
Applicant,	)	
vs.	)	**CERTIFICATE OF SERVICE**
STATE OF SOUTH CAROLINA,	)	
Respondent.	)	
	)	

The undersigned certifies that a copy of the foregoing Applicant's Notice of Intent to Rely Upon Affidavits, was served by first class United States mail, postage prepaid, this 4th day of June, 2012, upon the following:

Alphonso Simon, Jr.
Assistant Attorney General
P.O. Box 11549
Columbia, SC 29211

Jill A. Rider

Jill A. Rider

FORM 4

STATE OF SOUTH CAROLINA
COUNTY OF HORRY
IN THE COURT OF COMMON PLEAS

JUDGMENT IN A CIVIL CASE

CASE NO. 2011-CP-26-3907

Louis Michael Winkler, Jr.
PLAINTIFF(S)

State of South Carolina
DEFENDANT(S)

Submitted by: Benjamin H. Culbertson, Presiding Judge	Attorney for : ☐ Plaintiff ☐ Defendant or ☐ Self-Represented Litigant

DISPOSITION TYPE (CHECK ONE)

☐ **JURY VERDICT.** This action came before the court for a trial by jury. The issues have been tried and a verdict rendered.

☑ **DECISION BY THE COURT.** This action came to trial or hearing before the court. The issues have been tried or heard and a decision rendered.*

☐ **ACTION DISMISSED** (*CHECK REASON*): ☐ Rule 12(b), SCRCP; ☐ Rule 41(a), SCRCP (Vol. Nonsuit); ☐ Rule 43(k), SCRCP (Settled); ☐ Other

☐ **ACTION STRICKEN** (*CHECK REASON*): ☐ Rule 40(j), SCRCP; ☐ Bankruptcy; ☐ Binding arbitration, subject to right to restore to confirm, vacate or modify arbitration award; ☐ Other

☐ **DISPOSITION OF APPEAL TO THE CIRCUIT COURT** (*CHECK APPLICABLE BOX*): ☐ Affirmed; ☐ Reversed; ☐ Remanded; ☐ Other

NOTE: ATTORNEYS ARE RESPONSIBLE FOR NOTIFYING LOWER COURT, TRIBUNAL, OR ADMINISTRATIVE AGENCY OF THE CIRCUIT COURT RULING IN THIS APPEAL.

IT IS ORDERED AND ADJUDGED: ☑ See attached order (formal order to follow) ☐ Statement of Judgment by the Court:

Applicant's Motion to Limit Scope of Cross Examination is DENIED.
***This motion was decided without oral arguments.**

ORDER INFORMATION

This order ☐ ends ☑ does not end the case.
Additional Information for the Clerk :

INFORMATION FOR THE JUDGMENT INDEX

Complete this section below when the judgment affects title to real or personal property or if any amount should be enrolled. If there is no judgment information, indicate "N/A" in one of the boxes below.

Judgment in Favor of (List name(s) below)	Judgment Against (List name(s) below)	Judgment Amount To be Enrolled (List amount(s) below)
N/A	N/A	$ N/A
		$
		$

If applicable, describe the property, including tax map information and address, referenced in the order:

The judgment information above has been provided by the submitting party. Disputes concerning the amounts contained in this form may be addressed by way of motion pursuant to the SC Rules of Civil Procedure. Amounts to be computed such as interest or additional taxable costs not available at the time the form and final order are submitted to the judge may be provided to the clerk. **Note: Title abstractors and researchers should refer to the official court order for judgment details.**

Benjamin H. Culbertson

Benjamin H. Culbertson, Circuit Court Judge | 2148 **Judge Code** | June 6, 2012 **Date**

For Clerk of Court Office Use Only

This judgment was entered on the day of , 20 and a copy mailed first class or placed in the appropriate attorney's box on this day of , 20 to attorneys of record or to parties (when appearing pro se) as follows:

Emily C. Paavola
John R. Mills

ATTORNEY(S) FOR THE PLAINTIFF(S)

Alphonzo Simon, Jr.

ATTORNEY(S) FOR THE DEFENDANT(S)

CLERK OF COURT

Court Reporter: None

STATE OF SOUTH CAROLINA)	IN THE COURT OF COMMON PLEAS
)	FIFTEENTH JUDICIAL CIRCUIT
COUNTY OF HORRY)	CASE NUMBER: 2011-CP-26-3907
Louis Michael Winkler, Jr.,)	
)	
Applicant,)	
)	
vs.)	ORDER REGARDING APPLICANT'S MOTION
)	TO LIMIT SCOPE OF CROSS EXAMINATION
State of South Carolina,)	
)	
Respondent.)	
)	

Before the court is a motion *in limine* by the applicant ("Winkler") to limit the scope of cross examination by the respondent ("State") at the trial of this post-conviction relief case. This motion is decided on the arguments set forth in Winkler's written motion and without oral arguments.

In his motion, Winkler "asserts that his trial attorneys...provided ineffective assistance of counsel for, ***among other things***, failing to protect his Sixth Amendment right to proceed *pro se* at trial." (emphasis added). The motion is supported by Winkler's affidavit stating that he requested to represent himself at his criminal trial but the court denied his request. Winkler now seeks to limit the State's cross-examination of him at the trial of this case to the sole issue of whether his criminal trial attorneys provided ineffective assistance of counsel for failing to protect his Sixth Amendment right to proceed *pro se* at his criminal trial. Winkler argues that cross examination beyond the scope of his direct examination violates his right against self-incrimination as guaranteed by the fifth amendment of the *United States Constitution*.

Even though Winkler's affidavit in support of this motion refers only to his denied request to proceed *pro se* at his criminal trial, the motion alleges ineffective assistance of counsel on this ground and "among other things...." Further, Winkler's Application for Post-Conviction

Relief alleges numerous deficiencies by his criminal trial attorneys constituting ineffective assistance of counsel. Therefore, the State's cross examination of Winkler should not be limited solely to his denied request to proceed *pro se* at his criminal trial. However, Winkler may still assert his Fifth Amendment right against self-incrimination during the course of the State's cross examination of him if a reasonable possibility exists that requiring him to answer a certain question would provide information that could be used against him in a criminal proceeding or would lead to the discovery of such information. See *Grosshuesch v. Cramer*, 377 S.C. 12, 659 S.E.2d 112 (S.Ct. 2008). Whether the privilege is applicable to a certain question will have to be ruled upon by the court when the situation presents itself at trial. Therefore, Winkler's motion *in limine* to limit the scope of the State's cross examination should be denied.

NOW, THEREFORE, it is hereby ORDERED that the applicant's Motion to Limit Scope of Cross Examination is DENIED.

AND IT IS SO ORDERED.

Benjamin H. Culbertson
Presiding Judge

June 6, 2012
Conway, SC

STATE OF SOUTH CAROLINA

ISSUED BY THE COMMON PLEAS COURT IN THE COUNTY OF HORRY

Louis Michael Winkler, Plaintiff

v. SUBPOENA IN A CIVIL CASE

South Carolina, Defendant Case Number: 2011-CP-26-03907

Pending in Horry County

TO: Mr. Aaron Wilkes [redacted]

☒ YOU ARE COMMANDED to appear in the above named court at the place, and time specified below to testify in the above case.

PLACE OF TESTIMONY	COURTROOM 3A (Judge Culbertson)
Georgetown County Courthouse 201 Cleland Street Georgetown, SC 29442	DATE AND TIME June 18, 2012, 2:00 PM

☐ YOU ARE COMMANDED to appear at the place, date, and time specified below to testify at the taking of a deposition in the above case.

PLACE OF DEPOSITION	DATE AND TIME , AM

☐ YOU ARE COMMANDED to produce and permit inspection and copying of the following documents or objects in your possession, custody or control at the place, date and time specified below (list documents of objects:

PLACE	DATE AND TIME , AM

☐ YOU ARE COMMANDED to permit inspection of the following premises at the date and time specified below.

PREMISES	DATE AND TIME , AM

ANY SUBPOENAED ORGANIZATION NOT A PARTY TO THIS IS HEREBY DIRECTED TO RULE 30(b)(6), SOUTH CAROLINA RULES OF CIVIL PROCEDURE, TO FILE A DESIGNATION WITH THE COURT SPECIFYING ONE OR MORE OFFICERS, DIRECTORS, OR MANAGING AGENTS, OR OTHER PERSONS WHO CONSENT TO TESTIFY ON ITS BEHALF, SHALL SET FORTH, FOR EACH PERSON DESIGNATED, THE MATTERS ON WHICH HE WILL TESTIFY OR PRODUCE DOCUMENTS OR THINGS. THE PERSON SO DESIGNATED TESTIFY AS TO MATTERS KNOWN OR REASONABLY AVAILABLE TO THE ORGANIZATION

I CERTIFY THAT THE SUBPOENA IS ISSUED IN COMPLIANCE WITH RULE 45(c)(1), AND THAT NOTICE AS REQUIRED BY RULE 45(b)(1) HAS BEEN GIVEN TO ALL PARTIES.

John R. Hicks 6/7/2012 John R. Hicks III

Attorney/Issuing Officer's Signature Date Print Name

(Indicate if Attorney for Plaintiff or Defendant

Attorney's Address and Telephone Number:

919-251-6259

201 W. Main Street; Suite 301; Durham, NC 27701

Clerk of Court/Issuing Officer's Signature Date Print Name

Pro Se Litigant's Name, Address and Telephone Number:

SCCA 254 (05/2011) (See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

PROOF OF SERVICE

SERVED	DATE 6/7/2012	FEES AND MILEAGE TENDERED TO WITNESS ☐YES ☒NO AMOUNT $
	PLACE Aaron Wilkes; [redacted]; [redacted]; Attorney General's Office; P.O. Box 1159; Columbia, SC 29211	

SERVED ON Aaron Wilkes; Al Simon	MANNER OF SERVICE Mail
SERVED BY John R. Mills	TITLE Attorney

DECLARATION OF SERVER

I certify that the foregoing information contained in the Proof of Service is true and correct.

Executed on 6/7/2012

SIGNATURE OF SERVER

201 W. Main Street, Suite 301; Durham, NC 27701
ADDRESS OF SERVER

Rule 45, South Carolina Rules of Civil Procedures, Parts (c) and (d):

(c) Protection of Persons Subject to Subpoenas.

(1) A party or an attorney responsible for the issuance and service of a subpoena shall take reasonable steps to avoid imposing undue burden or expense on a person subject to that subpoena. The court on behalf of which the subpoena was issued shall enforce this duty and impose upon the party or attorney in breach of this duty an appropriate sanction, which may include, but is not limited to, lost earnings and a reasonable attorney's fee.

(2) (A) A person commanded to produce and permit inspection and copying of designated books, papers, documents or tangible things, or inspection of premises need not appear in person at the place of production or inspection unless commanded to appear for deposition, hearing or trial. A party or an attorney responsible for the issuance and service of a subpoena for production of books, papers and documents without a deposition shall provide to another party copies of documents so produced upon written request. The party requesting copies shall pay the reasonable costs of reproduction.

(B) Subject to paragraph (d) (2) of this rule, a person commanded to produce and permit inspection and copying may, within 14 days after service of the subpoena or before the time specified for compliance if such time is less than 14 days after service, serve upon the party or attorney designated in the subpoena written objection to inspection or copying of any or all of the designated materials or of the premises. If objection is made, the party serving the subpoena shall not be entitled to inspect and copy the materials or inspect the premises except pursuant to an order of the court by which the subpoena was issued. If objection has been made, the party serving the subpoena may, upon notice to the person commanded to produce, move at any time in the court that issued the subpoena for an order to compel the production. Such an order to compel production shall protect any person who is not a party or an officer of a party from significant expense resulting from the inspection and copying commanded.

(3) (A) On timely motion, the court by which a subpoena was issued, or regarding a subpoena commanding appearance at a deposition, or production or inspection directed to a non-party, the court in the county where the non-party resides, is employed or regularly transacts business in person, shall quash or modify the subpoena if it:

i. fails to allow reasonable time for compliance; or

ii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to travel more than 50 miles from the county where that person resides, is employed or regularly transacts business in person, except that, subject to the provisions of clause (c)(3)(B)(iii) of this rule, such a person may in order to attend trial be commanded to travel from any such place within the state in which the trial is held; or

iii. requires disclosure of privileged or otherwise protected matter and no exception or waiver applies; or

iv. subjects a person to undue burden.

(B) If a subpoena:

i. requires disclosure of a trade secret or other confidential research, development, or commercial information, or

ii. requires disclosure of an unretained expert's opinion or information not describing specific events or occurrences in dispute and resulting from the expert's study made not at the request of any party, or

iii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to incur substantial expense to travel from the county where that person resides, is employed or regularly transacts business in person,

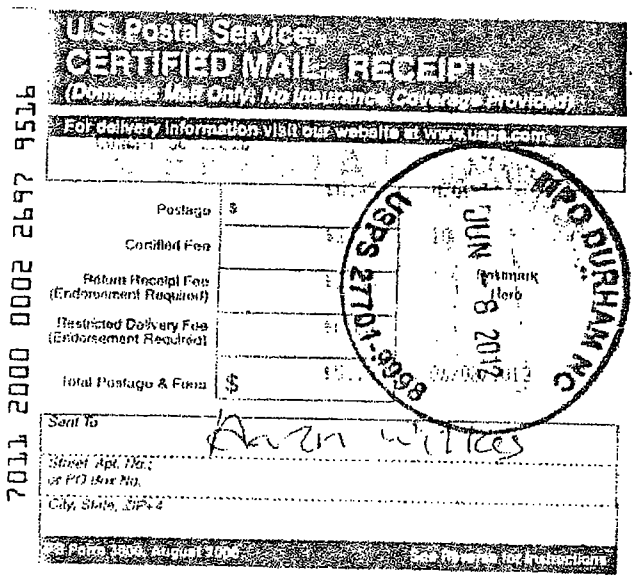
the court may, to protect a person subject to or affected by the subpoena, quash or modify the subpoena or, if the party in whose behalf the subpoena is issued shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship and assures that the person to whom the subpoena is addressed will be reasonably compensated, the court may order appearance or production only upon specified conditions.

(d) Duties in Responding to Subpoena.

(1) A person responding to a subpoena to produce documents shall produce them as they are kept in the usual course of business or shall organize and label them to correspond with the categories in the demand.

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

(2) When information subject to a subpoena is withheld on a claim that it is privileged or subject to protection as trial preparation materials, the claim shall be made expressly and shall be supported by a description of the nature of the documents, communications, or things not produced that is sufficient to enable the demanding party to contest the claim.


U.S. Postal Service
CERTIFIED MAIL™ RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)
For delivery information visit our website at www.usps.com
Postage $
Certified Fee
Return Receipt Fee (Endorsement Required)
Restricted Delivery Fee (Endorsement Required)
Total Postage & Fees $
Sent To
Street, Apt. No.; or PO Box No.
City, State, ZIP+4
7011 2000 0002 2692 9574
USPS 27101-9998
JUN 8 2012
Postmark Here
RPD DURHAM NC

STATE OF SOUTH CAROLINA

ISSUED BY THE COMMON PLEAS COURT IN THE COUNTY OF HORRY

Louis Michael Winkler, Plaintiff

v.

South Carolina, Defendant

SUBPOENA IN A CIVIL CASE

Case Number: 2011-CP-26-03907

Pending in Horry County

TO: Denise Bellamy; [redacted]

☒ YOU ARE COMMANDED to appear in the above named court at the place, and time specified below to testify in the above case.

PLACE OF TESTIMONY	COURTROOM 3A (Judge Culbertson)
Georgetown County Courthouse 201 Cleland Street Georgetown, SC 29442	DATE AND TIME June 18, 2012, 2:00 PM

☐ YOU ARE COMMANDED to appear at the place, date, and time specified below to testify at the taking of a deposition in the above case.

PLACE OF DEPOSITION	DATE AND TIME , AM

☐ YOU ARE COMMANDED to produce and permit inspection and copying of the following documents or objects in your possession, custody or control at the place, date and time specified below (list documents of objects:

PLACE	DATE AND TIME , AM

☐ YOU ARE COMMANDED to permit inspection of the following premises at the date and time specified below.

PREMISES	DATE AND TIME , AM

ANY SUBPOENAED ORGANIZATION NOT A PARTY TO THIS IS HEREBY DIRECTED TO RULE 30(b)(6), SOUTH CAROLINA RULES OF CIVIL PROCEDURE, TO FILE A DESIGNATION WITH THE COURT SPECIFYING ONE OR MORE OFFICERS, DIRECTORS, OR MANAGING AGENTS, OR OTHER PERSONS WHO CONSENT TO TESTIFY ON ITS BEHALF, SHALL SET FORTH, FOR EACH PERSON DESIGNATED, THE MATTERS ON WHICH HE WILL TESTIFY OR PRODUCE DOCUMENTS OR THINGS. THE PERSON SO DESIGNATED TESTIFY AS TO MATTERS KNOWN OR REASONABLY AVAILABLE TO THE ORGANIZATION

I CERTIFY THAT THE SUBPOENA IS ISSUED IN COMPLIANCE WITH RULE 45(c)(1), AND THAT NOTICE AS REQUIRED BY RULE 45(b)(1) HAS BEEN GIVEN TO ALL PARTIES.

Attorney/Issuing Officer's Signature — 6/7/2012 (Date) — John R. Wills (Print Name)

Indicate if Attorney for Plaintiff or Defendant

Attorney's Address and Telephone Number :

919-251-6259

201 W. Main Street; Suite 301; Durham, NC 27701

Clerk of Court/Issuing Officer's Signature — Date — Print Name

Pro Se Litigant's Name, Address and Telephone Number :

SCCA 254 (05/2011)

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

PROOF OF SERVICE

SERVED	DATE 6/7/2012	FEES AND MILEAGE TENDERED TO WITNESS ☐YES ☒NO AMOUNT $
	PLACE [redacted]; Attorney General's Office; P.O. Box 1159; Columbia, SC 29211	
SERVED ON Denise Bellamy; Al Simon		MANNER OF SERVICE Mail
SERVED BY John R. Mills		TITLE Attorney

DECLARATION OF SERVER

I certify that the foregoing information contained in the Proof of Service is true and correct.

Executed on 6/7/2012

SIGNATURE OF SERVER

201 W. Main Street, Suite 301; Durham, NC 27701
ADDRESS OF SERVER

Rule 45, South Carolina Rules of Civil Procedures, Parts (c) and (d):

(c) Protection of Persons Subject to Subpoenas.

(1) A party or an attorney responsible for the issuance and service of a subpoena shall take reasonable steps to avoid imposing undue burden or expense on a person subject to that subpoena. The court on behalf of which the subpoena was issued shall enforce this duty and impose upon the party or attorney in breach of this duty an appropriate sanction, which may include, but is not limited to, lost earnings and a reasonable attorney's fee.

(2) (A) A person commanded to produce and permit inspection and copying of designated books, papers, documents or tangible things, or inspection of premises need not appear in person at the place of production or inspection unless commanded to appear for deposition, hearing or trial. A party or an attorney responsible for the issuance and service of a subpoena for production of books, papers and documents without a deposition shall provide to another party copies of documents so produced upon written request. The party requesting copies shall pay the reasonable costs of reproduction.

(B) Subject to paragraph (d) (2) of this rule, a person commanded to produce and permit inspection and copying may, within 14 days after service of the subpoena or before the time specified for compliance if such time is less than 14 days after service, serve upon the party or attorney designated in the subpoena written objection to inspection or copying of any or all of the designated materials or of the premises. If objection is made, the party serving the subpoena shall not be entitled to inspect and copy the materials or inspect the premises except pursuant to an order of the court by which the subpoena was issued. If objection has been made, the party serving the subpoena may, upon notice to the person commanded to produce, move at any time in the court that issued the subpoena for an order to compel the production. Such an order to compel production shall protect any person who is not a party or an officer of a party from significant expense resulting from the inspection and copying commanded.

(3) (A) On timely motion, the court by which a subpoena was issued, or regarding a subpoena commanding appearance at a deposition, or production or inspection directed to a non-party, the court in the county where the non-party resides, is employed or regularly transacts business in person, shall quash or modify the subpoena if it:

i. fails to allow reasonable time for compliance; or

ii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to travel more than 50 miles from the county where that person resides, is employed or regularly transacts business in person, except that, subject to the provisions of clause (c)(3)(B)(iii) of this rule, such a person may in order to attend trial be commanded to travel from any such place within the state in which the trial is held; or

iii. requires disclosure of privileged or otherwise protected matter and no exception or waiver applies; or

iv. subjects a person to undue burden.

(B) If a subpoena:

i. requires disclosure of a trade secret or other confidential research, development, or commercial information, or

ii. requires disclosure of an unretained expert's opinion or information not describing specific events or occurrences in dispute and resulting from the expert's study made not at the request of any party, or

iii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to incur substantial expense to travel from the county where that person resides, is employed or regularly transacts business in person,

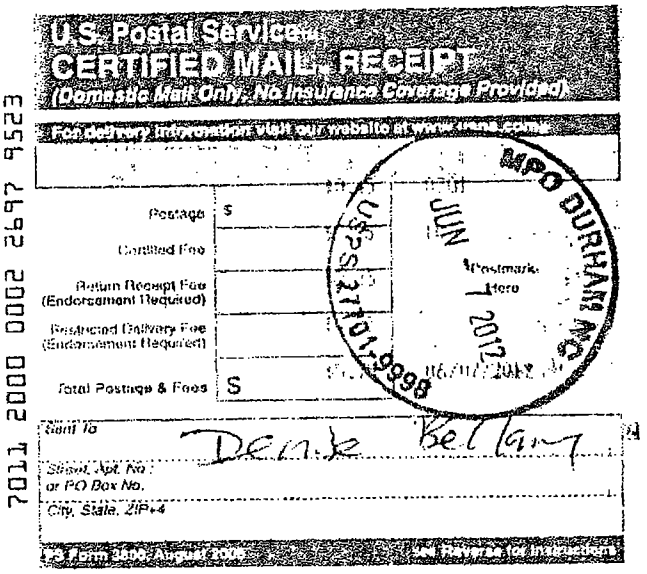
the court may, to protect a person subject to or affected by the subpoena, quash or modify the subpoena or, if the party in whose behalf the subpoena is issued shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship and assures that the person to whom the subpoena is addressed will be reasonably compensated, the court may order appearance or production only upon specified conditions.

(d) Duties in Responding to Subpoena.

(1) A person responding to a subpoena to produce documents shall produce them as they are kept in the usual course of business or shall organize and label them to correspond with the categories in the demand.

(2) When information subject to a subpoena is withheld on a claim that it is privileged or subject to protection as trial preparation materials, the claim shall be made expressly and shall be supported by a description of the nature of the documents, communications, or things not produced that is sufficient to enable the demanding party to contest the claim.

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)


U.S. Postal Service
CERTIFIED MAIL RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)
Postage
Certified Fee
Return Receipt Fee (Endorsement Required)
Restricted Delivery Fee (Endorsement Required)
Total Postage & Fees
$
Sent To
Street, Apt. No.; or PO Box No.
City, State, ZIP+4
MPO DURHAM NC
JUN 1 2012
Postmark Here
USPS 27101-9998
7011 2000 0002 2697 9523

STATE OF SOUTH CAROLINA

ISSUED BY THE COMMON PLEAS COURT IN THE COUNTY OF HORRY

Louis Michael Winkler, Plaintiff

v.

South Carolina, Defendant

SUBPOENA IN A CIVIL CASE

Case Number: 2011-CP-26-03907

Pending in Horry County

TO: Mr. Paul Rathbun; 203 Laurel Street; Conway, SC 29526

☒ YOU ARE COMMANDED to appear in the above named court at the place, and time specified below to testify in the above case.

PLACE OF TESTIMONY	COURTROOM 3A (Judge Culbertson)
Georgetown County Courthouse 201 Cleland Street Georgetown, SC 29442	DATE AND TIME June 19, 2012, 9:30 AM

☐ YOU ARE COMMANDED to appear at the place, date, and time specified below to testify at the taking of a deposition in the above case.

PLACE OF DEPOSITION	DATE AND TIME , AM

☐ YOU ARE COMMANDED to produce and permit inspection and copying of the following documents or objects in your possession, custody or control at the place, date and time specified below (list documents of objects:

PLACE	DATE AND TIME , AM

☐ YOU ARE COMMANDED to permit inspection of the following premises at the date and time specified below.

PREMISES	DATE AND TIME , AM

ANY SUBPOENAED ORGANIZATION NOT A PARTY TO THIS IS HEREBY DIRECTED TO RULE 30(b)(6), SOUTH CAROLINA RULES OF CIVIL PROCEDURE, TO FILE A DESIGNATION WITH THE COURT SPECIFYING ONE OR MORE OFFICERS, DIRECTORS, OR MANAGING AGENTS, OR OTHER PERSONS WHO CONSENT TO TESTIFY ON ITS BEHALF, SHALL SET FORTH, FOR EACH PERSON DESIGNATED, THE MATTERS ON WHICH HE WILL TESTIFY OR PRODUCE DOCUMENTS OR THINGS. THE PERSON SO DESIGNATED TESTIFY AS TO MATTERS KNOWN OR REASONABLY AVAILABLE TO THE ORGANIZATION

I CERTIFY THAT THE SUBPOENA IS ISSUED IN COMPLIANCE WITH RULE 45(c)(1), AND THAT NOTICE AS REQUIRED BY RULE 45(b)(1) HAS BEEN GIVEN TO ALL PARTIES.

John R. Meltz — 6/7/2012 — John R. Meltz

Attorney/Issuing Officer's Signature — Date — Print Name

Indicate if Attorney for Plaintiff or Defendant

Attorney's Address and Telephone Number:

919-251-6259

201 W. Main Street; Suite 301; Durham, NC 27701

Clerk of Court/Issuing Officer's Signature — Date — Print Name

Pro Se Litigant's Name, Address and Telephone Number:

SCCA 254 (05/2011)

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

PROOF OF SERVICE

SERVED	DATE 6/7/2018	FEES AND MILEAGE TENDERED TO WITNESS
	PLACE Paul Rathbun; Horry County Public Defender; 203 Laurel Street; Conway, SC 29526; Attorney General's Office; P.O. Box 1159; Columbia, SC 29211	☐YES ☒NO AMOUNT $

SERVED ON Paul Rathbun; Al Simon	MANNER OF SERVICE Mail
SERVED BY John R. Mills	TITLE Attorney

DECLARATION OF SERVER

I certify that the foregoing information contained in the Proof of Service is true and correct.

Executed on 6/7/2018

SIGNATURE OF SERVER

201 W. Main Street, Suite 301; Durham, NC 27701
ADDRESS OF SERVER

Rule 45, South Carolina Rules of Civil Procedures, Parts (c) and (d):

(c) Protection of Persons Subject to Subpoenas.

(1) A party or an attorney responsible for the issuance and service of a subpoena shall take reasonable steps to avoid imposing undue burden or expense on a person subject to that subpoena. The court on behalf of which the subpoena was issued shall enforce this duty and impose upon the party or attorney in breach of this duty an appropriate sanction, which may include, but is not limited to, lost earnings and a reasonable attorney's fee.

(2) (A) A person commanded to produce and permit inspection and copying of designated books, papers, documents or tangible things, or inspection of premises need not appear in person at the place of production or inspection unless commanded to appear for deposition, hearing or trial. A party or an attorney responsible for the issuance and service of a subpoena for production of books, papers and documents without a deposition shall provide to another party copies of documents so produced upon written request. The party requesting copies shall pay the reasonable costs of reproduction.

(B) Subject to paragraph (d) (2) of this rule, a person commanded to produce and permit inspection and copying may, within 14 days after service of the subpoena or before the time specified for compliance if such time is less than 14 days after service, serve upon the party or attorney designated in the subpoena written objection to inspection or copying of any or all of the designated materials or of the premises. If objection is made, the party serving the subpoena shall not be entitled to inspect and copy the materials or inspect the premises except pursuant to an order of the court by which the subpoena was issued. If objection has been made, the party serving the subpoena may, upon notice to the person commanded to produce, move at any time in the court that issued the subpoena for an order to compel the production. Such an order to compel production shall protect any person who is not a party or an officer of a party from significant expense resulting from the inspection and copying commanded.

(3) (A) On timely motion, the court by which a subpoena was issued, or regarding a subpoena commanding appearance at a deposition, or production or inspection directed to a non-party, the court in the county where the non-party resides, is employed or regularly transacts business in person, shall quash or modify the subpoena if it:

i. fails to allow reasonable time for compliance; or

ii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to travel more than 50 miles from the county where that person resides, is employed or regularly transacts business in person, except that, subject to the provisions of clause (c)(3)(B)(iii) of this rule, such a person may in order to attend trial be commanded to travel from any such place within the state in which the trial is held; or

iii. requires disclosure of privileged or otherwise protected matter and no exception or waiver applies; or

iv. subjects a person to undue burden.

(B) If a subpoena:

i. requires disclosure of a trade secret or other confidential research, development, or commercial information, or

ii. requires disclosure of an unretained expert's opinion or information not describing specific events or occurrences in dispute and resulting from the expert's study made not at the request of any party, or

iii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to incur substantial expense to travel from the county where that person resides, is employed or regularly transacts business in person,

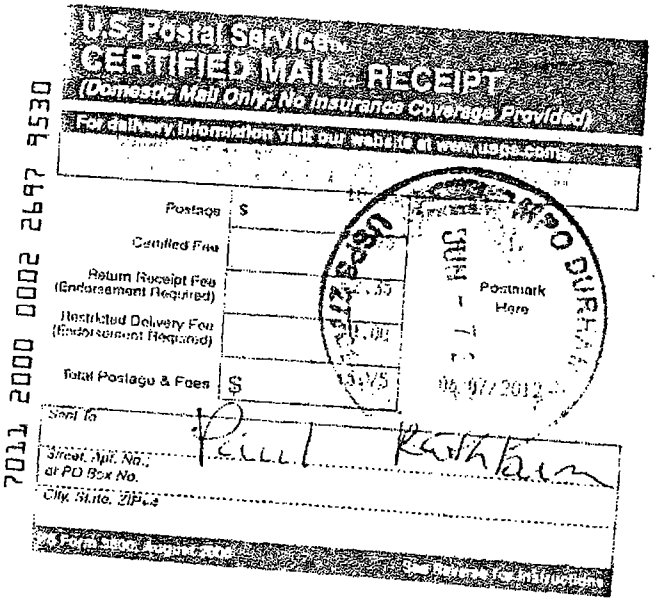
the court may, to protect a person subject to or affected by the subpoena, quash or modify the subpoena or, if the party in whose behalf the subpoena is issued shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship and assures that the person to whom the subpoena is addressed will be reasonably compensated, the court may order appearance or production only upon specified conditions.

(d) Duties in Responding to Subpoena.

(1) A person responding to a subpoena to produce documents shall produce them as they are kept in the usual course of business or shall organize and label them to correspond with the categories in the demand.

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

(2) When information subject to a subpoena is withheld on a claim that it is privileged or subject to protection as trial preparation materials, the claim shall be made expressly and shall be supported by a description of the nature of the documents, communications, or things not produced that is sufficient to enable the demanding party to contest the claim.


U.S. Postal Service
CERTIFIED MAIL™ RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)
Postage $
Certified Fee
Return Receipt Fee (Endorsement Required)
Restricted Delivery Fee (Endorsement Required)
Total Postage & Fees $
Postmark Here
7011 2000 0002 2697 9530

STATE OF SOUTH CAROLINA

ISSUED BY THE COMMON PLEAS COURT IN THE COUNTY OF HORRY

Louis Michael Winkler, Plaintiff

v.

SUBPOENA IN A CIVIL CASE

South Carolina, Defendant

Case Number: 2011-CP-26-03907

Pending in Horry County

TO: Ralph Wilson Sr.; 1411 1st Avenue; Conway, SC 29526

☒ YOU ARE COMMANDED to appear in the above named court at the place, and time specified below to testify in the above case.

PLACE OF TESTIMONY	COURTROOM 3A (Judge Culbertson)
Georgetown County Courthouse 201 Cleland Street Georgetown, SC 29442	DATE AND TIME June 19, 2012, 9:30 AM

☐ YOU ARE COMMANDED to appear at the place, date, and time specified below to testify at the taking of a deposition in the above case.

PLACE OF DEPOSITION	DATE AND TIME , AM

☐ YOU ARE COMMANDED to produce and permit inspection and copying of the following documents or objects in your possession, custody or control at the place, date and time specified below (list documents of objects:

PLACE	DATE AND TIME , AM

☐ YOU ARE COMMANDED to permit inspection of the following premises at the date and time specified below.

PREMISES	DATE AND TIME , AM

ANY SUBPOENAED ORGANIZATION NOT A PARTY TO THIS IS HEREBY DIRECTED TO RULE 30(b)(6), SOUTH CAROLINA RULES OF CIVIL PROCEDURE, TO FILE A DESIGNATION WITH THE COURT SPECIFYING ONE OR MORE OFFICERS, DIRECTORS, OR MANAGING AGENTS, OR OTHER PERSONS WHO CONSENT TO TESTIFY ON ITS BEHALF, SHALL SET FORTH, FOR EACH PERSON DESIGNATED, THE MATTERS ON WHICH HE WILL TESTIFY OR PRODUCE DOCUMENTS OR THINGS. THE PERSON SO DESIGNATED TESTIFY AS TO MATTERS KNOWN OR REASONABLY AVAILABLE TO THE ORGANIZATION

I CERTIFY THAT THE SUBPOENA IS ISSUED IN COMPLIANCE WITH RULE 45(c)(1), AND THAT NOTICE AS REQUIRED BY RULE 45(b)(1) HAS BEEN GIVEN TO ALL PARTIES.

Attorney/Issuing Officer's Signature — Date: 6/7/2012 — Print Name: John R. Ulmer

Indicate if Attorney for Plaintiff or Defendant

Attorney's Address and Telephone Number:

919-251-6259

201 W. Main Street; Suite 301; Durham, NC 27701

Clerk of Court/Issuing Officer's Signature — Date — Print Name

Pro Se Litigant's Name, Address and Telephone Number:

SCCA 254 (05/2011)

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

PROOF OF SERVICE

SERVED	DATE 6/7/2012	FEES AND MILEAGE TENDERED TO WITNESS ☐YES ☒NO AMOUNT $
	PLACE Law Offices of Ralph Wilson; 1411 1st Aveneu; Conway, SC 29526; Attorney General's Office; P.O. Box 1159; Columbia, SC 29211	
SERVED ON Ralph Wilson Sr.; Al Simon		MANNER OF SERVICE Mail
SERVED BY John R. Mills		TITLE Attorney

DECLARATION OF SERVER

I certify that the foregoing information contained in the Proof of Service is true and correct.

Executed on 6/7/2012

SIGNATURE OF SERVER

201 W. Main Street, Suite 301; Durham, NC 27701
ADDRESS OF SERVER

Rule 45, South Carolina Rules of Civil Procedures, Parts (c) and (d):

(c) Protection of Persons Subject to Subpoenas.

(1) A party or an attorney responsible for the issuance and service of a subpoena shall take reasonable steps to avoid imposing undue burden or expense on a person subject to that subpoena. The court on behalf of which the subpoena was issued shall enforce this duty and impose upon the party or attorney in breach of this duty an appropriate sanction, which may include, but is not limited to, lost earnings and a reasonable attorney's fee.

(2) (A) A person commanded to produce and permit inspection and copying of designated books, papers, documents or tangible things, or inspection of premises need not appear in person at the place of production or inspection unless commanded to appear for deposition, hearing or trial. A party or an attorney responsible for the issuance and service of a subpoena for production of books, papers and documents without a deposition shall provide to another party copies of documents so produced upon written request. The party requesting copies shall pay the reasonable costs of reproduction.

(B) Subject to paragraph (d) (2) of this rule, a person commanded to produce and permit inspection and copying may, within 14 days after service of the subpoena or before the time specified for compliance if such time is less than 14 days after service, serve upon the party or attorney designated in the subpoena written objection to inspection or copying of any or all of the designated materials or of the premises. If objection is made, the party serving the subpoena shall not be entitled to inspect and copy the materials or inspect the premises except pursuant to an order of the court by which the subpoena was issued. If objection has been made, the party serving the subpoena may, upon notice to the person commanded to produce, move at any time in the court that issued the subpoena for an order to compel the production. Such an order to compel production shall protect any person who is not a party or an officer of a party from significant expense resulting from the inspection and copying commanded.

(3) (A) On timely motion, the court by which a subpoena was issued, or regarding a subpoena commanding appearance at a deposition, or production or inspection directed to a non-party, the court in the county where the non-party resides, is employed or regularly transacts business in person, shall quash or modify the subpoena if it:

i. fails to allow reasonable time for compliance; or

ii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to travel more than 50 miles from the county where that person resides, is employed or regularly transacts business in person, except that, subject to the provisions of clause (c)(3)(B)(iii) of this rule, such a person may in order to attend trial be commanded to travel from any such place within the state in which the trial is held; or

iii. requires disclosure of privileged or otherwise protected matter and no exception or waiver applies; or

iv. subjects a person to undue burden.

(B) If a subpoena:

i. requires disclosure of a trade secret or other confidential research, development, or commercial information, or

ii. requires disclosure of an unretained expert's opinion or information not describing specific events or occurrences in dispute and resulting from the expert's study made not at the request of any party, or

iii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to incur substantial expense to travel from the county where that person resides, is employed or regularly transacts business in person,

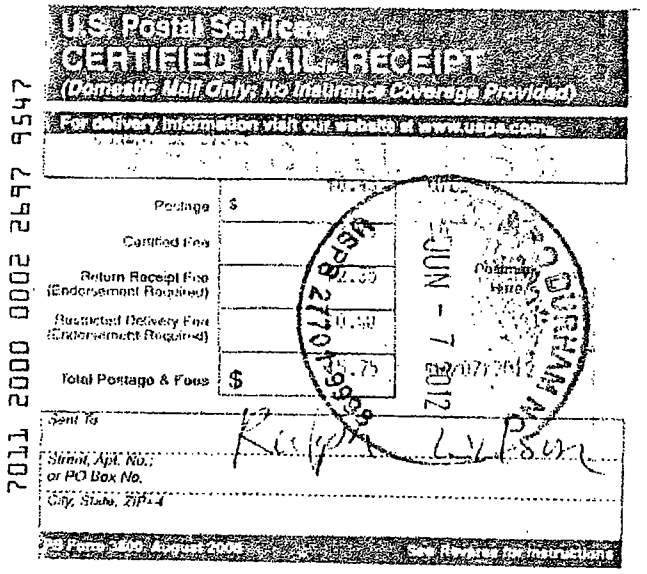
the court may, to protect a person subject to or affected by the subpoena, quash or modify the subpoena or, if the party in whose behalf the subpoena is issued shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship and assures that the person to whom the subpoena is addressed will be reasonably compensated, the court may order appearance or production only upon specified conditions.

(d) Duties in Responding to Subpoena.

(1) A person responding to a subpoena to produce documents shall produce them as they are kept in the usual course of business or shall organize and label them to correspond with the categories in the demand.

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

(2) When information subject to a subpoena is withheld on a claim that it is privileged or subject to protection as trial preparation materials, the claim shall be made expressly and shall be supported by a description of the nature of the documents, communications, or things not produced that is sufficient to enable the demanding party to contest the claim


7011 2000 0002 2697 9547
U.S. Postal Service
CERTIFIED MAIL™ RECEIPT
(Domestic Mail Only; No Insurance Coverage Provided)
For delivery information visit our website at www.usps.com
Postage $
Certified Fee
Return Receipt Fee (Endorsement Required)
Restricted Delivery Fee (Endorsement Required)
Total Postage & Fees $
Sent To
Street, Apt. No.; or PO Box No.
City, State, ZIP+4
PS Form 3800, August 2006
See Reverse for Instructions
JUN - 7 2012
DURHAM NC

STATE OF SOUTH CAROLINA

ISSUED BY THE COMMON PLEAS COURT IN THE COUNTY OF HORRY

Louis Michael Winkler, Plaintiff

v.

South Carolina, Defendant

SUBPOENA IN A CIVIL CASE

Case Number: 2011-CP-26-03907

Pending in Horry County

TO: Mr. Kenneth Martinelli; 4150 J. Reuben Long, Ave; Conway, SC 29526

☒ YOU ARE COMMANDED to appear in the above named court at the place, and time specified below to testify in the above case.

PLACE OF TESTIMONY	COURTROOM 3A (Judge Culbertson)
Georgetown County Courthouse 201 Cleland Street Georgetown, SC 29442	DATE AND TIME June 19, 2012, 9:30 AM

☐ YOU ARE COMMANDED to appear at the place, date, and time specified below to testify at the taking of a deposition in the above case,

PLACE OF DEPOSITION	DATE AND TIME , AM

☐ YOU ARE COMMANDED to produce and permit inspection and copying of the following documents or objects in your possession, custody or control at the place, date and time specified below (list documents of objects:

PLACE	DATE AND TIME , AM

☐ YOU ARE COMMANDED to permit inspection of the following premises at the date and time specified below.

PREMISES	DATE AND TIME , AM

ANY SUBPOENAED ORGANIZATION NOT A PARTY TO THIS IS HEREBY DIRECTED TO RULE 30(b)(6), SOUTH CAROLINA RULES OF CIVIL PROCEDURE, TO FILE A DESIGNATION WITH THE COURT SPECIFYING ONE OR MORE OFFICERS, DIRECTORS, OR MANAGING AGENTS, OR OTHER PERSONS WHO CONSENT TO TESTIFY ON ITS BEHALF, SHALL SET FORTH, FOR EACH PERSON DESIGNATED, THE MATTERS ON WHICH HE WILL TESTIFY OR PRODUCE DOCUMENTS OR THINGS. THE PERSON SO DESIGNATED TESTIFY AS TO MATTERS KNOWN OR REASONABLY AVAILABLE TO THE ORGANIZATION

I CERTIFY THAT THE SUBPOENA IS ISSUED IN COMPLIANCE WITH RULE 45(c)(1), AND THAT NOTICE AS REQUIRED BY RULE 45(b)(1) HAS BEEN GIVEN TO ALL PARTIES.

John R. Mills — 6/8/12 — John R. Mills

Attorney/Issuing Officer's Signature — Date — Print Name

Indicate if Attorney for Plaintiff or Defendant

Attorney's Address and Telephone Number:

919-251-6259

201 W. Main Street; Suite 301; Durham, NC 27701

Clerk of Court/Issuing Officer's Signature — Date — Print Name

Pro Se Litigant's Name, Address and Telephone Number:

SCCA 254 (05/2011)

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

PROOF OF SERVICE

SERVED	DATE 6/8/12	FEES AND MILEAGE TENDERED TO WITNESS
	PLACE Kenneth Martinelli; 4150 J. Reuben Long Avenue; Conway, SC 29526; Attorney General's Office; P.O. Box 1159; Columbia, SC 29211	☐YES ☒ NO AMOUNT $

SERVED ON Kenneth Martinelli; Al Simon	MANNER OF SERVICE Mail
SERVED BY John R. Mills	TITLE Attorney

DECLARATION OF SERVER

I certify that the foregoing information contained in the Proof of Service is true and correct.

Executed on 6/8/12

SIGNATURE OF SERVER

201 W. Main Street, Suite 301; Durham, NC 27701
ADDRESS OF SERVER

Rule 45, South Carolina Rules of Civil Procedure, Parts (c) and (d):

(c) Protection of Persons Subject to Subpoenas.

(1) A party or an attorney responsible for the issuance and service of a subpoena shall take reasonable steps to avoid imposing undue burden or expense on a person subject to that subpoena. The court on behalf of which the subpoena was issued shall enforce this duty and impose upon the party or attorney in breach of this duty an appropriate sanction, which may include, but is not limited to, lost earnings and a reasonable attorney's fee.

(2) (A) A person commanded to produce and permit inspection and copying of designated books, papers, documents or tangible things, or inspection of premises need not appear in person at the place of production or inspection unless commanded to appear for deposition, hearing or trial. A party or an attorney responsible for the issuance and service of a subpoena for production of books, papers and documents without a deposition shall provide to another party copies of documents so produced upon written request. The party requesting copies shall pay the reasonable costs of reproduction.

(B) Subject to paragraph (d) (2) of this rule, a person commanded to produce and permit inspection and copying may, within 14 days after service of the subpoena or before the time specified for compliance if such time is less than 14 days after service, serve upon the party or attorney designated in the subpoena written objection to inspection or copying of any or all of the designated materials or of the premises. If objection is made, the party serving the subpoena shall not be entitled to inspect and copy the materials or inspect the premises except pursuant to an order of the court by which the subpoena was issued. If objection has been made, the party serving the subpoena may, upon notice to the person commanded to produce, move at any time in the court that issued the subpoena for an order to compel the production. Such an order to compel production shall protect any person who is not a party or an officer of a party from significant expense resulting from the inspection and copying commanded.

(3) (A) On timely motion, the court by which a subpoena was issued, or regarding a subpoena commanding appearance at a deposition, or production or inspection directed to a non-party, the court in the county where the non-party resides, is employed or regularly transacts business in person, shall quash or modify the subpoena if it:

i. fails to allow reasonable time for compliance; or

ii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to travel more than 50 miles from the county where that person resides, is employed or regularly transacts business in person, except that, subject to the provisions of clause (c)(3)(B)(iii) of this rule, such a person may in order to attend trial be commanded to travel from any such place within the state in which the trial is held; or

iii. requires disclosure of privileged or otherwise protected matter and no exception or waiver applies; or

iv. subjects a person to undue burden.

(B) If a subpoena:

i. requires disclosure of a trade secret or other confidential research, development, or commercial information, or

ii. requires disclosure of an unretained expert's opinion or information not describing specific events or occurrences in dispute and resulting from the expert's study made not at the request of any party, or

iii. requires a person who is not a party nor an officer, director or managing agent of a party, nor a general partner of a partnership that is a party, to incur substantial expense to travel from the county where that person resides, is employed or regularly transacts business in person,

the court may, to protect a person subject to or affected by the subpoena, quash or modify the subpoena or, if the party in whose behalf the subpoena is issued shows a substantial need for the testimony or material that cannot be otherwise met without undue hardship and assures that the person to whom the subpoena is addressed will be reasonably compensated, the court may order appearance or production only upon specified conditions.

(d) Duties In Responding to Subpoena.

(1) A person responding to a subpoena to produce documents shall produce them as they are kept in the usual course of business or shall organize and label them to correspond with the categories in the demand.

(See Rule 45, South Carolina Rules of Civil Procedure, Parts (c) & (d) on next page)

(2) When information subject to a subpoena is withheld on a claim that it is privileged or subject to protection as trial preparation materials, the claim shall be made expressly and shall be supported by a description of the nature of the documents, communications, or things not produced that is sufficient to enable the demanding party to contest the claim.

STATE OF SOUTH CAROLINA COUNTY OF HORRY Louis Michael Winkler Jr. Applicant, v. State of South Carolina, Respondent.	IN THE COURT OF COMMON PLEAS Case No. 2011-CP 26-03907 **RETURN TO RESPONDENT'S OBJECTION TO APPLICANT'S RELIANCE ON STATEMENTS AND AFFIDAVITS**

On June 4, Applicant, Louis Michael Winkler, provided notice of his intent to rely on affidavits. Applicant attached the affidavits he intended to rely upon to the notice. Respondent was served via first class and electronic mail. Ex. 1 (e-mail to Al Simon); Ex. 2 (certificate of service of process). The previous Friday, June 1, Applicant had mailed discovery responses to Respondent, consistent with this court's scheduling order. On June 8, 2012 Respondent filed an Objection to Applicant's Notice of Intent to Rely Upon Affidavits and a Motion to Exclude Statements and Affidavits containing three arguments. Applicant files this Return pursuant to the Court's request.

First, Respondent claims that Applicant's claim of jury misconduct, as outlined in his Application for Post-Conviction Relief and as supported by the affidavits of Philip Randall, Lauren Roughten, and Jeron Wallingford, does not implicate fundamental fairness. Applicant agrees that "as a general rule," juror testimony about "internal misconduct" is inadmissible to impeach a verdict. *State v. Hunter*, 320 S.C. 85, 88, 463, S.E.2d 313, 316 (1995). But, as Respondent acknowledges, where "fundamental fairness" is implicated, the testimony is admissible. *Id.* Here, fundamental fairness is implicated. The only person of color on the jury was teamed up on by several men, and physically intimidated into changing his vote—but not

into changing his preference for a life sentence. Thus, Mr. Winkler should not have been sentenced to death. Being executed pursuant to a jury verdict brought on by physical intimidation, rather than deliberation about the facts of the case, implicates "fundamental fairness." *Id.*

Second, Respondent argues that several affidavits offered by Mr. Winkler are not admissible because they are not properly notarized. South Carolina Code section 17-27-80 allows this Court to "receive proof by affidavits, depositions, oral testimony or other evidence." The challenged affidavits were sworn to and signed before Mr. Mills, who has been admitted *pro hac vice* in this matter and is a notary in North Carolina. In light of counsel's *pro hac vice* admission and authority as a notary, counsel believes he was "some person legally authorized to administer an oath or affirmation." *State v. McKnight*, 291 S.C. 110, 113, 352 S.E.2d 471, 472 (1987). Even if Mr. Mills is not such a person, the statements are "other evidence" and, with proper authentication, admissible within the terms of the statute.[1] S.C. Code § 17-27-80 (West 2012); S.C. Evid. R. 901 (West 2012).

Third, Respondent claimed that Applicant had not provided the affidavits during the discovery process. This morning, counsel for Respondent confirmed that he did, in fact, receive Applicant's Supplemental Responses and Answers, but because of post office error, he did not receive them until today, June 11, 2012. Thus, Respondent has received the affidavits twice: once as part of Applicant's compliance with the scheduling order and once attached to Applicant's Notice of Intent to Rely on Affidavits. Applicant's notice was not "late," and Respondent was not prejudiced by their timely disclosure. *C.f.* Resp't Objection at 4.

[1] Attached to this motion is an affidavit of John Mills authenticating the affidavits in question. Ex. 3.

Applicant respectfully requests this Court overrule Respondent's objections, and to allow Mr. Winkler to present the affidavits of Philip Randall, Stephen Fitzwater, Pat White, Frank Patterson, Dickie Caines, Chuck Webster, Jeannie Walker, Carolyn Samuels, Lauren Roughton, Thomas Hardwick, Jeron Wallingford, Edward Genet, John Burch, and Ben Hege in support of his Application for Post-Conviction Relief.

Respectfully submitted,

June 11, 2012
DATE

COUNSEL FOR MR. WINKLER

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
900 Elmwood Avenue
Suite 101
Columbia, South Carolina 29201
(803) 765-1044

JOHN R. MILLS
Attorney at Law
201 W. Main Street
Suite 301
Durham, NC 27701
(919) 251-6259

EXHIBIT 1

From:	Jill Rider
To:	bculbertsonj@sccourts.org; BCulbertsonSC@sccourts.or
Cc:	Emily Paavola; john@jrmillslaw.com; aslmon@scag.gov
Subject:	Winkler v. State
Date:	Monday, June 04, 2012 3:19:59 PM
Attachments:	Motion to Limit Scope of Cross.pdf Notice of Intent to Rely on Affidavits.pdf

Judge Culbertson,

Please find attached Applicant's Motion to Limit Scope of Cross-Examination and Applicant's Notice of Intent to Rely on Affidavits that were filed via US Mail with the Horry County Clerk of Court's office today. I have also sent you a hard copy in the mail.

If you should have any questions, please do not hesitate to contact me.

Sincerely,

Jill A. Rider
Paralegal to Emily Paavola

EXHIBIT 2

STATE OF SOUTH CAROLINA	)	
	)	IN THE COURT OF COMMON PLEAS
COUNTY OF HORRY	)	11-CP-26-03907
	)	
LOUIS MICHAEL WINKLER, JR. SK6027	)	
Applicant,	)	
vs.	)	**CERTIFICATE OF SERVICE**
STATE OF SOUTH CAROLINA,	)	
Respondent.	)	
	)	

The undersigned certifies that a copy of the foregoing Applicant's Notice of Intent to Rely Upon Affidavits, was served by first class United States mail, postage prepaid, this 4th day of June, 2012, upon the following:

Alphonso Simon, Jr.
Assistant Attorney General
P.O. Box 11549
Columbia, SC 29211

Jill A. Rider

Jill A. Rider

EXHIBIT 3

STATE OF NORTH CAROLINA)
) AFFIDAVIT
COUNTY OF DURHAM)

John R. Mills, who appeared personally before me, affirms and states the following:

1. I am a notary, authorized and licensed in North Carolina.

2. Attached to this affidavit are copies of the affidavits of Philip Randall, Stephen Fitzwater, Pat White, Frank Patterson, Dickie Caines, Chuck Webster, Jeannie Walker, Carolyn Samuels, Laruen Roughton, Thomas Hardwick, and Jeron Wallingford. Each of these persons appeared personally before me and offered the statements under penalty of perjury. Each are accurate representations of the statements that these persons signed.

I have reviewed this affidavit, and I affirm, under the penalty of perjury, that the foregoing is true and correct.

John R. Mills
JOHN R. MILLS

Sworn to and subscribed before me
This 11th day of June, 2012

June S. Arrington
Notary Public for the State of North Carolina
My commission expires: Jan. 13, 2014

JRM

STATE OF SOUTH CAROLINA COUNTY OF HORRY LOUIS MICHAEL WINKLER, JR. Applicant, v. STATE OF SOUTH CAROLINA, Respondent.	)	IN THE COURT OF COMMON PLEAS 11-CP-26-03907 **CERTIFICATE OF SERVICE**

The undersigned certifies that a copy of Applicant's ReSupplemental Answers to Respondent's Interrogatories and Supplemental Responses to Respondent's Request for Documents and Things was served by first class United States mail, postage prepaid on this the 14th day of June 2012 upon the following:

Mr. Al Simon
South Carolina Attorney General's Office
P.O. Box 11549
Columbia, SC 29211

John R. Mills
Law Offices of John R. Mills

STATE OF SOUTH CAROLINA	)	IN THE COURT OF COMMON PLEAS
COUNTY OF HORRY	)	Case No. 2011-CP-26-03907
LOUIS MICHAEL WINKLER, JR. Applicant,	)	**MOTION TO DISMISS FOR FAILURE TO STATE FACTS SUFFICIENT TO CONSTITUTE A CAUSE OF ACTION PURSUANT TO RULE 12(b)(6), SCRCP**
vs.	)	
STATE OF SOUTH CAROLINA, Respondent.	)	

Comes now, Respondent, ("the State"), above named, by and through the Attorney General of South Carolina and moves to dismiss grounds 10(c) and 10(d) of applicant, Louis Michael Winkler's ("Applicant") application seeking post-conviction relief ("PCR"). Specifically, the State moves for dismissal as the above-referenced grounds, even if true, fail to state facts sufficient to constitute a cause of action pursuant to Rule 12(b)(6) of the South Carolina Rules of Civil Procedure and South Carolina law. See Rule 12(b)(6), SCRCP (explaining a claim may be dismissed for failing to state facts sufficient to constitute a cause of action); Simmons v. State, 264 S.C. 417, 423, 215 S.E.2d 883, 885 (1975) ("[P]ost-conviction hearing statutes do not afford relief in the case of alleged errors for which remedies were available before and during the original trial, or by review on motion for a new trial or on appeal."). In support of this motion, the State would show this Court the following:

I. BACKGROUND

Applicant was tried before the Honorable James E. Lockemy in the Horry County Court of General Sessions on charges of murder, burglary first and assault and battery of a high and aggravated nature ("ABHAN"). He was represented by Ralph Wilson, Sr. and Paul Rathbun. At the conclusion of the guilt-phase of his trial, Applicant was found guilty as charged and received

a sentence of death. After unsuccessfully appealing his conviction and sentence, Applicant filed his initial application for PCR on May 2, 2011. Thereafter, Applicant was appointed counsel in Emily Paavola and John Mills, who subsequently filed a first amended application for PCR and on May 1, 2012, filed a second amended application for PCR.

Within the second amended application, Applicant alleges *inter alia*, two free-standing Constitutional claims regarding his right to self-representation (ground 10(c)) and his right to a fair and impartial jury (ground 10(d)). Specifically, with respect to ground 10(c), Applicant contends his "right to self-representation, as guaranteed by the Sixth and Fourteenth Amendments to the United States Constitution and Article 1 § 14 of the South Carolina Constitution, was violated by the trial court's refusal to permit him to discharge appointed counsel and proceed *pro se*."[1] With respect to ground 10(d) of Applicant's second amended PCR application, Applicant maintains his "right to a fair and impartial jury determination of his sentence—free from the influence of passion, prejudice, or any other arbitrary factor—guaranteed by the Sixth, Eighth and Fourteenth Amendments to the United States Constitution, Article 1 §§ 3, 14 and 15 of the South Carolina Constitution, and S.C. Code § 16-3-25(C), was violated by the trial court's repeated refusal to answer the juror's question about what would happen if they could not reach a unanimous sentencing verdict and the court's improper instructions to the jury under unduly coercive circumstances." The State nnow moves for dismissal of the above-referenced grounds pursuant to Rule 12(b)(6) of the South Carolina Rules of Civil Procedure.

[1] This claim is properly asserted in ground 10 & 11(a)(1) of Applicant's second amended PCR application as an ineffective assistance of counsel claim premised upon trial counsel's alleged failure to "object to the trial court's pre-trial refusal to permit Applicant to discharge appointed counsel and allow him to proceed *pro se*." See Drayton v. Evatt, 312 S.C. 4, 8, 430 S.E.2d 517, 520 (1993) ("Issues that could have been raised at trial or on direct appeal cannot be reasserted in an application for post-conviction relief absent a claim of ineffective assistance of counsel.").

II. GROUNDS 10(c) AND 10(d) FAIL TO STATE FACTS SUFFICIENT TO CONSTITUTE A CAUSE OF ACTION AS SOUTH CAROLINA LAW PROHIBITS THE LITIGATION OF DIRECT APPEAL CLAIMS IN PCR MATTERS, AND AS A RESULT, APPLICANT IS UNABLE TO RECEIVE RELIEF ON SUCH CLAIMS AS A MATTER OF LAW

As noted above, grounds 10(c) and 10(d) fail to alleged facts sufficient to constitute a cause of action in PCR as South Carolina law prohibits the litigation of direct appeal claims in PCR matters. As a result, even assuming the facts alleged in ground 10(c) and 10(d) are true, Applicant would still be procedurally barred from receiving relief on such claims as a matter of law and therefore, the State's 12(b)(6) motion must be granted.

In analyzing a motion to dismiss under Rule 12(b)(6), the trial court must "construe the complaint in a light most favorable to the nonmovant and determine if the facts alleged and the inferences reasonably deducible from the pleadings would entitle the plaintiff to relief on any theory of the case." Rydde v. Morris, 381 S.C. 643, 646, 675 S.E.2d 431, 433 (2009). If the facts alleged and inferences deducible therefrom would entitle the non-moving party to any relief, then dismissal under Rule 12(b)(6) is improper. Sloan Const. Co. v. Southco Grassing, Inc., 377 S.C. 108, 113, 659 S.E.2d 158, 161 (2008). Here, the State submits Applicant's claims 10(c) and 10(d), by virtue of the fact they are free-standing claims which could have been presented to the trial court or raised on appeal, cannot prevail on these claims in PCR as a matter of law, and therefore, the State's motion to dismiss must be granted.

In Simmons v. State, 264 S.C. 417, 215 S.E.2d 883 (1975) the Supreme Court of South Carolina declined to address two issues of trial court error in post-conviction relief stating, "[i]t is uniformly held that an application for post-conviction relief is not a substitute for an appeal." 264 S.C. at 423, 215 S.E.2d at 885. Continuing, the Simmons Court explained "post-conviction hearing statutes do not afford relief in the case of alleged errors for which remedies were

available before and during the original trial, or by review on motion for a new trial or on appeal." Id. Elaborating, the Simmons Court reasoned, "[PCR] statutes were not intended to afford a procedure to operate as a substitute for a motion for a new trial, or for an appeal or writ of error; and ordinarily a judgment of conviction may not be challenged on grounds which could have been raised by a direct appeal." Id.

The rationale of Simmons was reaffirmed in Drayton v. Evatt, 312 S.C. 4, 430 S.E.2d 517 (1993) where the Supreme Court of South Carolina again noted, "errors which can be reviewed on direct appeal may not be asserted for the first time, or reasserted, in post-conviction proceedings." 312 S.C. at 8, 430 S.E.2d at 519. Interpreting the state PCR statute at the time, the Drayton Court concluded, "post-conviction relief is not a substitute for nor does it affect any remedy incident to the proceedings in the trial court, or of direct review of the sentence or conviction." 312 S.C. at 8, 430 S.E.2d at 520 (internal citations omitted). Accordingly, the Drayton Court affirmed the PCR court's dismissal of a PCR applicant's free-standing Eighth and Fourteenth Amendment claims related to the trial court's exclusion of evidence regarding prison adaptability; the trial court's admission of allegedly irrelevant, improper and prejudicial evidence; and the trial court's allegedly erroneous jury instructions. 312 S.C. at 7, 430 S.E.2d at 519. In so holding, the Drayton Court reinforced the Simmons rule stating, "[i]ssues that could have been raised at trial or on direct appeal cannot be asserted in an application for post-conviction relief absent a claim of ineffective assistance of counsel." 312 S.C. at 8, 430 S.E.2d at 520.

Here, grounds 10(c) and 10(d), which allege free-standing claims that were either addressed on appeal or could have been addressed on appeal, are not cognizable claims in PCR and therefore, must be dismissed. See Rule 12(b)(6), SCRCP (explaining a claim may be

dismissed for failing to state facts sufficient to constitute a cause of action); see also Drayton, 312 S.C. at 8, 430 S.E.2d at 520 ("Issues that could have been raised at trial or on direct appeal cannot be asserted in an application for post-conviction relief absent a claim of ineffective assistance of counsel."). Specifically, the issue in ground 10(c) was ruled upon in Applicant's direct appeal by virtue of the fact the record on appeal contained the pre-trial proceedings, but the Court determined that Applicant did not raise the issue to the trial court until the sentencing phase of trial. See State v. Winkler, 388 S.C. 574, 585-87, 698 S.E.2d 596, 602-03 (2011) ("Appellant did not make his request to proceed pro se at the beginning of trial. Appellant made his request to proceed pro se at the beginning of the sentencing phase, which is not a separate trial. Thus, review of this issue is governed by the abuse of discretion standard outlined above and Appellant's right to represent himself was sharply curtailed by his failure to exercise this right prior to trial."). Furthermore, even assuming this did not amount to a ruling on the trial court's *pre-trial refusal* to rule on such a claim, Applicant is still unable to prevail under such a theory because the issue is structured as a free-standing claim of trial court error rather than a claim of ineffective assistance of counsel. See Drayton, 312 S.C. at 8, 430 S.E.2d at 520 ("Issues that could have been raised at trial or on direct appeal cannot be asserted in an application for post-conviction relief absent a claim of ineffective assistance of counsel."). The same is true with respect to ground 10(d). In particular, ground 10(d) is not cognizable and must be dismissed by virtue of the fact it raises a free-standing claim of trial court error which clearly could have been "raised at trial or on direct appeal" had defense counsel registered an objection. See Drayton, 312 S.C. at 8, 430 S.E.2d at 520 ("Issues that could have been raised at trial or on direct appeal cannot be asserted in an application for post-conviction relief absent a claim of

ineffective assistance of counsel."). Accordingly, grounds 10(c) and 10(d) must be dismissed as Applicant is unable to assert facts supporting such a claim for relief.

III. CONCLUSION

In light of the foregoing, the State respectfully requests this Court, to dismiss claims 10(c) and 10(d) of Applicant's second amended application for PCR pursuant to Rule 12(b)(6) of the South Carolina Rule of Civil Procedure.

Respectfully Submitted,

ALAN WILSON
Attorney General

JOHN W. McINTOSH
Chief Deputy Attorney General

DONALD J. ZELENKA
Senior Assistant Deputy Attorney General

BRENDAN J. McDONALD
Assistant Attorney General

ALPHONSO SIMON, JR.
Assistant Attorney General

South Carolina Office of Attorney General
Capital and Collateral Litigation Unit
P.O. Box 11549
Columbia, SC 29211-1549
(803) 734-6305

By: _____
ATTORNEY(S) FOR THE RESPONDENT

STATE OF SOUTH CAROLINA)
COUNTY OF HORRY)

IN THE COURT OF COMMON PLEAS

CASE NO. 2011 - CP - 26 - 03907

Louis Michael Winkler, Jr.
[x] Plaintiff

v.

State of South Carolina
[ ] Defendant.

MOTION AND ORDER INFORMATION FORM AND COVER SHEET

Plaintiff's Attorney:	Defendant's Attorney:
John R. Mills, Bar No. 42301	Al Simon, Bar No.
Address: 201 W. Main Street, Suite 301 Durham, NC 27701	Address: P.O. Box 11549 Columbia, SC 29211
phone: 919-251-6259 fax: 919-237-9254	phone: 803-734-6307 fax:
e-mail: john@jrmillslaw.com her:	e-mail: her:

[ ] **MOTION HEARING REQUESTED (attach written motion and complete SECTIONS I and III)**
[x] **FORM MOTION, NO HEARING REQUESTED (complete SECTIONS II and III)**
[ ] **PROPOSED ORDER/CONSENT ORDER (complete SECTIONS II and III)**

SECTION I: Hearing Information

Nature of Motion:
Estimated Time Needed: Court Reporter Needed: [ ] YES / [ ] NO

SECTION II: Motion/Order Type

[x] Written motion attached
[ ] Form Motion/Order

I hereby move for relief or action by the court as set forth in the attached proposed order.

John R. Mills
Signature of Attorney for [x] Plaintiff / [ ] Defendant

6/12/2012
Date submitted

SECTION III: Motion Fee

[ ] PAID – AMOUNT:
[x] EXEMPT: (check reason)
- [ ] Rule to Show Cause in Child or Spousal Support
- [ ] Domestic Abuse or Abuse and Neglect
- [x] Indigent Status
- [ ] State Agency v. Indigent Party
- [ ] Sexually Violent Predator Act
- [x] Post-Conviction Relief
- [ ] Motion for Stay in Bankruptcy
- [ ] Motion for Publication
- [ ] Motion for Execution (Rule 69, SCRCP)
- [ ] Proposed order submitted at request of the court; or, reduced to writing from motion made in open court per judge's instructions

Name of Court Reporter:
- [ ] Other:

JUDGE'S SECTION

[ ] Motion Fee to be paid upon filing of the attached order.
[ ] Other:

JUDGE

CODE: Date:

CLERK'S VERIFICATION

Date Filed:

Collected by:

[ ] MOTION FEE COLLECTED:
[ ] CONTESTED – AMOUNT DUE:

SCCA/233 (11/03)

STATE OF SOUTH CAROLINA COUNTY OF HORRY Louis Michael Winkler Jr. Applicant, v. State of South Carolina, Respondent.	IN THE COURT OF COMMON PLEAS Case No. 2011-CP 26-03907 **RETURN TO RESPONDENT'S MOTION TO DISMISS FOR FAILURE TO STATE FACTS SUFFICIENT TO CONSTITUTE A CAUSE OF ACTION PURSUANT TO RULE 12(b)(6)**

On June 11, 2012 Respondent filed a Motion to Dismiss two of Applicant's claims under South Carolina Rule of Civil Procedure 12(b)(6). Applicant files this Return in response to that Motion.

ARGUMENT

I. Respondent's Motion to Dismiss Is Not Timely.

Respondent's Motion to Dismiss is not timely. On December 8, 2011 this Court entered a scheduling order entitling each party fourteen days to respond to pretrial motions. Sched. Order at 2. The hearing is set for June 18, 2012. On May 1, Applicant filed his Final Amended Application, which includes the claims in question. Respondent, however, did not file the motion until the evening of June 11, 2012. This eleventh hour filing only leaves Applicant four business days to respond to the motion before the start of the hearing. Applicant's response to the Motion will be necessarily abbreviated, as he has considerably less than the contemplated fourteen days to respond.

Because Respondent did not file the pre-trial motion within the terms of the scheduling order, it is untimely, and should not be considered. *See Arthur v. Sexton*, 368 S.C. 326, 338, 628 S.E.2d

894, 900 (2006) ("Given Appellant's failure to strictly comply with the scheduling order, the trial judge had discretionary authority to impose the appropriate sanction.")

II. Relief Can Be Granted on the Claims in Question.

Respondent argues that no set of facts could support two of Applicant's claims for relief. *Rydde v. Morris*, 381 S.C. 643, 646, 675 S.E.2d 431, 433 (2009) (in considering motions to dismiss under Rule 12(b)(6), the trial court must "construe the complaint in a light most favorable to the nonmovant and determine if the facts alleged and the inferences reasonably deducible from the pleadings would entitle the plaintiff to relief on any theory of the case.").

a. The claims are appropriate for post-conviction review.

The first claim Respondent argues should be dismissed is 10(c). This claim addresses whether Mr. Winkler's right to represent himself was violated. *See Farretta v. California*, 422 U.S. 806 (1975). This allegation relates to whether trial counsel failed to request and the trial judge failed to hold a hearing on whether Applicant desired to represent himself. The allegation is based on conversations that took place off-the-record. Because the basis for the claim is not contained in the record of proceedings below, it could not have been presented during direct review and is appropriate for review for post-conviction review. *C.f. Simmons v. State*, 264 S.C. 417, 215 S.E.2d 883 (1975) (declining to review record-based errors available for review on appeal); *Drayton v. Evatt*, 312 S.C. 4, 430 S.E.2d 517 (1993) (same). Because claim 10(c) relies on material outside the record of the trial, it is appropriate for post-conviction review.

The same is true of the other claim Respondent moves to dismiss. Claim 10(d) addresses whether the jury's verdict was rendered under unduly coercive circumstances. Because those circumstances include information outside the record of what happened at trial, this claim is appropriate for post conviction review.

Neither of the claims in questions are barred from review because they rely on information outside the record of what happened at trial.

b. Even if the claims are procedurally barred, trial counsel's ineffectiveness is cause for excusing the default.

Even if this Court finds that the claims are procedurally barred, trial counsel's ineffectiveness is cause for excusing the default. Although whether trial counsel's ineffective assistance can constitute cause for excusing a procedural default is an open question in South Carolina, it is well established under federal law that trial counsel's ineffectiveness can constitute cause for excusing a default. *See Coleman v. Thompson*, 501 U.S. 753-54 (1991) ("Attorney error that constitutes ineffective assistance of counsel is cause [for excusing a procedural default]."). The Supreme Court explained that post-conviction counsel's ineffectiveness may also provide cause for excusing a procedural default. *See Martinez v. Ryan*, __ U.S. __, 132 S. Ct. 1309 (2012). Because Applicant has alleged ineffective assistance of counsel related to both of these claims, any procedural bar should be excused.

Even if the claims are procedurally bared, they are properly before this Court because of trial counsel's ineffectiveness.

CONCLUSION

Because Respondent's motion is not timely, this Court should not consider it. Nonetheless, Applicant's claims 10(c) and 10(d) rely on evidence external to the record on appeal, are not procedurally barred, and constitute claims upon which relief can be granted. For the foregoing reasons, Respondent's Motion should be denied.

Respectfully submitted,

June 12, 2012
DATE

COUNSEL FOR MR. WINKLER

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
900 Elmwood Avenue
Suite 101
Columbia, South Carolina 29201
(803) 765-1044

JOHN R. MILLS
Attorney at Law
201 W. Main Street
Suite 301
Durham, NC 27701
(919) 251-6259

STATE OF SOUTH CAROLINA	)	
	)	IN THE COURT OF COMMON PLEAS
COUNTY OF HORRY	)	11-CP-26-03907
	)	
LOUIS MICHAEL WINKLER, JR.	)	**CERTIFICATE OF SERVICE**
Applicant,	)	
	)	
v.	)	
	)	
STATE OF SOUTH CAROLINA,	)	
Respondent.	)	
	)	

The undersigned certifies that a copy of Applicant's Return to Respondent's Motion to Dismiss for Failure to State Facts Sufficient to Constitute a Cause of Action Pursuant to Rule 12(b)(6) was served by first class United States mail, postage prepaid on this the 4th day of June 20__ upon the following:

Mr. Al Simon
South Carolina Attorney General's Office
P.O. Box 11549
Columbia, SC 29211

John R. Mills
Law Offices of John R. Mills

STATE OF SOUTH CAROLINA COUNTY OF HORRY LOUIS MICHAEL WINKLER, JR. Applicant, vs. STATE OF SOUTH CAROLINA, Respondent.	IN THE COURT OF COMMON PLEAS Case No. 2011-CP-26-03907 **REPLY TO APPLICANT'S RETURN TO RESPONDENT'S MOTION TO DISMISS FOR FAILURE TO STATE FACTS SUFFICIENT TO CONSTITUTE A CAUSE OF ACTION PURSUANT TO RULE 12(b)(6), SCRCP**

Comes now, Respondent, ("the State"), above named, by and through the Attorney General of South Carolina and replies to applicant Louis Winkler's ("Applicant") return to the State's motion to dismiss grounds 10(c) and 10(d) of his application for post-conviction relief ("PCR"). In his return, Applicant alleges the State's motion should be denied for essentially two reasons. First Applicant contends (1) the motion is allegedly untimely; and (2) the claims are purportedly appropriate for PCR. In reply, the State would show this Court the following:

I. THE MOTION IS TIMELY

Applicant contends the State's motion is untimely arguing the motion is a pre-trial motion and therefore, should have been raised prior to the close of pleadings. In response, the State notes Applicant's position ignores the dictates of Rules 12(g) and 12(h)(2), of the Rules of Civil Procedure as a 12(b)(6) defense cannot be waived and can even be raised at trial. See Rule 12(g), SCRCP ("If a party makes a motion under this rule but omits therefrom any defense or objection then available to him which this rule permits to be raised by motion, he shall not thereafter make a motion based on the defense or objection so omitted, *except a motion as provided in subdivision (h)(2) hereof on any grounds there stated.*") (emphasis added); Rule 12(h)(2), SCRCP ("A defense of failure to state a cause of action upon which relief can be

granted . . .may be made in any pleading permitted or ordered under Rule 7(a), *or by motion for judgment on the pleadings, or at the trial on the merits.*") (emphasis added). In fact, the denial of a motion to dismiss for failure to state facts sufficient to constitute a cause of action on the basis of timeliness is reversible error. See Inman v. Ken Hyatt Chrysler Plymouth, Inc., 294 S.C. 240, 241-42, 363 S.E.2d 691, 692 (1988) ("At trial, the judge denied as untimely Dealer's motion to dismiss the complaint for failure to state facts sufficient to constitute a cause of action. This was error. As permitted under Rule 12(h)(2), SCRCP, a defense of failure to state a cause of action upon which relief can be granted may be raised at the trial on the merits.") (internal quotations omitted). With this in mind, the State submits the motion is timely.

II. GROUNDS 10(c) AND 10(d) FAIL TO STATE FACTS SUFFICIENT TO CONSTITUTE A CAUSE OF ACTION UNDER SOUTH CAROLINA LAW AS DISCUSSED IN THE STATE'S MOTION TO DISMISS

Furthermore, despite Applicant's assertion to the contrary, neither ground 10(c) or 10(d) are appropriate claims for relief as discussed previously in the State's motion to dismiss.[1] While Applicant casts ground 10(c) as an allegation focused on trial counsel's failure to request a hearing and the trial judge's failure to hold a hearing, this is inconsistent with the language of the claim itself. Ground 10(c) merely alleges Applicant's "right to self-representation, as guaranteed by the Sixth and Fourteenth Amendments to the United States Constitution and Article 1 § 14 of the South Carolina Constitution, was violated by the *trial court's refusal* to permit him to discharge appointed counsel and proceed *pro se*." (emphasis added). Indeed, there is nothing within ground 10(c) which alleges counsel was in any way deficient in its representation as this

[1] See Simmons v. State, 264 S.C. 417, 215 S.E.2d 883 (1975) ("It is uniformly held that an application for post-conviction relief is not a substitute for an appeal."); Drayton v. Evatt, 312 S.C. 4, 8, 430 S.E.2d 517, 519 (1993) ("[E]rrors which can be reviewed on direct appeal may not be asserted for the first time, or reasserted, in post-conviction proceedings."); Drayton, 312 S.C. at 8, 430 S.E.2d at 420 ("Issues that could have been raised at trial or on direct appeal cannot be asserted in an application for post-conviction relief absent a claim of ineffective assistance of counsel.").

is the allegation submitted in ground 10(a)(1). Rather, the issue in ground 10(c) is clearly a claim premised on trial court error and must be dismissed under Simmons and its progeny.

The same is true with respect to ground 10(d). In particular, ground 10(d), by its terms, alleges that Applicant's "right to a fair and impartial jury determination of his sentence—free from the influence of passion, prejudice, or any other arbitrary factor—guaranteed by the Sixth, Eighth and Fourteenth Amendments to the United States Constitution, Article 1 §§ 3, 14 and 15 of the South Carolina Constitution, and S.C. Code § 16-3-25(C), was violated *by the trial court's repeated refusal* to answer the juror's question about what would happen if they could not reach a unanimous sentencing verdict *and the court's improper instructions to the jury* under unduly coercive circumstances." (emphasis added). In other words, Applicant is alleging his rights were violated when the trial court refused to answer the jury's question and then gave an allegedly improper instruction. Quite simply, this claim, like ground 10(c), is a claim of trial court error, and therefore, should be dismissed under the Simmons doctrine.

Additionally, Applicant appears to argue that should his claims be barred under Simmons, they still should not be dismissed under the South Carolina Rules of Civil Procedure because the Supreme Court of the United States, in Martinez v. Ryan, __ U.S. __, 132 S.Ct. 1309 (2012), determined the federal habeas corpus statute, 28 U.S.C. § 2254(d), allows for the excusal of a procedural default where initial-review collateral counsel (i.e. PCR trial counsel) failed to raise a substantial claim of ineffective assistance of counsel in state court. In response, the State submits Martinez is irrelevant to this discussion because Applicant's failure to state a cause of action in state court has nothing to do with the Martinez Court's interpretation of the federal habeas corpus statute. Even assuming South Carolina courts interpreted the state PCR statute consistent with the Martinez Court's interpretation of the federal habeas corpus statute, such an

interpretation would have no bearing on whether Applicant had stated facts sufficient to constitute a cause of action in his PCR application. In other words, the Martinez decision does not magically transform a claim of trial court error that pursuant to the Simmons doctrine, is not a cause of action in a state PCR, into a cause of action. Rather, this is a question which South Carolina courts have already addressed in Simmons and its progeny.

III. CONCLUSION

In light of the foregoing, the State respectfully requests this Court, to dismiss claims 10(c) and 10(d) of Applicant's second amended application for PCR.

Respectfully Submitted,

ALAN WILSON
Attorney General

JOHN W. McINTOSH
Chief Deputy Attorney General

DONALD J. ZELENKA
Senior Assistant Deputy Attorney General

J. ANTHONY MABRY
Assistant Attorney General

ALPHONSO SIMON, JR.
Assistant Attorney General

BRENDAN J. McDONALD
Assistant Attorney General

South Carolina Office of Attorney General
Capital and Collateral Litigation Unit
P.O. Box 11549
Columbia, SC 29211-1549
(803) 734-6305

By: _____
ATTORNEY(S) FOR THE RESPONDENT

CERTIFICATE OF SERVICE

I, J. Anthony Mabry, counsel for the Respondent, certify that I have served the Reply to Applicant's Return to Respondent's Motion to Dismiss by depositing one (1) copy of same in the United States mail, postage prepaid, addressed to:

John R. Mills, Esquire
Attorney At Law
201 West Main Street, Suite 301
Durham, NC 27701

Emily C. Paavola, Esquire
Death Penalty and Defense Center
Post Office Box 11311
Columbia, SC 29211

This 14th day of June, 2012.

J. ANTHONY MABRY

STATE OF SOUTH CAROLINA **COUNTY OF HORRY** Louis Michael Winkler, Jr., #6027, Applicant, v. The State of South Carolina, Respondent.	**IN THE COURT OF COMMON PLEAS** C/A No. 2011-CP-26-3907 **REPLY TO APPLICANT'S RETURN TO RESPONDENT'S OBJECTION TO APPLICANT'S NOTICE OF INTENT TO RELY ON AFFIDAVITS AND RESPONDENT'S MOTION TO EXCLUDE STATEMENTS AND AFFIDAVITS** **(Capital Case)**

Respondent, above-named, by and through the Office of the Attorney General, hereby replies to the Return to Respondent's Objection to Applicant's Reliance on Statements and Affidavits. In reply, Respondent would show this Court the following:

1. Contrary to Mr. Mills' assertion, he is not "some person legally authorized to administer an oath or affirmation" in South Carolina. North Carolina law only allows notaries to perform notarial acts within North Carolina. N.C. Gen. Stat. Ann. § 10B-9 (West). Furthermore, Applicant has not shown, and Respondent has not found any South Carolina statute that authorizes attorneys in South Carolina to administer an oath or affirmation based solely on their admission to the bar.

2. The statements notarized by Mr. Mills are not admissible as "other evidence" under S.C. Code Ann. § 17-27-80. At this point, Respondent submits those statements are inadmissible as hearsay. Furthermore, the statements have to be authenticated. Respondent submits that to be authenticated, Applicant must either present the

testimony of those issuing the statements or of the witness to the statement. See Rule 901, SCRE. In light of the fact that Mr. Mills was the person who witnessed the signing of the statements, Respondent believes that the admission of those statements would necessarily render Mr. Mills a potential witness in this proceeding.[1]

3. Applicant is correct in that Respondent did not receive the supplemental responses and answers until June 11, 2012. A note on the envelope of the disclosures indicated it was placed in the wrong post office box. Respondent would note that the address on the envelope does list the wrong post-office box for counsel for Respondent. A copy of the envelope is attached hereto as Exhibit A. Whether service of the affidavits was timely or not, Respondent submits that two weeks' notice did not provide Respondent with enough time to either depose or arrange for the presence of the three out-of-state affiants, and Respondent respectfully reserved the right to request additional time to submit the cross-examination of those witnesses either counter-affidavits or depositions of those individuals if they cannot be obtained before the hearing.

WHEREFORE, premises considered, for the reasons stated above and in the Respondent's Objection to Applicant's Notice of Intent to Rely Upon Affidavits and Respondent's Motion to Exclude Statements and Affidavits, Respondent respectfully requests this Court deny Applicant's request to admit the statements of Philip Randall,

[1] Respondent would note that the affidavit submitted by Mr. Mills with the Applicant's Return supports this conclusion. In the Notice of Intent to Rely on Affidavits, the Applicant noted that it would be within the Respondent's discretion to call any and all witnesses who have provided affidavits for the purposes of cross-examination. (Notice, pg. 2). The same would clearly apply if Applicant intends to submit and rely upon Mr. Mills' affidavit in support of the Applicant's case.

Stephen Fitzwater, Pat White, Frank Patterson, Dickie Caines, Chuck Webster, Jeannie Walker, Carolyn Samuels, Lauren Roughton, Thomas Hardwick, and Jeron Wallingford, along with the affidavits of Edward Genet, John Burch, and Ben Hege. Respondent further requests any other relief this Court deems appropriate.

Respectfully submitted,

ALAN WILSON
Attorney General

JOHN W. McINTOSH
Chief Deputy Attorney General

DONALD J. ZELENKA
Senior Assistant Deputy Attorney General

J. ANTHONY MABRY
Assistant Attorney General

BRENDAN J. McDONALD
Assistant Attorney General

ALPHONSO SIMON JR.
Assistant Attorney General

Post Office Box 11549
Columbia, South Carolina 29211
(803) 734-6305

By: _____
ATTORNEYS FOR RESPONDENT

June 14, 2012.

CERTIFICATE OF SERVICE

I, Alphonso Simon, Jr., counsel for the Respondent, certify that I have served the ***Reply to Applicant's Return to Respondent's Objection to Applicant's Notice of Intent to Rely Upon Affidavits and Respondent's Motion to Exclude Statements and Affidavits,*** by depositing one (1) copy of same in the United States mail, postage prepaid, addressed to:

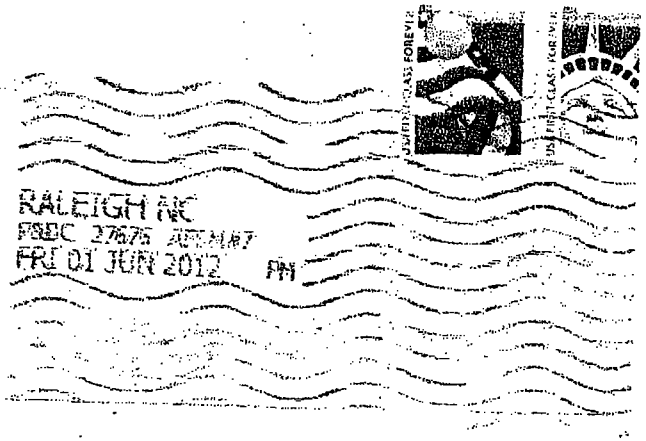
Emily C. Paavola, Esquire
Death Penalty Resource and Defense Ctr
900 Elmwood Ave., Ste. #101
Columbia, SC 29201

John R. Mills, Esq.
201 West Main St., Ste. # 301
Durham, NC 27701

This 14th day of June, 2012.

ALPHONSO SIMON, JR.

Exhibit A



LAW OFFICES OF JOHN R. MILLS
201 W. Main Street, Suite 301
Durham, NC 27705

Mr. Al Simon

SC Attorney General's Office
P.O. Box 1159
Columbia, SC 29211

CERTIFICATE OF SERVICE

I, J. Anthony Mabry, counsel for the Respondent, certify that I have served the *Respondent's Reply to Applicant's Return to Respondent's Objection to Applicant's Notice of Intent to Rely on Affidavits and Respondent's Motion to Exclude Statements and Affidavits* by depositing one (1) copy of same in the United States mail, postage prepaid, addressed to:

John R. Mills, Esquire
Attorney At Law
201 West Main Street, Suite 301
Durham, NC 27701

Emily C. Paavola, Esquire
Death Penalty and Defense Center
Post Office Box 11311
Columbia, SC 29211

This 14th day of June, 2012.

J. ANTHONY MABRY

STATE OF SOUTH CAROLINA)
COUNTY OF HORRY)

IN THE COURT OF COMMON PLEAS

Louis Michael Winkler, Jr.
[x] Plaintiff

v.

State of South Carolina
[ ] Defendant.

CASE NO. 2011 - CP - 26 - 03907

MOTION AND ORDER INFORMATION FORM AND COVER SHEET

Plaintiff's Attorney:	Defendant's Attorney:
John R. Mills, Bar No. 42301	Al Simon, Bar No.
Address: 201 W. Main Street, Suite 301 Durham, NC 27701	Address: P.O. Box 11549 Columbia, SC 29211
phone: 919-251-6259 fax: 919-237-9254	phone: 803-734-6307 fax:
e-mail: john@jrmillslaw.com her:	e-mail: her:

[ ] **MOTION HEARING REQUESTED (attach written motion and complete SECTIONS I and III)**
[ ] **FORM MOTION, NO HEARING REQUESTED (complete SECTIONS II and III)**
[x] **PROPOSED ORDER/CONSENT ORDER (complete SECTIONS II and III)**

SECTION I: Hearing Information

Nature of Motion:
Estimated Time Needed: Court Reporter Needed: [ ] YES / [ ] NO

SECTION II: Motion/Order Type

[ ] Written motion attached
[x] Form Motion/Order

I hereby move for relief or action by the court as set forth in the attached proposed order.

John R. Mills
Signature of Attorney for [x] Plaintiff / [ ] Defendant

6/15/2012
Date submitted

SECTION III: Motion Fee

[ ] PAID – AMOUNT:
[x] EXEMPT: (check reason)
- [ ] Rule to Show Cause in Child or Spousal Support
- [ ] Domestic Abuse or Abuse and Neglect
- [x] Indigent Status [ ] State Agency v. Indigent Party
- [ ] Sexually Violent Predator Act [x] Post-Conviction Relief
- [ ] Motion for Stay in Bankruptcy
- [ ] Motion for Publication [ ] Motion for Execution (Rule 69, SCRCP)
- [ ] Proposed order submitted at request of the court; or, reduced to writing from motion made in open court per judge's instructions

Name of Court Reporter:
- [ ] Other:

JUDGE'S SECTION

[ ] Motion Fee to be paid upon filing of the attached order.
[ ] Other:

JUDGE

CODE: Date:

CLERK'S VERIFICATION

Date Filed:
Collected by:

[ ] MOTION FEE COLLECTED:
[ ] CONTESTED – AMOUNT DUE:

STATE OF SOUTH CAROLINA COUNTY OF HORRY Louis Michael Winkler Jr. Applicant, v. State of South Carolina, Respondent.	IN THE COURT OF COMMON PLEAS Case No. 2011-CP 26-03907 **EX PARTE** **TO BE FILED UNDER SEAL** **MEDICATION ORDER**

This Court hereby orders J. Reuben Long Detention Center to continue Mr. Winkler's current prescription medication schedule during his hearing in Conway. Mr. Winkler shall receive his medication three times each day: once in the morning before court, once with lunch, and once in the afternoon.

AND IT IS SO ORDERED.

Benjamin Culbertson
Circuit Judge

June 15, 2012

Respectfully submitted,

6/15/2012

JOHN R. MILLS
Law Offices of John R. Mills, NPC
201 W. Main Street, Suite 301
Durham, NC 27701
919-251-6259

EMILY C. PAAVOLA
Death Penalty Resource & Defense Center
Post Office Box 11311
Columbia, SC 29211
803-765-1044

http://www.nap.edu/catalog/12162.html

Ballistic Imaging

Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database

Daniel L. Cork, John E. Rolph, Eugene S. Meieran, and Carol V. Petrie, *Editors*

Committee on Law and Justice
Committee on National Statistics

Division of Behavioral and Social Sciences and Education

National Materials Advisory Board

Division on Engineering and Physical Sciences

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu

PETITIONER'S EXHIBIT 7
10/12 BB

Copyright © National Academy of Sciences. All rights reserved

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

THE NATIONAL ACADEMIES PRESS 500 Fifth Street, N.W. Washington, DC 20001

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

The project that is the subject of this report was supported by contract 2003-IJ-CX-1013 between the National Academy of Sciences and the National Institute of Justice. The work of the Committee on National Statistics is provided by a consortium of federal agencies through a grant from the National Science Foundation (Number SBR-0112521). Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the organizations or agencies that provided support for the project.

Library of Congress Cataloging-in-Publication Data

National Research Council (U.S.). Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database.
Ballistic imaging / Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database ; Daniel L. Cork ... [et al.].
p. cm.
Includes bibliographical references and index.
ISBN 978-0-309-11724-1 (pbk. : alk. paper) — ISBN 978-0-309-11725-8 (pdf : alk. paper) 1. Forensic ballistics—Atlases—Data processing—Government policy—United States. 2. Bullets—Identification—Databases. 3. Images, Photographic—Databases. 4. Electronic records—United States—Management—Data processing. I. Cork, Daniel L. II. Title.
HV8077.N38 2008
363.25'62—dc22

2008015181

Additional copies of this report are available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, http://www.nap.edu.

Copyright 2008 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

Second printing with corrections.

Cover illustration and design by Van Nguyen.
Cover images: Gun and bullets images provided by C. Sherburne/PhotoLink ©1999 PhotoDisc, Inc. All rights reserved.

Suggested citation: National Research Council. (2008). *Ballistic Imaging*. Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database. Daniel L. Cork, John E. Rolph, Eugene S. Meieran, and Carol V. Petrie, eds. Committee on Law and Justice and Committee on National Statistics, Division of Behavioral and Social Sciences and Education; National Materials Advisory Board, Division on Engineering and Physical Sciences. Washington, DC: The National Academies Press.

Copyright © National Academy of Sciences. All rights reserved

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

www.national-academies.org

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

COMMITTEE TO ASSESS THE FEASIBILITY, ACCURACY, AND TECHNICAL CAPABILITY OF A NATIONAL BALLISTICS DATABASE

JOHN E. ROLPH *(Chair)*, Marshall School of Business, University of Southern California
EUGENE S. MEIERAN *(Vice Chair)*, Fellow, Intel Corporation, Santa Clara, California
ALFRED BLUMSTEIN, H. John Heinz III School of Public Policy and Management, Carnegie Mellon University
ALICIA CARRIQUIRY, Department of Statistics, Iowa State University
SCOTT CHUMBLEY, Department of Materials Science and Engineering, Iowa State University
PHILIP J. COOK, Sanford Institute of Public Policy, Duke University
MARC DE GRAEF, Department of Materials Science and Engineering, Carnegie Mellon University
DAVID L. DONOHO, Department of Statistics, Stanford University
WILLIAM F. EDDY, Department of Statistics, Carnegie Mellon University
GEORGE (RUSTY) GRAY, Materials Science Division, Los Alamos National Laboratories
ERIC GRIMSON, Department of Electrical Engineering and Computer Science and Department of Medical Engineering, Massachusetts Institute of Technology
DANIEL HUTTENLOCHER, Department of Computing, Information Science, and Business, Cornell University
MICHAEL M. MEYER, Google, Inc., Seattle, Washington
VIJAY NAIR, Department of Statistics and Department of Industrial and Operations Engineering, University of Michigan
ANGELO NINIVAGGI, Plexus Corp., Neenah, Wisconsin
DAVID W. PISENTI, Consultant, Fredericksburg, Virginia
DARYL PREGIBON, Google, Inc., New York, New York
HERMAN M. REININGA, Rockwell Collins, Cedar Rapids, Iowa
JAMES K. (CHIPS) STEWART, CNA Corporation, Alexandria, Virginia
MICHAEL STONEBRAKER, Department of Computer Science, Massachusetts Institute of Technology
HARRY WECHSLER,* Department of Computer Science, George Mason University
JULIA WEERTMAN, Department of Materials Science and Engineering, Northwestern University (emeritus)

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

CAROL V. PETRIE, *Study Director*
DANIEL L. CORK, *Senior Program Officer*
GARY FISCHMAN,** *Director, National Materials Advisory Board*
MICHAEL SIRI, *Senior Program Assistant*
ANTHONY A. BRAGA, *Consultant*
LAWDEN YATES, *Consultant*

*Served until May 2004.
**Served as liaison member to the committee from the National Materials Advisory Board until becoming that board's staff director in March 2005.

Copyright © National Academy of Sciences. All rights reserved

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

COMMITTEE ON LAW AND JUSTICE
2007

JAMES Q. WILSON *(Chair)*, School of Public Policy, Pepperdine University, and Anderson School of Management, University of California, Los Angeles (emeritus)
PHILIP J. COOK *(Vice Chair)*, Sanford Institute of Public Policy, Duke University
DAVID H. BAYLEY, School of Criminal Justice, University at Albany, State University of New York
RICHARD BONNIE, Institute of Law, Psychiatry, and Public Policy, University of Virginia Law School
MARTHA CRENSHAW, Department of Political Science, Wesleyan University
ROBERT CRUTCHFIELD, Department of Sociology, University of Washington
JOHN DIIULIO, JR., Department of Political Science, University of Pennsylvania
STEVEN DURLAUF, Department of Economics, University of Wisconsin, Madison
JOHN FEREJOHN, Hoover Institution, Stanford University
ARTHUR GOLDBERGER, Department of Economics, University of Wisconsin, Madison (emeritus)
BRUCE HOFFMAN, Edmund A. Walsh School of Foreign Service, Georgetown University
ROBERT L. JOHNSON, Office of the Dean, New Jersey Medical School
JOHN H. LAUB, Department of Criminology and Criminal Justice, University of Maryland
TRACEY MEARES, Yale Law School
TERRIE MOFFITT, Department of Psychology and Neuroscience, Duke University
MARK MOORE, Kennedy School of Government, Harvard University
RUTH PETERSON, Department of Sociology, Ohio State University
RICHARD ROSENFELD, Department of Criminology and Criminal Justice, University of Missouri, St. Louis
ROBERT J. SAMPSON, Department of Sociology, Harvard University
JEREMY TRAVIS, Office of the President, John Jay College of Criminal Justice
CHRISTY VISHER, Department of Sociology and Criminal Justice, University of Delaware

CAROL V. PETRIE, *Director*

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

COMMITTEE ON NATIONAL STATISTICS
2008

WILLIAM F. EDDY *(Chair)*, Department of Statistics, Carnegie Mellon University
KATHARINE ABRAHAM, Department of Economics and Joint Program in Survey Methodology, University of Maryland
WILLIAM DUMOUCHEL, Lincoln Technologies, Inc., Waltham, Massachusetts
JOHN HALTIWANGER, Department of Economics, University of Maryland
V. JOSEPH HOTZ, Department of Economics, Duke University
KAREN KAFADAR, Department of Statistics, Indiana University
DOUGLAS MASSEY, Department of Sociology, Princeton University
SALLY MORTON, Statistics and Epidemiology, RTI International, Research Triangle Park, North Carolina
VIJAY NAIR, Department of Statistics and Department of Industrial and Operations Engineering, University of Michigan
JOSEPH NEWHOUSE, Division of Health Policy Research and Education, Harvard University
SAMUEL H. PRESTON, Population Studies Center, University of Pennsylvania
KENNETH PREWITT, School of International and Public Affairs, Columbia University
LOUISE RYAN, Department of Biostatistics, Harvard University
ROGER TOURANGEAU, Survey Research Center, University of Michigan, and Joint Program in Survey Methodology, University of Maryland
ALAN ZASLAVSKY, Department of Health Care Policy, Harvard Medical School

CONSTANCE F. CITRO, *Director*

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

NATIONAL MATERIALS ADVISORY BOARD
2007

KATHARINE G. FRASE *(Chair)*, IBM Corporate Technology and Intellectual Property, Somers, New York
LYLE H. SCHWARTZ *(Vice Chair)*, Consultant, Chevy Chase, Maryland
JOHN ALLISON, Ford Research Laboratories, Dearborn, Michigan
PAUL BECHER, Metals and Ceramic Division, Oak Ridge National Laboratory
CHERYL R. BLANCHARD, Zimmer, Inc., Warsaw, Indiana
EVERETT E. BLOOM, Metal and Ceramics Division, Oak Ridge National Laboratory
BARBARA D. BOYAN, Wallace H. Coulter Department of Biomedical Engineering, Georgia Institute of Technology
L. CATHERINE BRINSON, Departments of Mechanical Engineering and Materials Science and Engineering, Northwestern University
JOHN W. CAHN, University of Washington
DIANNE CHONG, Materials and Process Technology and Structural Technology, Prototyping and Quality, The Boeing Company, St. Louis, Missouri
PAUL CITRON, Medtronic, Inc., Minneapolis, Minnesota (retired)
FIONA DOYLE, Department of Materials Science and Engineering, University of California, Berkeley
SOSSINA M. HAILE, Associate Professor of Materials Science and of Chemical Engineering, California Institute of Technology
CAROL A. HANDWERKER, Department of Materials Engineering, Purdue University
ELIZABETH HOLM, Sandia National Laboratories, Hoboken, New Jersey
ANDREW T. HUNT, *n*Gimat Company, Atlanta, Georgia
DAVID W. JOHNSON, JR., Senior Advisor, Stevens Institute of Technology
ROBERT H. LATIFF, SAIC, Alexandria, Virginia
TERRY LOWE, Los Alamos National Laboratory
KENNETH H. SANDHAGE, Department of Materials Science and Engineering, Georgia Institute of Technology
LINDA SCHADLER, Materials Science and Engineering, Rensselaer Polytechnic Institute
ROBERT E. SCHAFRIK, Materials and Process Engineering Department, GE Aircraft Engines, Cincinnati, Ohio
JAMES C. SEFERIS, Department of Chemical Engineering, University of Washington
SHARON L. SMITH, Advanced Technologies, Lockheed Martin Corporation, Bethesda, Maryland

GARY FISCHMAN, *Director*

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Preface

The Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database is pleased to submit this final report and wishes to thank the many people who have contributed to our work over the committee's lifetime.

This project was sponsored by the National Institute of Justice (NIJ), Office of Justice Programs, U.S. Department of Justice. We are grateful for the support of NIJ staff and their participation in our meetings. We are particularly indebted to Christopher Miles, the program manager for this project, and to John Morgan, deputy director, NIJ Office of Science and Technology, for their assistance and their patience as our committee worked through this complex project.

Through a separate contract initiated by NIJ, the National Institute of Standards and Technology (NIST) was engaged to conduct experiments in support of the committee's work. As described in Chapters 7 and 8 of this report, NIST's work for the panel focused on the potential of one possible major enhancement to current ballistic imaging technology: a change from two-dimensional photography to three-dimensional surface measurements. Just as this committee required extensive collaboration between disparate units within the National Academies and representation from a breadth of disciplines, so too did the NIST experimental work for the committee draw together staff from several NIST units, and we have benefited greatly from this collaboration. Susan Ballou, Office of Law Enforcement Standards, provided excellent oversight of the NIST team, and Theodore Vorburger, Surface Metrology Division, was unstinting in his zeal for this work. NIST subcontracted and partnered in this work with Benjamin Bachrach of

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Intelligent Automation, Inc., whose insights from past and current three-dimensional analysis of bullet and cartridge evidence gave shape to many of the committee's discussions. As the work developed, James Filliben of NIST's statistical unit oversaw the final experiment design and analysis plan, and he provided outstanding assistance. We are grateful to all the current and former NIST staff who worked on this project, including Dewey Foreman, John Libert, Brian Renegar, Mike Riley, John Song, James Yen, and Alan Zhang.

Throughout the panel's deliberations, we benefited from the counsel of two consultants, Anthony Braga and Lawden Yates. Braga, a senior research associate and lecturer at the Kennedy School of Government at Harvard University, provided empirical analysis and extended and elaborated on previous work on the use of ballistic imaging in the Boston area. His paper on the latter topic appears as Appendix A.

When the committee was being formed, it was decided not to include an active firearms examiner. Instead, the committee had the counsel of Lawden Yates, a former firearms and toolmark examiner and laboratory director, who also served as general counsel to the Alabama Department of Forensic Sciences and as assistant district attorney for Blount and Saint Clair Counties, Alabama. He provided invaluable information and advice to the committee on a range of technical matters.

Though motivated by questions concerning a new data collection system, this project also required a comprehensive review and assessment of the current National Integrated Ballistic Information Network (NIBIN) Program of the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). The ATF responded to our requests with exceptional openness and enthusiasm. In particular, we are grateful for the assistance of Benjamin Wilson, firearms project manager at ATF's Office of Laboratory Services. The committee's analyses, described in Chapter 8, required image acquisition and analysis by staff at ATF's Ammendale, Maryland, laboratory; we appreciate the effort of firearms examiner Martin Ols and the other ATF examiners who contributed to this work. We also appreciate the initial guidance to our work provided by Robert Thompson and by Patricia Galupo, former director of the NIBIN program. ATF afforded the committee and staff the opportunity to participate in a meeting of its NIBIN Users' Congress, which proved most valuable.

In March 2005, a nondisclosure agreement was negotiated between Forensic Technology WAI Inc. (FTI) and the National Academies to facilitate a site visit to FTI's headquarters in Montréal by selected members of the committee. FTI is the creator and manufacturer of the equipment and software (IBIS) used by the nation's forensic laboratories to create and maintain a database of ballistic images consisting of evidence collected from crime scenes or confiscated during arrests. The nondisclosure agreement

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

covered information about this system that FTI and the National Academies Office of Legal Counsel agreed are proprietary within the meaning of Exemption 4 of the U.S. Freedom of Information Act, 5 U.S.C. Section 552(b)(4). The meeting, which took place at FTI's offices in Montreal on March 22, provided a detailed understanding of the features and capabilities of the imaging technology developed by FTI. Only information that was not designated as proprietary information is included, referenced, or quoted in this final report. The committee is grateful to FTI for its cooperation and for the high degree of professionalism and scientific competence it demonstrated at this meeting.

We are particularly grateful for a thoughtful and candid discussion with FTI technical staff; both Michael McLean, project manager for the Integrated Ballistics Identification System (IBIS), and Pete Gagliardi, vice president of marketing and strategic planning, took special interest in the committee's work and provided much useful information. Along with McLean, Alain Beauchamp gave a useful presentation at a committee meeting and responded to other committee requests for information. We appreciate the contributions of other past and present FTI staff, including Robert Walsh, chairman and president; René Bélanger, vice president and general manager; John O'Neil, firearms examiner consultant; Michael Clamen; Cybele Daley; Tim Heaney; Serge Labrecque; and Danny Roberge.

Gerald Zeosky, inspector and director of the New York State Police Forensic Investigation Center (FIC), and John Hicks, director of forensic services for the New York State Division of Criminal Justice Services, were invited to a committee meeting to describe their state's Combined Ballistic Information System (CoBIS), a state-level reference ballistic image database. Following that presentation, both men then invited the committee and staff to the FIC in Albany to perform experimental runs on the CoBIS database. During that visit (and a follow-up visit by committee staff), FIC staff gave freely of their time and talent; for this, we are particularly grateful to Rebecca Barretta, James Campbell, Mike D'Allaird, Craig Grazier, and Mark Heller.

Similarly, a presentation to the committee by deputy chief Denis McCarthy of the New York City Police Department (NYPD) led to an invitation to visit and perform limited analyses using the NYPD's ballistic image database, which uses the same technology as the NIBIN program but is not directly linked. At that visit to the NYPD crime laboratory in Jamaica, Queens, Lt. James Kenny, commanding officer of the firearms analysis section, and detective Anthony Pellicio, firearms examiner and microscopist were extremely helpful.

Over the course of the study, every committee member visited at least one NIBIN installation at a state or local law enforcement agency, and various members also visited the ATF national laboratories in Ammendale,

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Maryland, and Walnut Creek, California. We thank all involved for their time and talent. Subgroups of the committee also visited firearms and ammunition manufacturers and developers of microstamping technologies. We are grateful to all those who helped make the visits smooth and informative, including from Federal Cartridge Company, Gary Svendsen, Mike Larsen, Mike Hollen, Ken Croteau, and Rick Vickerman; from Hi-Point Firearms, Tom Deeb; and from Beretta Firearms, Jeffrey Reh, general counsel. Todd Lizotte of Hitachi Via Electronics attended a committee meeting and generously spent time discussing the microstamping of firing pins and other firearms parts at his facility in Londonderry, New Hampshire. Ammunition Coding Systems, a Seattle-based firm acting as a proponent of a methodology for microstamping ammunition that was then under active consideration by the California legislature, convened a very helpful session with the firm's staff and related contractors in Seattle for a group of committee members. We thank Steven Mace, Russell Ford, John Knickerbocker, David Howell, Patrick Grace, and Paul Curry for their guidance in that meeting. We also appreciate the participation of Randy Rossi, California Department of Justice, in the Seattle subcommittee discussion.

Ann Davis, Virginia Division of Forensic Sciences, was president of the Association of Firearm and Tool Mark Examiners (AFTE) when our committee began operations. She offered comments at our first meeting and assembled a liaison committee to interact with the committee as needed; for these contributions, we are grateful. Lucien Haag (Forensic Science Services, Inc., Carefree, Arizona) attended and participated in a panel discussion at a committee meeting in Chandler, Arizona, and subsequently discussed trials that he had performed on microstamped firing pins for a committee meeting in Washington; we thank him for the information he shared with us.

We appreciate the time taken by other experts to present issues to our committee, including Kenneth Green of the Sporting Arms and Ammunition Manufacturers' Institute, Inc., and Marianne Hinkle, former assistant U.S. attorney for the district of Massachusetts. At the committee's meeting in Chandler, Arizona—hosted by committee vice chair Eugene Meieran at Intel Corporation—we made use of the fact that several NIBIN sites are located in the Phoenix metropolitan area. Representatives of the various NIBIN-hosting law enforcement agencies participated in a very useful panel discussion: they included Judie Welch, Eric Brown, and Randy Leister of the Phoenix Police Department Crime Laboratory; Patrick Chavez of the City of Mesa Crime Laboratory; Steve Valdez of the City of Scottsdale Crime Laboratory; Dustin Engel of the Maricopa County Sheriff's Office; and Vince Figarelli and Lisa Peloza of the Arizona Department of Public Safety.

Emily Ann Meyer provided initial literature collection for the committee during her service as a research associate with the National Materials

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Advisory Board (NMAB). Michael Siri, senior program assistant with the Committee on National Statistics (CNSTAT) deftly provided logistical support to the committee in the later phases of its work; he was preceded as program assistant and coordinator for the committee's activities by Ralph Patterson during his tenure with the Committee on Law and Justice. Special thanks are due to Barbara Boyd for pinch-hitting as program assistant for one of our committee meetings during a gap in staffing and for generally providing back-up assistance when needed. Toni Marechaux, former director of the NMAB, contributed to the formation of the committee and its early work, and we have also benefited from the counsel of Constance Citro, CNSTAT director, and Jane Ross, director of the Center for Economic, Governance, and International Studies of the Division of Behavioral and Social Sciences and Education.

We were extremely fortunate to have two experienced and extremely capable individuals as staff: Carol Petrie and Daniel Cork. Carol was particularly helpful in the process of forming the committee, managing the panel's consultations with its sponsor and other external parties, organizing meetings, and stewarding this report through the Academies' review process. Dan managed much of the panel's analytic work and had primary responsibility for drafting the report. Together they organized the work of the committee and guided its evaluation of the NIBIN program and its consideration of a national reference ballistic image database. To say we have benefited enormously from their talents and knowledge and are very grateful to have had the opportunity to work with them is a considerable understatement. Regardless of the committee's expertise and commitment, this report would have significantly less value than we believe it does have, but for Carol's and Dan's contributions.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the Report Review Committee of the National Research Council (NRC). The purpose of this independent review is to provide candid and critical comments that will assist the institution in making the published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

We thank the following individuals for their participation in the review of this report: William A. Ellingson, Nuclear Engineering Division, Argonne National Laboratory; David L. Faigman, Hastings College of Law, University of California, San Francisco; Stephen E. Fienberg, Department of Statistics, Carnegie Mellon University; Barry A.J. Fisher, Los Angeles County Sheriff's Department Crime Laboratory, Los Angeles, California; David C. Hoaglin, Abt Associates Inc., Cambridge, Massachusetts; Paul

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

F. Johnson, Emeritus Professor of Ceramic Engineering, Alfred University, Alfred, New York; Alan F. Karr, Director's Office, National Institute of Statistical Sciences, Research Triangle Park, North Carolina; Diane Lambert, Google, Inc., New York, New York; Lyle H. Schwartz, Consultant, Chevy Chase, Maryland; Pete Striupaitis, Northeastern Illinois Regional Crime Laboratory, Vernon Hills, Illinois; Charles F. Wellford, Department of Criminology, University of Maryland; and James Q. Wilson, School of Public Policy, Pepperdine University.

Although the reviewers listed above provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations nor did they see the final draft of the report before its release. The review of the report was overseen by John C. Bailar, III, Professor Emeritus, Department of Health Studies, The University of Chicago, and Hyla S. Napadensky, Office of President, Napadensky Energetics, Inc., Grand Marais, Minnesota. Appointed by the NRC, they were responsible for making certain that an independent examination of the report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring panel and the institution.

John E. Rolph, *Chair*
Eugene S. Meieran, *Vice Chair*
Committee to Assess the Feasibility, Accuracy, and
Technical Capability of a National Ballistics Database

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Contents

Executive Summary 1

Part I Context for Ballistic Imaging Analysis

1 Introduction 11
2 Firearms and Ammunition: Physics, Manufacturing, and Sources of Variability 30
3 Firearms Identification and the Use of Ballistic Evidence 53

Part II Current Ballistic Imaging and Databases

4 Current Ballistic Imaging Technology 91
5 Current Ballistic Image Databases: NIBIN and the State Reference Databases 133
6 Operational and Technical Enhancements to NIBIN 162
7 Three-Dimensional Measurement and Ballistic Imaging 186

Part III Implications for a National Reference Ballistic Image Database

8 Experimental Evidence on Sources of Variability and Imaging Standards 199
9 Feasibility of a National Reference Ballistic Image Database 223

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Part IV Future Directions

10 Microstamping: Alternative Technology for Tracing to Point of Sale 255
11 Best Standards for Future Developments in Computer-Assisted Firearms Identification 272

References 281

Appendixes
A Gun Enforcement and Ballistic Imaging Technology in Boston 293
Anthony A. Braga
B Biographical Sketches of Committee Members and Staff 312

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Tables, Figures, and Boxes

TABLES

1-1 Gun Homicides and Crime Gun Recoveries in 32 Cities in 2000, 25

4-1 Summary Results of George Study of IBIS Cartridge Case Comparison Performance, 114
4-2 Summary Results of Forensic Technology WAI, Inc., Benchmark Evaluation, 120

5-1 NIBIN Usage Data, May 2003–April 2004, 152

8-1 Number of Same-Gun Matches Found in Top 10 Ranks, Two-Dimensional/IBIS Analysis of DKT Exhibit Set, 208
8-2 Number of Same-Gun Matches Found in Top 10 Ranks, Three-Dimensional/NIST Analysis of DKT Exhibit Set, 209
8-3 Number of Same-Gun Matches Found in Top 10 Ranks, Two-Dimensional/IBIS Analysis of NBIDE Exhibit Set, 210
8-4 Number of Same-Gun Matches Found in Top 10 Ranks, Three-Dimensional/NIST Analysis of NBIDE Exhibit Set, 211
8-5 Summary of IBIS Comparisons for Full 144-Exhibit NBIDE Set, 213
8-6 Summary of Overlap Metrics for Three-Dimensional Images, 215
8-7 IBIS Comparison Results, DKT Exhibit Set Extract in CoBIS Database, 220

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

9-1 Firearms Manufactured in and Exported from the United States, 2002–2004, 225
9-2 Values of $K(\alpha)$ for Various Configurations of N and α for the Optimistic Scenario, 248
9-3 Values of $K(\alpha)$ for Various Configurations of N and α for the Pessimistic Scenario, 249
9-4 Values of $K(\alpha)$ for Various Configurations of $n_1 - 1$, n_2, Δ_1, Δ_2, and α for the Optimistic Scenario, 250
9-5 Values of $K(\alpha)$ for Various Configurations of $n_1 - 1$, n_2, Δ_1, Δ_2, and α for the Pessimistic Scenario, 251

A-1 Staffing Levels of the Boston Police Department Ballistics Unit, 1993–2003, 300
A-2 Crime Types in 104 Sets of Boston IBIS-Suggested Matches, 303
A-3 Results of Information Linked by IBIS-Suggested Matches on Investigations by Boston Law Enforcement Agencies, 2003, 305

FIGURES

1-1 Crimes committed with firearms, 1973–2003, 23
1-2 Firearms crime rates, 1973–2003, 24
1-3 Homicides committed with firearms, 1973–2003, 24

2-1 Breech faces with firing pin holes: Two firearms, 33
2-2 Breech face markings and firing pin impressions for three ammunition types and two firearm brands, 42

4-1 IBIS breech face images, 99
4-2 Sample "cover sheet:" Top 10 ranking report from an IBIS comparison, 105
4-3 Sample matched pairs of breech face and firing pin images, 119

5-1 Geographic distribution of NIBIN sites, 140

8-1 IBIS two-dimensional images and rendered three-dimensional surfaces, breech face, and firing pin impressions from one casing, 205
8-2 Empirical distribution of matching and nonmatching pairwise comparisons, 214

A-1 Types of investigative information linked by IBIS-suggested matches, 296
A-2 Boston Police Department ballistics matches, 1990–2003, 299

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

A-3 Serious gun crime incidents in Boston, 1990–2003, 299
A-4 Recovered handguns in Boston, 1991–2003, 302

BOXES

1-1 "Ballistics" Terminology, 15
1-2 Content of a Reference Ballistic Image Database, 16

2-1 Nonfiring Manufacturing Marks, 51

3-1 Association of Firearm and Tool Mark Examiners (AFTE) Theory of Identification and Range of Conclusions, 59
3-2 Examples of Subclass Carryover, 61
3-3 Highlights in the History of Traditional Firearms Identification, 62
3-4 Recent Court Decisions: "To the Exclusion of All Other Guns," 83

4-1 "IBIS" Terminology, 94
4-2 *CSI* Ballistic Imaging, 125

5-1 Criteria for Participation in the NIBIN Program, 135
5-2 DRUGFIRE, 136
5-3 NIBIN Definition of "Hit," 151

6-1 Recommendations from 2005 U.S. Department of Justice Inspector General Audit of NIBIN Program, 164
6-2 New York City Police Department "Fast Brass" Processing, 171

8-1 Design of Test-Fire Cartridge Sets, 201
8-2 Exhibit Set Tested in Work with CoBIS Database, 219

9-1 Tracing Guns, 228

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Executive Summary

Since the late 1980s computerized imaging technology has been used to assist forensic firearms examiners in finding potential links between images of ballistics evidence gathered from crime scene investigations, namely, cartridge cases and bullets from fired guns. To support this effort, the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) in 1997 formed the National Integrated Ballistic Information Network (NIBIN). Law enforcement agencies participating in NIBIN contribute to a database of images of bullet and cartridge case evidence recovered from (or test-fired from weapons linked to) crime scenes. This system facilitates rapid comparison with archived evidence and with evidence gathered at other crime sites; when matches look promising, the physical evidence can be retrieved for direct examination and confirmation by an examiner. NIBIN was designed as a tool for search, not for verification, which is always done by an examiner.

The rapid development of computerized ballistic imaging technology has led to speculation about its future potential. A particularly interesting proposal is to create a national reference ballistic image database (RBID) that would house images from firings of all newly manufactured or imported firearms. Proponents of this proposal argue that such a database could provide a quick investigative lead from evidence recovered at a crime scene to the underlying firearm's original point of sale. State RBIDs already exist in Maryland and New York, and wide attention was drawn to the issue when California studied the feasibility of creating its own RBID.

In 2004 the National Institute of Justice (NIJ) of the U.S. Department of Justice requested that the National Academies appoint a committee of

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

experts to address the issues raised by the computerized ballistic imaging technology. The Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database was asked to "assess the feasibility, accuracy and reliability, and technical capability of developing and using a national ballistics database as an aid to criminal investigations." To accomplish this, the panel's charge is to:

> (1) Assess the technical feasibility, through analysis of the uniqueness of ballistic images, the ability of imaging systems to capture unique characteristics and to parameterize them, the algorithmic and computational challenges of an imaging database, the reproducibility of ballistic impressions and the ability of imaging systems to extract reproducible information from ballistic impressions.
>
> (2) Assess the statistical probabilities that ballistics evidence presented would lead to a match with images captured in a database, whether and how the base rate can be estimated for those crimes that present bullet or casing evidence that do in fact come from a gun that produced a database entry, and the probabilities and consequences of false positives and false negatives.
>
> (3) Assess the operational utility of ballistics evidence in criminal investigations—that is the extent to which it is used or can be used to identify crime guns and suspects and to solve specific crimes.
>
> (4) Assess the sources of error in ballistics database matching (from examination, digitization, computer matching, chain of custody and documentation of tests, and expert confirmation), how they may be quantified, and how these errors interact.

The charge continues:

> The committee's work will provide scientific and technical knowledge to inform the government's deliberations on three policy options with regard to ballistics databases:
>
> (1) Maintain the National Integrated Ballistic Information Network (NIBIN) on ballistics recovered from crime scenes. It is operated by the Bureau of Alcohol, Tobacco, and Firearms.
>
> (2) Enhance the NIBIN system so that it can be used to match crime scene evidence with the gun used.
>
> (3) Establish a national ballistics database of images from bullets fired from all, or nearly all, newly manufactured or imported guns for the purpose of matching ballistics from a crime scene to a gun and information on its initial owner.

Addressing the issues raised by the tasks of the charge permitted the committee to provide guidance to NIJ on the three federal policy options. Specifically, for option 2, enhancing the NIBIN system, we address how

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

to increase its effectiveness as a search tool, including changes to the basic imaging standard used by the system, and improving procedures for working with the existing hardware and software. For option 3, establishing a national RBID, the committee considers it a counterpart to NIBIN, containing images of ballistic samples from all newly manufactured and imported weapons. The committee also considered the feasibility of alternative technologies that could achieve the same goal as a national RBID. These alternative technologies include microstamping to imprint a known, unique marker on firearms parts or ammunition: analysis of such marks would complement or perhaps replace the need to examine the currently used toolmarks.

Underlying the specific tasks with which the committee was charged is the question of whether firearms-related toolmarks are unique: that is, whether a particular set of toolmarks can be shown to come from one weapon to the exclusion of all others. Very early in its work the committee found that this question cannot now be definitively answered.

Finding: The validity of the fundamental assumptions of uniqueness and reproducibility of firearms-related toolmarks has not yet been fully demonstrated.

Notwithstanding this finding, we accept a minimal baseline standard regarding ballistics evidence. Although they are subject to numerous sources of variability, firearms-related toolmarks are not completely random and volatile; one can find similar marks on bullets and cartridge cases from the same gun.

A significant amount of research would be needed to scientifically determine the degree to which firearms-related toolmarks are unique or even to quantitatively characterize the probability of uniqueness. Assessing uniqueness at, say, a submicroscopic level, though probably technically possible, would be extremely difficult and time consuming compared with less definitive but more practical and generally available methods at the macroscopic level. It is an issue of policy and of economics as to whether doing so would be worthwhile. The committee did not and could not undertake such research, nor does it offer any conclusions about undertaking such research. Although it appears to the committee that the needs for research are extensive, specifying the nature of that research was not part of the committee's charge. We also note that the committee does not provide an overall assessment of firearms identification as a discipline nor does it advise on the admissibility of firearms-related toolmark evidence in legal proceedings: these topics are not within its charge.

The committee's charge is to determine the extent to which the toolmarks left on bullets and cartridge casings after firing a weapon can be

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

captured by imaging technology. It is also to assess whether a ballistic image database—particularly a national RBID containing images of exhibits fired from all newly manufactured and imported guns—would be feasible and operationally useful, by which we mean capable of generating leads for follow-up and further investigation. Whether or not toolmarks are unique to a given weapon does not preclude the committee from addressing this charge. Indeed, in many situations a sufficient level of toolmark reproducibility can be picked up by imaging or other measurement systems to be useful for narrowing a search down to a set of possible weapons, as is currently done. The final determination of a "match" is made by a human examiner.

FEASIBILITY OF A NATIONAL REFERENCE BALLISTIC IMAGE DATABASE

Independent of the reliability and effectiveness of the technology used in making comparisons of images in a national RBID, there would be significant limitations in the usefulness of such a database. Most importantly, there is a huge existing supply of weapons and ammunition that would not be entered into the database. In addition, revolvers do not eject cartridge cases at crime scenes as do other handguns. Consequently, even under the best of circumstances, when random variability is kept to a minimum, the database itself would be incomplete. Finally, to implement a national RBID, national protocols would have to be created for the test firing of new and imported guns; ensuring that test-fired cartridge cases or bullets are correctly packaged with their corresponding firearm and maintaining a chain of custody for the exhibits after they are imaged would create a formidable logistical challenge.

In our detailed assessment, three additional points regarding the implementation of a national RBID have particular salience.

First, the current technology in use for automated toolmark comparison, based on two-dimensional greyscale images, is useful for gross categorization and sorting of large quantities of evidence. However, it is less reliable for distinguishing extremely fine individual marks that would be necessary to make successful matches in RBIDs in which large numbers of exhibits on file would share gross class and subclass characteristics.

Second, basic probability calculations under reasonable assumptions suggest that the process of identifying a subset of possible matches that contains the true match with a specified level of certainty depends critically on as-yet underived measures of similarity between and within gun types. This process is very likely to return too large a subset of candidates to be practically useful for investigative purposes.

Third, the large influence of ammunition type and variability introduces a significant source of error in identification. A standard, protocol type of

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

ammunition could be specified in an RBID (as it is in NIBIN), but it is likely not to correspond with the ammunition actually used in a crime; the choice of protocol ammunition, or a requirement to use multiple ammunition types, would have significant financial implications for both ammunition and firearm manufacturers, as well as on the information systems involved.

Conclusion: A national reference ballistic image database of all new and imported guns is not advisable at this time.

MAINTAIN OR ENHANCE NIBIN

By facilitating access by state and local law enforcement agencies to ballistic imaging technology, the NIBIN program provides a valuable service in helping to solve gun-related crimes. However, agencies differ in the degree to which they use the NIBIN resources and, consequently, they differ markedly in the benefits they derive in establishing links between crimes and investigative leads. The committee's principal task includes offering guidance on either maintaining NIBIN as it currently operates or enhancing it in various ways to improve its effectiveness. The former is not really a viable option: there are always opportunities for improvement in any program, particularly one as broad as NIBIN.

Conclusion: NIBIN can and should be made more effective through operational and technological improvements.

To this end, the committee offers 15 specific recommendations to improve NIBIN's performance and effectiveness. Seven of the recommendations are oriented principally at the operation of the NIBIN program itself and the practices of NIBIN partner agencies, and they address:

- priority for NIBIN entry of cartridge casings collected from crime scenes;
- ballistic imaging as a part of the criminal investigation process for state and local agencies;
- cross-jurisdictional tally of hits using the NIBIN system;
- streamlining of the ballistic image acquisition process and reporting requirements;
- development of "best practices" in using NIBIN;
- a protocol for the entry of more than one exhibit from the same crime scene or test firing; and
- allocation of NIBIN system technology.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

We also offer eight specific recommendations for enhancing the current technical platform for the NIBIN program, the Integrated Ballistics Identification System (IBIS), and the hardware and software system developed by Forensic Technology WAI, Inc. These eight recommendations address:

- research on the distributions of comparison scores;
- an "audit trail" in the NIBIN system's hardware and software systems;
- ammunition brand information in NIBIN;
- the capacity for national or cross-regional searches against the NIBIN database;
- NIBIN's database partition structure;
- enhancements to the NIBIN interface;
- side-light imagery of breech face impressions; and
- the 20 percent threshold used in the IBIS.

In support of this study, the National Institute of Standards and Technology (NIST) was separately contracted by NIJ to perform experimental work at the committee's request. This experimental work considered the value of one major technical enhancement to the current NIBIN system: a change in imaging standard from two-dimensional, greyscale photography to three-dimensional surface measurement using noncontact microscopy. NIST's work included analysis of an extract of cartridges from one of the major existing studies of ballistic imaging performance as well as a new dataset of test-fired cartridges designed by the committee. The work highlights the promise of three-dimensional surface measurement, which performs comparably with—and, for some cartridge markings, often better than—the current two-dimensional methodology. However, there are major substantive challenges—among them the reduction of data collection time and the refinement of image comparison algorithms that make use of three-dimensional information but are still compatible with existing two-dimensional imagery—that need to be addressed before full consideration can be given to adopting the new standard.

ALTERNATIVE TECHNOLOGIES

The goal of a national reference ballistic image database is to provide an investigative link from ballistics evidence to the point of sale of the weapon or ammunition used in a crime. The same goal could be achieved through an entirely different approach, microstamping, which is to place a known, unique, and unalterable identifier on gun parts, cartridge cases, or bullets at the time of manufacture. These uniquely microstamped products could then be associated with their purchaser when sold. Microstamping, if

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

feasible and practical, would have the advantage of imposing uniqueness as a characteristic of ballistics evidence, substituting known and fixed markings for microscopically fine, individualizing characteristics that result from random processes in manufacture and weapon firing.

A distinct advantage of microstamping is that the marks could be examined at a crime scene using equipment no more sophisticated than a magnifying glass, vastly simplifying and speeding up the process of developing investigative leads. The state of California recently passed a law, to take effect in 2010, which requires microstamping on internal parts of new semiautomatic pistols. However, the committee believes that for such a technology to be implemented successfully, in-depth investigations on several topics are needed. These topics include the reliability and durability of the marks in a variety of firing conditions, their susceptibility to tampering and countermeasures, whether it would be best to place them on guns or ammunition or both, and the cost implications and feasibility of adding a microstamping process to established manufacturing processes.

PROCESS FOR IMPROVING COMPUTER-ASSISTED FIREARMS IDENTIFICATION

The current technology used in automated examination of images of ballistics evidence is produced and maintained by a single vendor. As a result, it does not benefit from the improvements that could be gained through competition and vetting among the broader research community, and its potential for advancement and innovation is limited. The committee suggests that improvements in matching ballistics evidence be made through government procurement efforts that demonstrate best practices.

Two recent examples of government-mandated large-scale imaging system developments based on initially, nonmature technologies include systems for fingerprint identification and for facial recognition. Both systems required the creation of dedicated pattern recognition algorithms, similar to the requirements of NIBIN. Instead of relying on a single system produced by a single vendor, both systems were organized as competitions between vendors with the goal of advancing the technology as quickly as possible. Both competitions required that well-vetted datasets from several sources be made available to researchers so that the correct features could be identified for extraction. Finally, the results of both competitions were subjected to independently administered evaluations, using well-defined and published evaluation methodologies that allowed for a direct quantitative assessment of the relative strengths and weaknesses of different approaches.

This approach to procurement—removing strict dependence on a sole-source provider and ensuring government ownership of and access to

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

result data—should be applied for all work related to the improvement in ballistics evidence analysis, including large-scale two-dimensional image search engines, three-dimensional topographical techniques, and micro-stamping processes.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

3

Firearms Identification and the Use of Ballistics Evidence

This chapter provides a key context for the next part of the report by examining the nature of ballistics evidence itself and the ways it has been analyzed and used over the past century. Since the primary focus in this study is the ability of computer-based systems to discern unique characteristics in ballistics evidence on the basis of images of different sorts, it is useful to first consider how uniqueness and reproducibility of characteristic marks have been discerned through the particular media of the comparison microscope and the human eye.

We briefly describe the general nature of toolmarks as evidence (Section 3–A) and then outline the basic history and theory of firearms identification (3–B). Section 3–C summarizes the literature on the uniqueness, reproducibility, and permanence of marks as detected by traditional methodology. The circumstances of firing a weapon, the manufacture of firearms and ammunition, and measures taken (or not taken) by firearms users can all pose various complications to the identification and linking of ballistics evidence; we review some of these issues in Section 3–D. Section 3–E offers key commentary on the scope of the committee's work in the context of the material in this chapter. The final section (3–F) briefly describes the general role of imaging and photography in firearms identification, as a prelude to the next section of the report.

3–A TOOLMARKS AS EVIDENCE

Various branches of forensic science—dealing with the analysis of evidence as diverse as handwriting samples and soil or mineral samples—are

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

increasingly compared with one of their sister branches: the analysis of deoxyribonucleic acid (DNA) markers and identification based on those markers. As we note in Section 1–C, the term "ballistic fingerprinting" has also come into common (albeit somewhat inaccurate) usage to describe some features of firearms identification, suggesting a comparison with fingerprint evidence.

Firearms toolmark evidence differs from DNA and fingerprint evidence due to their basic point of reference: the former links to a particular firearm while the latter two link to a particular person. Links between pieces of ballistics evidence can point to a common gun from which exhibits were fired, but not necessarily to the same person pulling the trigger. A potential match suggested by a national reference ballistic image database could suggest a link from a piece of crime scene evidence to an original firearm point of sale, but that link is at least doubly indirect: the link is only to the location of the transaction and not immediately to the firearm's purchaser, and subsequent identification of the purchaser does not necessarily mean that the purchaser still possesses the gun (or fired the shot in a crime). However, it is important to consider that—alone, absent any other evidence or knowledge of circumstances—even person-specific fingerprint and DNA evidence is necessarily one step removed and indirect. It is possible for fingerprint or DNA evidence to be present and retrievable at crime scenes without its source person having been the crime's perpetrator. Forensic evidence can be used—in combination with other investigative findings—to develop a theory of what transpired at the scene and who may have committed the crime, but the link to any specific person from the ballistics evidence alone is necessarily indirect.

Toolmark evidence and DNA evidence are markedly different in another crucial respect, which is the subjectivity inherent in the analysis. Firearms identification ultimately comes down to a subjective assessment—specifically, a subjective probability statement (although practitioners often render these as absolute statements). Firearms examiners observe concrete, objective phenomena, but—as Thornton and Peterson (2002:24–25) observe, "there is an incredible amount of difficulty attached to the development of a statistical basis for evidence evaluation" in forensic science fields like firearms examination:

> Behind every opinion rendered by a forensic scientist there is a statistical basis. We may not know what that basis is, and we may have no feasible means of developing an understanding of that basis, but it is futile to deny that one exists. . . . The most common and coherent theory of forensic identification is that where there is a high degree of variation among attributes (of toolmark striations, writing, friction ridges on skin, and so on), then where a "match" is observed the probability that the match is

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

> coincidental rather than reflecting a shared source will be very small. . . . Forensic individualization sciences that lack actual data, which is most of them, have no choice but to either intuitively estimate those underlying probabilities and calculate the coincidental match probability from those subjective probabilities, or simply to assume the conclusion of a miniscule probability of a coincidental match (and in fact they do the latter).

In the specific context of firearms and toolmark examination, derivation of an objective, statistical basis for rendering decisions is hampered by the fundamentally random nature of parts of the firing process. The exact same conditions—of ammunition, of wear and cleanliness of firearms parts, of burning of propellant particles and the resulting gas pressure, and so forth—do not necessarily apply for every shot from the same gun. Ultimately, as firearms identification is currently practiced, an examiner's assessment of the quality and quantity of resulting toolmarks and the decision of what does or does not constitute a match comes down to a subjective determination based on intuition and experience. By comparison, DNA analysis is practically unique among forensic science specialties as having a strong objective basis for determination and as being amenable to formal probability statements.

Thornton and Peterson (2002:Fig. 1) rank various forensic science subfields on a continuum of relative subjectivity. On the low end of that scale is DNA analysis, along with serology (blood type determination) and drug and narcotic identification. They identify firearms and toolmark identification as having relatively high subjectivity, on par with fiber identification. They identify blood spatter interpretation, voiceprint analysis, and bitemarks as a group of forensic science specialties just slightly more subjective than toolmark identification, and handwriting and hair identification as a cluster slightly more subjective yet.

3-B TRADITIONAL FIREARMS IDENTIFICATION

Smith (2004:130) succinctly summarized the basic task of a firearms examiner in making an identification between pieces of evidence:

> Before a microscopic comparison begins, a foundation is built by measuring and comparing available class characteristics, such as General Rifling Characteristics (GRCs). These objective criteria are used to narrow the pool of candidates for determining a common source. Once an available foundation has been established, a common source often can be determined by evaluating individual microscopic marks of value using pattern recognition.

In traditional firearms identification—part science and part art form, still carried out today using the same basic tools that gave rise to the field

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

in the 1930s—the firearms examiner faces the formidable cognitive task of forming a mental pattern of identifying marks and features on bullet and cartridge case evidence. That pattern must then be matched to those from other exhibits.[1]

3-B.1 Individualization and Identification: Class, Subclass, and Individual Characteristics

The label "firearms identification" is another instance in which language can be a bit elusive. Although "the terms 'identification' and 'identity' are used constantly by practitioners" of criminalistics, or the forensic analysis of evidence, Kirk (1963:236) argued that the usage is an "unfortunate failure of nomenclature." Rather than identification (as that term is commonly understood), Kirk argues that "criminalistics is the science of individualization:"

> The criminalist does not attempt identification except as a prelude to his real function—that of individualizing. The real aim of all forensic science is to establish individuality, or to approach it as closely as the present state of the science allows. . . . What was actually done was not the identification of the fingerprint, but rather the individualization of a person as the one who left the fingerprint. . . . [Likewise,] if the firearms examiner said that the bullet was a Colt 45 A.C.P. but could not individualize the gun that fired it, his value would be relatively slight.

Thornton and Peterson (2002:8, 9) further differentiate between the two terms: "Individualization is the process of placing an object in a unit category which consists of a single unit. Individualization implies uniqueness; identification, strictly speaking, does not require it." They also note the frequent use in forensic science of "identification" when "individualization" is meant, but recognized that "it is a constraint imposed by our language"; relying on the term "individualize" would likely lead to public confusion. "It should be appreciated, however, that the process of identification means one thing to the forensic scientist, and another thing to the botanist or the zoologist." (See also Champod [2000:1077] on "individualization" versus "identification.")

The phrasing of "individualization" as the act of associating an object

[1]Further information on current practice in firearms identification and images connected with that work are available through resources at the Association of Firearm and Tool Mark Examiners (http://www.afte.org) and the Scientific Working Group for Firearms and Toolmarks (http://www.swggun.org). Additional information and images—and tools for simulating the use of the comparison microscope for comparing bullet and cartridge evidence—are accessible at http://www.firearmsid.com.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

with a category that contains only one unit is a useful one in addressing the basic approach of firearms examination. Firearms examiners typically give testimony to the effect that *this particular gun*, and not any other gun in the world, was used to fire particular shots. Yet even in the profession's earliest days, Hatcher (1935:266) anticipated a common reply to this type of argument:

> The firearms witness may expect to be asked how he can be sure of his findings, in view of the fact that he can have examined only a few of the countless thousands of guns that exist. But how does [an eyewitness to the crime] that identified the prisoner know that some other person may not look exactly like him? He will say that he has seen enough people in his life to know that the rule is that all people look different, and that the chances are overwhelmingly against finding two people who look so much alike that they cannot be told apart.
>
> In precisely the same way, the firearms expert, who admittedly cannot have actually examined more than the tiniest fraction of a percent of all the guns in the world, can still have had enough experience to be well aware of what differences do occur, and to know that the chance of finding two bullets from different guns that are exactly alike in every detail of their surface markings is infinitesimally small. The same thing applies with equal force to the finger-print method of identification.

Subsequently, he posited this idea more succinctly: "It may be quite common for two or more prominent individual marks on bullets from two entirely different guns to match exactly, but the chance that there will be a correspondence of a great many of the individual characteristic marks on two bullets that came from different guns is so remote as to amount to a practical impossibility" (Hatcher, 1935:288).

The basic approach to identification in forensic science developed into the concept of *class characteristics* and *individual characteristics*. Thornton and Peterson (2002:5–6) define these concepts:

> Class characteristics are general characteristics that separate a group of objects from a universe of diverse objects. In a comparison process, class characteristics serve the very useful purpose of screening a large number of items by eliminating from consideration those items that do not share the characteristics common to all the members of that group. Class characteristics do not, and cannot, establish uniqueness. Individual characteristics, on the other hand, are those exceptional characteristics that may establish the uniqueness of an object. It should be recognized that an individual characteristic, taken in isolation, might not in itself be unique. The uniqueness of an object may be established by an ensemble of individual characteristics. A scratch on the surface of a bullet, for example, is not a unique event; it is the arrangement of the scratches on the bullet that mark it as unique.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

In the context of examining bullet and cartridge case evidence, such parameters as caliber and the number of lands and grooves are class characteristics that can be used to screen or filter out possible comparisons that could not possibly have been fired from the same gun. Other class characteristics include firing pin shape (for instance, the distinctive rectangular firing pin impressions left by Glock firearms[2]) or pronounced "drag marks" that can be caused by firing pins as the cartridge case goes through the ejection process. Individual characteristics—the fine striations on a bullet's surface or peculiar microscopic textures in the firing pin impression, for instance—allow for the set of possible guns from which an exhibit could have been fired to be narrowed.

However, a binary split between class and individual characteristics proved too limited to describe the full range of phenomena observed by experienced examiners. In 1985, the Association of Firearm and Tool Mark Examiners (AFTE) convened a committee to develop a consensus document on a theory of toolmark identification and a range of basic conclusions that could be reached from comparison of toolmark evidence. The result, produced in 1989 and unanimously approved by the organization's membership, is reproduced in Box 3-1. Importantly, the 1989 standard also added a new term to the firearms identification lexicon: *subclass characteristics*, defined as follows (Moran, 2002:228):

> Discernable surface features of an object, which are more restrictive than "class characteristics" in that they are
>
> - Produced incidental to manufacture
> - Significant in that they relate to a small group source (a subset of the class to which they belong)
> - Can arise from a source which changes over time
>
> Caution should be exercised in distinguishing subclass characteristics from individual characteristics.

As a middle ground between class and individual characteristics, subclass characteristics covered marks or features that—arising from specific manufacturing techniques, or flaws in said techniques—could induce similar marks on pieces of evidence even though they originated from different

[2]Rectangular firing pin marks were a telltale sign of Glock pistols "prior to the introduction of Smith & Wesson's Sigma Series, Model SW40F, semi-automatic pistol," the design of which is very similar to Glock standards. Nichols (1995:133, 134), in documenting the similarity between this firearm's marks and the known Glock characteristics, notes that the two highly similar gun types can be distinguished by ejector and extractor marks, as well as a characteristic "dimple on the [casing] head above the firing pin drag" on Glock rounds.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

BOX 3-1
Association of Firearm and Tool Mark Examiners (AFTE)
Theory of Identification and Range of Conclusions

Theory of Identification as It Relates to Toolmarks

A. The theory of identification as it pertains to the comparison of toolmarks enables opinions of common origin to be made when the unique surface contours of two toolmarks are in "sufficient agreement."
B. This "sufficient agreement" is related to the significant duplication of random toolmarks as evidenced by the correspondence of a pattern or combination of patterns of surface contours. Significance is determined by the comparative examination of two or more sets of surface contour patterns comprised of individual peaks, ridges, and furrows. Specifically, the relative height or depth, width, curvature, and spatial relationship of the individual peaks, ridges, and furrows within one set of surface contours are defined as compared to the corresponding features in the second set of surface contours. Agreement is significant when it exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with the agreement demonstrated by toolmarks known to have been produced by the same tool. The statement that "sufficient agreement" exists between two toolmarks means that the agreement is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.
C. Currently, the interpretation of individualization/identification is subjective in nature, founded on scientific principles and based on the examiner's training and experience.

Range of Conclusions Possible When Comparing Toolmarks

The examiner is encouraged to report the objective observations that support the findings of toolmark examinations. The examiner should be conservative when reporting the significance of these observations.

The following represents a spectrum of statements:

A. IDENTIFICATION: Agreement of a combination of individual characteristics and all discernible class characteristics where the extent of agreement exceeds that which can occur in the comparison of toolmarks made by different tools and is consistent with the agreement demonstrated by toolmarks known to have been produced by the same tool.
B. INCONCLUSIVE:
a. Some agreement of individual characteristics and all discernible class characteristics, but insufficient for an identification.

continued

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

BOX 3-1 Continued

b. Agreement of all discernible class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility.
c. Agreement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for an elimination.

C. ELIMINATION: Significant disagreement of discernible class characteristics and/or individual characteristics.

D. UNSUITABLE: Unsuitable for comparison.

SOURCES: Excerpted from AFTE Criteria for Identification Committee (1992) and Grzybowski et al. (2003).

sources. Two examples of carryover of subclass characteristics are described in Box 3-2.

The AFTE theory of identification is rooted in the recognition that "the interpretation of individualization/identification is subjective in nature." However, it melds that recognition with more objective, quasi-quantitative benchmarks—"sufficient agreement," "significance," "likelihood . . . so remote," and agreement in both "quantity and quality"—but no specific empirical definition is given for these terms. Importantly, the AFTE theory does set up two cognitive thresholds that must be crossed in order to arrive at the conclusion that two exhibits share the same source, to the exclusion of all others. In describing the comparison of fingerprints, Stoney (1991; quoted in Moran, 2002:233) wrote of the basic cognitive process:

> When more and more corresponding features are found between two patterns, scientists and lay person alike become subjectively certain that the patterns could not possibly be duplicated by chance. What has happened here is somewhat analogous to a leap of faith.[3] It is a jump, an "extrapolation," based on the observation of highly variable traits among a few characteristics, and then considering the case of many characteristics. Duplication is inconceivable to the rational mind and we conclude that there is absolute identity.

[3]The "leap of faith" involved in extrapolating to all possible sources in the world was echoed, in specific reference to firearms identification by Rowe (1991). Understandably, some firearms examiners have objected to some overtones of the "leap of faith" phrasing; for instance, Miller and McLean (1998:17–18) "respond [to the phrasing] by stating that the published data which does exist, certainly presents enough statistical data to indicate more substance to the identification theory than a 'leap of faith.'"

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

BOX 3-2
Examples of Subclass Carryover

- Lomoro (1974:18) described test firings from F.I.E. Titanic revolvers, in a particular serial number range (but later shown to include some of a different make from the others). These firings produced seemingly similar striation patterns on fired bullets that could be naively matched to each other even though they had been fired from different weapons. "This pronounced stria [pattern] was only present on the lands of the bullets and very little if any matching stria was found on the grooves of the bullets. Examination of the bore revealed that either a worn or a very poor rifling tool was used during manufacturing," causing the similarity be imparted within a batch of separate barrels.
- Matty and Johnson (1984) observed that the particular tooling used on some Smith & Wesson firing pins results in a pattern of concentric rings that is repeatable in consecutively tooled pins. This pattern appears in the firing pin impression, meaning that examiners need to downweight the ring patterns and focus on other individual features to make correct matches on the firing pin impression.

He continues that this "leap" occurs—in fingerprinting, as in other branches of forensic science, "without any statistical foundation."

In a sense, the AFTE theory of identification requires two extrapolations: first, that marks are sufficiently consistent with true matches (produced by the same tool) to have come from the same source, and, second, that the quality and similarity of corresponding features exceed the best known apparent agreement between true nonmatches (produced by different tools). It follows that both of these extrapolations—but particularly the latter—require considerable experience in comparing exhibits and training in recognizing significant features.[4]

3–B.2 Historical Evolution

Some of the major advances in the field of traditional firearms identification are described in Box 3-3. Calvin H. Goddard, a founder of the Bureau of Forensic Ballistics in the New York City Police Department, is typically credited as the "father" of forensic ballistics in the United States;

[4]Biasotti and Murdock (2002:219–220) advocated the addition of the known nonmatch criterion, beginning with their conclusion in 1984 that "existing research was insufficient to validate the quantitative objective criteria necessary to conclude that a working surface is unique." The known nonmatch criterion "added a quantitative dimension" to the mix.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

BOX 3-3
Highlights in the History of Traditional Firearms Identification

- **1900:** The *Buffalo Medical Journal* published "The Missile and the Weapon" by Albert L. Hall, commenting on his observations that firearms of different mark impart different striated marks and impressions on fired bullets.
- **1907:** Cartridge case evidence was examined as part of the investigation of the 1906 Brownsville, Texas, riots in which black soldiers allegedly fired upon a white crowd in retaliation against racial slurs. Thirty-nine cartridges were recovered; all but six were matched to four rifles, based on examination of enlarged photographs of firing pin impressions. [Examiners concluded that no identifications could be made on the basis of recovered bullet evidence.]
- **1915:** Charlie Stielow, an illiterate farmer in New York state, was convicted and sentenced to death for killing his employer and the employer's housekeeper, the latter of whom was found dead on the doorstep of Stielow's nearby home. Stielow's conviction was due in part to testimony by an examiner who claimed to find nine abnormal scratches on the recovered bullets that corresponded to particular defects in the alleged murder weapon. However, a more careful subsequent analysis of the evidence by Charles Waite concluded that Stielow's revolver could not have been the murder weapon; Stielow was pardoned and released from prison.
- **1925:** Philip Gravelle was credited with the development of the comparison microscope for side-by-side comparison of ballistics evidence in Calvin Goddard's article "Forensic Ballistics" in *Army Ordinance*. Goddard used the technique in the article, and the comparison microscope technique grew in popularity after the *Saturday Evening Post*'s two-part "Finger-printing Bullets" article in 1926 profiled New York City's Bureau of Forensic Ballistics, which Goddard, Gravelle, and Waite helped found.
- **1929:** On February 14, six members of George "Bugs" Moran's North Side gang (and one acquaintance) were brutally killed in a Chicago warehouse by six men impersonating police officers, believed to be operatives of rival Al Capone's South Side gang, in what quickly became known as the "St. Valentine's Day Massacre." As part of the investigation, Goddard prepared a detailed examination of recovered bullet and cartridge case evidence, connecting them to two Thompson submachine guns and a 12-gauge shotgun. Goddard—considered the father of modern firearms examination—subsequently left New York City to establish the Scientific Crime Detection Laboratory of Chicago, affiliated with Northwestern University.
- **1934–1935:** First editions of two seminal texts on firearms examination were published: Gerald Burrard's *The Identification of Firearms and Forensic Ballistics* and Julian Hatcher's *Textbook of Firearms Investigation, Identification and Evidence*.
- **1958:** John Davis' *An Introduction to Tool Marks, Firearms and the Striagraph* argued for the use of the striagraph, an early tool for direct measurement of the surface contours of ballistics evidence. Though the striagraph never advanced beyond the research stage, it was a precursor to the use of imaging and profilometry techniques for firearms identification.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

BOX 3-3 Continued

- **1962:** J. Howard Matthews, a retired chemistry professor from the University of Wisconsin who became interested in forensic science after being called in to assist on a bombing case, published the two-volume *Firearms Identification.*
- **1969:** At a 35-member conference hosted by the Crime Laboratory of the Chicago Police Department, firearms identification practitioners form the Association of Firearm and Tool Mark Examiners (AFTE). The new association's newsletter developed into the *AFTE Journal* in 1973 and continues as a quarterly, peer-reviewed publication; the international association continues to hold an annual Training Seminar.

SOURCES: Information from Hamby and Thorpe (1999), Hatcher (1935), and Goddard (1999).

the text by Hatcher (1935) is generally considered the text on which the modern field of firearms and toolmark examination is based (Nichols, 2003).

The modern field of firearms identification owes much to the development of the comparison bridge, a system of mirrors or prisms that permits the views from two separate microscopic lenses to appear side by side in the same field of view. The device equipped with this optical bridge, called the comparison microscope, was not designed for analysis of bullet or cartridge case evidence, nor was it first used in such forensic applications (see, e.g., Thornton, 1978; Goddard, 1980). Even early advocates of forensic firearms analysis cautioned against making too much of the technology at hand, noting that the comparison microscope, on its own, has limitations. Foreshadowing some contemporary claims about the capability of ballistic imaging systems, Burrard (1962:131–132) lamented:

> The most fantastic claims have been put forward for, and the most ridiculous descriptions of, [the comparison microscope] which are enough to suggest that it has magical properties, and that it automatically, and wholly of its own accord, rings a bell or utters some similar warning, when the two cartridge cases under examination exhibit the same [individual markings]. Unhappily there is no foundation for this comforting belief. In the hands of a trained microscopist the comparison microscope can be of great value in determining the identity of fired bullets; but for cartridge cases I have come to the conclusion that a high-class single instrument is preferable. . . . And even for fired bullets the comparison microscope offers

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

> difficulties in illumination which are never encountered when using a single instrument, for the illumination of opaque objects such as the surfaces of fired cartridge cases and bullets is a far more difficult problem than the illumination of transparencies, fibres or spermatozoa.

Nevertheless, the application of the comparison microscope to firearms evidence analysis led the field of firearms identification to flourish and reinforced the analysis of ballistics evidence as a critical part of criminal investigations.

In recent years, as the increased workload of state and local law enforcement forensic laboratories has created a shortage of firearms examiners, placing increased attention on the training and recruitment of examiners. Noting that "there is no college degree a firearms examiner can pursue to reach true proficiency in firearms identification," and that the core of training activities consists of "extended on-the-job training," the Bureau of Alcohol, Tobacco, and Firearms (ATF) established a National Firearm Examiner Academy in 1998. The original plan for the academy was for a "16-week intensive program . . . to train candidates to become apprentice firearms examiners" and a pairing of apprentice examiners with participating law enforcement agencies (Ethridge, 1998:703, 704).

3–B.3 Pattern Matching and "Line Counting"

Traditional firearms examination is, fundamentally, one whose central task is pattern matching.[5] Moran (2002:227) summarizes the approach:

> Toolmark examiners (and examiners in other comparative evidence disciplines) in the United States approach the interpretation of evidence by employing a combination of their cognitive ability to recognize agreement between patterns that in their "minds eye" constitutes an identification or "match" between a questioned pattern or toolmark and toolmark patterns produced from known tools. . . . This traditional "pattern match" approach (for a lack of a better term) relies on art (the cognitive ability to recognize agreement of pattern) and science (supporting the uniqueness of tool surfaces as a means to establishing an identification between a questioned toolmark and the tool that produced it).

Hayes et al. (2004:139–140) add: "In traditional pattern recognition methodology, the details used to determine a match include the height,

[5]Technically, "pattern matching" in forensic science may further be differentiated into two categories, pattern fit and pattern transfer. Pattern fit is akin to a jigsaw puzzle, determining whether pieces or fragments of some object were once part of a whole object. Firearms toolmarks follow the pattern transfer form, in which patterns are created by the interaction of more than one object (Biasotti and Murdock, 2002:208).

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

weight, depth, spatial relationship and consecutiveness of the class and individual characteristics. When viewed as a whole, these components become significant."

Pattern matching—aided by the dual, side-by-side inspection made possible by the comparison microscope—has been the historical norm since the field of firearms identification emerged into prominence in the 1930s. As the AFTE theory of identification indicates (Box 3-1), the standard of identification is "currently . . . subjective in nature." In the late 1950s, two important developments were made in order to provide the field with a more objective and quantitative basis. The first, mentioned in Box 3-2, was the development by Davis (1958) of an instrument he called a "striagraph" to quantitatively measure the microscopic markings left by firearms on bullets and cartridge cases. The striagraph made traces of the contours of a bullet's surface using a stylus to record depth. Though the instrument was never developed commercially, it marked the first attempt to develop an explicit "signature" from pieces of evidence for comparison with each other, foreshadowing the signatures that are the basis of today's ballistic imaging systems.

A more significant development was a study by Biasotti (1959) that formed the foundation for what is now known as the consecutive matching striations (CMS) approach to identification. Nichols (2003:299) relates that this approach has developed and emerged to the point that a "fray appears to have developed within the discipline," pitting "the old school tradition of 'pattern matching' versus the new school of 'line counters.'"

Biasotti's (1959:34) work was motivated by what he described as "an almost complete lack of factual and statistical data pertaining to the problem of establishing identity in the field of firearms identification." Accordingly, he sought to "conduct a direct statistical count of the elements which actually form the basis of the identity; e.g., the individual characteristics;" he did so using a set of test firings from .38 Special Smith & Wesson revolvers. For each pair of bullets, Biasotti (1959:37–44) conducted a complete inventory of all striations; from this inventory, he noted that same-gun bullets yielded a greater number of corresponding marks than different-gun bullets, but he cautioned that a simple percentage of matching lines is an inappropriate measure of similarity:

> The average percent match for bullets fired from the same gun ranged from 36 to 38% for lead bullets and from 21 to 24% for metal-cased bullets. For bullets fired from different guns . . . 15 to 20% matching lines per land or groove mark was frequently found. Relatively speaking, this data indicates that even under such ideal conditions [as the experimental test firings] the average percent match for bullets from the same gun is low and the percent match for bullets from different guns is high, which

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

> should illustrate the limited value of percent matching lines without regard to consecutiveness. As frequently happens in actual practice, when there is a preponderance of non-matching lines and only a few land and groove marks available for comparison, the total number of matching lines is often no higher or even less than the number which could occur. [These results, along with those of Burd and Kirk (1942) on toolmarks generally] should dispel the erroneous conception of the "perfect match" which is actually only a theoretical possibility and a practical impossibility.

What Biasotti (1959:44) found compelling, though, was evidence of runs or series of consecutive matching striations:

> It should be obvious that consecutiveness; viz., the compounding of a number of individual characteristics, is the very basis of all identities. When individual characteristics are grouped or related by the criteria of consecutiveness, which is a simplified means of expressing a correspondence of contour, the chance occurrence of even a very small number of consecutive matching lines (e.g., more than 3 or 4) is for all practical purposes impossible except as the result of a common agent, e.g., same gun.

Based on subsequent research, Biasotti and Murdock (2002:224–225) formalized a set of "conservative quantitative criteria for identification:"[6]

> (1) In three-dimensional toolmarks when at least two different groups of at least three consecutive matching striae appear in the same relative position, or one group of six consecutive matching striae are in agreement in an evidence toolmark compared to a test toolmark.
>
> (2) In two-dimensional toolmarks when at least two groups of at least five consecutive matching striae appear in the same relative position, or one group of eight consecutive matching striae are in agreement in an evidence toolmark compared to a test toolmark.
>
> For these criteria to apply, however, the possibility of subclass characteristics must be ruled out.

These criteria differentiate between three-dimensional marks, which Biasotti and Murdock (2002:208) characterize as contour or impression, and two-dimensional marks, described as surface or imprint. That is, two-dimensional marks are "striae lacking depth and therefore appearing two-dimensional" (Biasotti and Murdock, 2002:224), giving rise to the "line

[6]The Biasotti and Murdock criteria were first published in 1997; no changes were made in 2002, though it was noted that in the intervening years "no known non-matching (two- or three-dimensional) toolmarks were found in [any follow-up] studies which exhibited agreement" of the conservative criteria (Biasotti and Murdock, 2002:225).

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

counting" appellation that has been applied to CMS methods. Recently, as surface metrology techniques have been applied to studying bullets—particularly the development of a three-dimensional-analysis system for bullets by the manufacturer of the Integrated Ballistics Identification System (IBIS) currently in use—this distinction has come under some question (see, e.g., Thompson, 2006). Striated toolmarks necessarily have depth, however slight; the availability of detailed measures of surface contours invites the question of significance levels in determining whether corresponding striations match. (We revisit the two-dimensional and three-dimensional distinction in Chapter 7.)

3–B.4 Legal Context of Firearms Examination

In order to testify to their findings at trial, firearms experts are subjected to qualifying questions in the *voir dire* process. If they are favorably ruled on by the trial court judge, the expert must testify to matches (or nonmatches) of ballistics evidence based on what is ultimately a subjective assessment. Molnar (1970:39) described the pressures that come with that task:

> [Serious criminal] cases very often never get off the ground until the firearms examiner has made a finding, which incidentally has to be correct, at which time the police file charges and the wheels of justice begin to grind. There is no second or reanalysis to be made, no excuses, no bad or spoiled reagents. The examiner's area of conclusions is more often either black or white, hardly ever the grey area enjoyed by other criminalists. Others may come along to say that he was wrong, or that they can't arrive at the same conclusion, but the firearms examiner has to be RIGHT and has to say so FIRST.

Consequently, firearms examiners may often express their findings in bold absolutes—matches made to the same gun, to the exclusion of all other firearms in the world—yet they tend to be conservative in reaching their opinions. If a firearms examiner is impeached through the *voir dire* process, his or her ability to testify in other cases can be severely affected; being associated with an error or misidentification can tarnish reputations. Thornton and Peterson (2002:21) argue that this belief—which they note "is not entirely without justification"—makes forensic science, in general, resistant to proficiency testing of examiners; "the potential exists that in court, counsel for the opposing side will in a self-serving fashion misconstrue, pervert and abuse a missed proficiency test." The AFTE range of conclusions (Box 3-1) envisions four possible outcomes when an examiner is asked to compare pieces of evidence. Regardless of which of these options the examiner deems

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

fit after careful consideration, it is in keeping with the nature and weight of their testimony—and the adversarial nature of courtroom questioning—that their findings are expressed as unequivocal and unyielding.

An examiner's conviction in the findings about the interrelationship of evidence, and the basic admissibility of that evidence in court, depends critically on the careful maintenance of the "chain of evidence." This begins at the crime scene itself, where the site must be preserved until an evidence technician can collect it in a safe and timely manner, maintaining its integrity. Collected evidence must not be allowed to be contaminated, lest its credibility be undermined; physical custody must be maintained and monitored throughout the laboratory examination, and processing steps should not be destructive or injurious to the physical evidence. Any break or delay in the sequence of events, or any miscommunication, may lead investigations to stall, crimes to remain unsolved, and prosecutions to lose key support.

Like other branches of forensic science, firearms and toolmark identification has had to grapple with the question of how well the field fits emerging standards for scientific evidence in legal proceedings. In 1923, *Frye v. United States* (293 F. 1013, DC Cir) observed that:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.

The ruling established a "general acceptance in the field" standard that became the basis for subsequent decisions.

In 1993, the U.S. Supreme Court's ruling in *Daubert v. Merrell Dow Pharmaceuticals* (509 U.S. 579) concluded that the legislatively enacted Federal Rules of Evidence superseded the *Frye* "general acceptance" standard. Justice Harry Blackmun's majority opinion tasked judges with a gatekeeper role, "assess[ing] whether the reasoning or methodology underlying the testimony is scientifically valid [and] whether that reasoning or methodology properly can be applied to the facts in issue." More concisely, the task is the assessment of reliability and relevance. Though the opinion expressly noted that "we do not presume to set out a definitive checklist or test," it also identified five criteria for reliability that have since become known as the *Daubert* standard: (1) "whether the theory or technique has been subjected to peer review and publication," (2) "whether it can be (and has been) tested" or falsified, (3) the techniques "known or potential rate

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

of error," (4) "the existence and maintenance of standards controlling the technique's operation," and (5) the *Frye* criterion of "general acceptance" by the scientific community. Due to its grounding in the Federal Rules of Evidence, the *Daubert* standard is not binding on individual states, about half of which continue to use the *Frye* test.

Branches of forensic science like toolmark evaluation are increasingly concerned with how their fields fit either standard, cognizant that the precedent of a single ruling of inadmissibility could jeopardize future proceedings. That question has grown ever greater with the Florida Supreme Court's December 2001 ruling in *Ramirez v. State of Florida* (No. SC92975). In that ruling, the court reversed the 1983 murder conviction (and death sentence) of Joseph Ramirez by excluding testimony on the toolmarks left by the knife on human cartilage. The ruling summarized the critical issue under review:

> Ramirez asserts that the trial court erred in allowing the State's experts to testify that the knife found in Ramirez's car was the murder weapon to the exclusion of every other knife in the world. He contends that [the toolmark examiner's] identification method is novel and untested and the State has failed to present sufficient proof of its reliability.

Moran and Murdock (2002:215) note that the court "reviewed testimony of five AFTE members who provided traditional justification for the identification of striated toolmarks throughout these proceedings based only on qualitative criteria established through 'training and experience.' The court found that these explanations did not satisfy Florida's rigorous [*Frye*] standards for *reliability*."[7] The court's ruling concluded that "the record does not show that [the examiner's] methodology—and particularly his claim of infallibility—has ever been formally tested or otherwise verified, [nor has it] ever been subjected to meaningful peer review or publication." They concluded further that that the examiner's claim of a match lacked documentation or substantiation and that "the error rate for [the examiner's] method has [never] been quantified."

For reviews in the firearms examiner literature on the applicability of *Daubert* criteria in the field, see Grzybowski and Murdock (1998) and Rosenberry (2003), among others. More recently, Schwartz (2005) extends what was originally an *amicus curiae* brief into a fuller argument as to why firearms and toolmark evidence should be ruled inadmissible in legal proceedings, to which Nichols (2005) offers a response.

[7]Florida is one of the states in which the courts have elected to continue applying the *Frye* "general acceptance" criterion rather than the *Daubert* standard. However, as the quotations from the ruling suggest, the *Ramirez* court considered elements of the *Daubert* criteria.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

3–C UNIQUENESS, REPRODUCIBILITY, AND PERMANENCE OF MARKINGS IN TRADITIONAL FIREARMS IDENTIFICATION

In recent years, several review articles have summarized the findings of individual studies on the basic principles of firearms and toolmarks—the uniqueness, reproducibility, and permanence of individual characteristics, as seen by trained examiners using comparison microscopy. Most of these studies are limited in scale and have been conducted by firearms examiners (and examiners in training) in state and local law enforcement laboratories as adjuncts to their regular casework. The review articles attempt to piece together major themes from decades of such studies, most having been published in the *AFTE Journal* but also in other forensic science publications. Nichols (1997, 2004) contributes a two-part narrative with the goal of characterizing the state of the field. Bonfanti and De Kinder (1999a, 1999b) review a broad array of experimental studies—on the influence of manufacturing techniques (e.g., consecutive tooling) and the endurance of marks over repeated firings, respectively—distilling the studies as entries in extensive summary tables. We draw from these review papers in this section and excerpt additional detail from individual studies, as appropriate.

3–C.1 Uniqueness of Markings

A fundamental assumption in firearms identification is that individual firearms vary microscopically in ways that leave unique markings on bullet and cartridge case evidence. Accordingly, the "gold standard" for demonstrating the uniqueness of toolmarks in ballistics evidence would be sets of firearms that are consecutively manufactured—that is, more than one gun where every constituent part is subjected to identical tooling and machining operations (e.g., minimizing the wear on cutting tools between different pieces). This is difficult to achieve in practice given the assembly-line nature of firearms manufacturing, where individual parts may be made in advance (and not necessarily at the same facility) and are drawn from bins prior to assembly. Due to the time and manufacturer cooperation needed to ensure consecutive manufacture, those studies that have been done—as summarized by Bonfanti and De Kinder (1999a)—deal with small numbers, typically less than 15.[8] It is also typically the case that only one part (or

[8]One entry in the tables in Bonfanti and De Kinder (1999a) stands out: amidst studies with small numbers of firearms with some level of consecutively manufactured parts, Grooß (1995) is reported as having examined 3,704 Walther P5 pistols. The entry is misleading in its placement in the tables—Grooß makes no claim of consecutive manufacturing or serial numbering—but the study is still interesting as a case study of a wide-scale search of evidence using conventional microscopy rather than being assisted by imaging methodology; see footnote 17 in this chapter.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

very few) of the guns in these studies are consecutively manufactured—e.g., consecutively reamed barrels or machined breech faces.

Several of the studies documented by Bonfanti and De Kinder (1999a) deal with firearms that have sequential serial numbers. That is, the weapons effectively came off of the assembly line consecutively. Lutz (1970:24) reiterated that "mere serial number sequence has no significance [in assessing the similarity of firearms], because firearm manufacturers usually have assembly line procedures that join the various weapons parts, without regard to actual manufacturing sequence." Still, depending on the manufacturer and where in the process serial numbering occurs, guns that have similar serial numbers may have at least some components that were manufactured in close temporal proximity; hence, it remains popular as a weak proxy for consecutive manufacture.[9]

Bonfanti and De Kinder (1999b:Table 1) profile 27 separate studies of bullets from firearms with some indication of consecutive manufacture (or close serial numbering); these studies spanned a variety of calibers and barrel rifling techniques.[10] From their review, they conclude that "for all types of rifling no problem occurs concerning the identification of the individual firearm if certain criteria are followed." Some firearms cannot be identified correctly solely by examination of the bullets (e.g., Churchman, 1981; Lomoro, 1974; Matty, 1985), but Bonfanti and De Kinder (1999b:5) explain some of these results through their suggested criteria: "correspondence between fine striation lines in (the central part) of the land impressions must be sought," as striations on the edges of the land engraved areas or in the groove engraved areas "may display subclass characteristics" that could be confused with individual features. For instance, Lomoro's (1974:18) test firings from different but close serial-numbered F.I.E. Titanic revolvers were very similar in groove markings but more readily distinguishable by markings in the land areas. Among more recent efforts, Brundage's (1998) set of 10 consecutively rifled Ruger barrels is prominent because it was conducted as a blind study—that is, a test set of firings from the barrels, without indication of the circumstances of the underlying barrel manufacture, was given to various firearms examiners for comparison. More recently, a set of bullets fired through consecutively manufactured Hi-Point

[9]This concept arises in discussing experimental results in Chapter 8. In addition to being a weak proxy for consecutive manufacture, sequential serial numbers may also suggest large batch purchases of firearms, such as the deployment of new duty firearms among police officers. In our analyses of the New York CoBIS reference ballistic image database, we encounter runs of consecutively serial-numbered firearms with similar IBIS comparison scores.

[10]This count excludes the Grooß (1995) study (see footnote 8 in this chapter) and the Biasotti (1959) study profiled in Section 3–B.3, neither of which made explicit claims of consecutiveness. They are included in the Bonfanti and De Kinder (1999b:Table 1) table but have no entry in the "Particularity" column.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

barrels (described in Beauchamp and Roberge, 2005), has become a similar proficiency test of sorts.

For markings on cartridge cases, Bonfanti and De Kinder (1999b: Table 3) summarize 13 studies with some indication of consecutive manufacture.[11] The conclusion that they derive from these studies is more nuanced than for bullets: "Depending on the firearm that was used, different results were used [and] in a number of cases a correct identification was difficult to perform." Among these problematic cases were the studies of Matty and Johnson (1984), Uchiyama (1986), and Lardizabal (1995), which we describe elsewhere in this chapter and in Chapter 2. Bonfanti and De Kinder found it hard to classify these problematic cases by manufacturing technique, but offered as "a probable solution to this problem" a common theme that recurred in several of the studies. Specifically, individual examiners noted remarkable similarities on some of the marks but found that they could make identifications using the full range of markings on the cartridge cases, not just the firing pin impression or breech face mark. Hence, Bonfanti and De Kinder (1999b:5) suggested making use of all applicable marks, including ejector and extractor marks, since "it is less likely that all these parts are manufactured consecutively and that they all bear subclass characteristics."

3–C.2 Reproducibility and Permanence of Markings

To be useful for identification, the characteristic marks left by firearms must not only be unique but reproducible—that is, the unique characteristics must be capable of being deposited over the multiple firings so that they can be found on recovered evidence and successfully compared with those on other items. This requirement is not the same as saying that every individual mark must be registered with equal clarity on every firing; as described in Chapter 2, the firing process depends on combustion processes and gas pressures that are inherently variable, and so will influence the exact conditions under which marks are imparted from shot to shot. But it is crucial to the theory of firearms identification that the unique marks of a firearm have a certain endurance (if not permanence) and do not change from shot to shot or change as the gun is subjected to increasing levels of wear.

Bonfanti and De Kinder (1999a) summarize 10 studies from the firearms identification literature that addressed the effect of wear or repeated use of a firearm on the markings it left on evidence; most of the studies con-

[11]Again, this excludes Grooß (1995), which is listed in the Bonfanti and De Kinder table, as well as a few other studies in which the firearms parts in question are described as being randomly selected from production runs.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

centrated on the effect on the striations left on bullets, while four included consideration of the markings left on cartridge cases. The numbers of shots fired in these studies range from 20 to 5,000.

From the 10 studies, Bonfanti and De Kinder (1999a:319, 321) conclude that the major cartridge case markings are relatively less vulnerable to change: "no substantial change in characteristics left by the breech face of the weapon can be discerned" over repeated firings; firing pin impressions and extractor marks are subject to "slight variations," while "in one study the ejector marks were seen to vary more strongly." Bullets, by comparison, showed more dramatic effects due to wear; this is not greatly surprising given that a firearm's barrel is subject to the most fouling (deposition of firing residue) and the most metal-against-metal scraping (as the bullet travels out of the barrel) of the firearm's internal surfaces. "Changes consist of disappearing fine and coarse striation lines," with the fine striations being more variable over time than the coarser. The composition and design of the bullet makes a great difference; simple lead bullets may be unmatchable to a first shot after 50 firings while the identifying stria left on jacketed bullets have been observed to endure for 500 or 5,000 shots.

Most of these studies either compare the first to the last firings in sequence or focus on a sample of the firings: for instance, the Ogihara et al. (1989) study retained 69 bullet and cartridge case sets from the total of 5,000 firings, and their major conclusions concern the comparison between firings 1 and 5,000.[12] Likewise, Hamby (1974) retained bullets from firings 1, 101, 201, 301, 401, and 501 from a M16A1 rifle; these were compared with each other in sequence (e.g., 1 to 101 and 101 to 201), as well as comparing shot 1 to shot 501.[13]

More recently, Vinci et al. (2005) examined a set of exhibits consisting of every 100th round in a sequence of 2,500 firings of 230 grain FMJ Giulio Fiocchi Lecco ammunition through a .45 caliber HP (ADLER customized) semiautomatic Springfield Armory pistol. Batches of 100 firings were performed at separate times; "the pistol was disassembled, cleaned and oiled after each 100 round firing session in respect of findings previously reported that accumulated residue on the weapon can affect the [breech face] marks on cartridges" (Vinci et al., 2005:369, citing findings from Molnar, 1977; see Section 3–D.1). Vinci et al. (2005:371) concluded that "there was a slight observable modification in the quality of the marks" over the long firing, but that "the gun could still be identified" even in the late-stage

[12]Ogihara et al. (1989) retained every 10th shot from firings 1–100, every 50th shot from firings 150–1,000, and every 100th shot from firings 1,100–5,000.

[13]Hamby (1974) chose the particular rifle because it was known to generate high pressures during firing, "which should hasten the barrel wearing process." The specific gun had already been fired "approximately 40,000 times." The barrel was not cleaned at any point during the test firings.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

exhibits. However, the breech face marks were "not useful for matching any of the 2500 cartridges to the weapon" because the presence and clarity of these marks were inconsistent. Firing pin impressions proved more useful although, "after round 70, the nose of the firing pin was beginning to lose its imperfections resulting in a small flattened circular area at the bottom of the marks. Although firing pin drag marks were not consistently produced throughout the 2500 round firing sequence, the last 200 rounds did contain sufficient stria to match the cartridges to the weapon." Meanwhile, the value of ejector marks to making identifications "was enhanced" over repeated firing; the size and depth of the ejector mark increased "after firing 600 rounds."

In comparison with these longevity studies, Uchiyama et al. (1988) completed a rarer study of actual shot-to-shot variability for a string of 100 firings. Specifically, they collected bullets and cartridge casings from each of the 100 test firings, divided between four different combinations of gun brand and caliber. Each mark—land areas on the bullets and breech face and firing pin marks on the cartridges—was examined separately by examiners to assess the quantity of unique, individualizing lines or features. Each mark was then assigned an identifiability score of 1, 2, or 3; 1 indicated few or no identifiable features and 3 indicated sufficient features to support an identification based on that mark alone. Each bullet and casing was then assigned a score corresponding to the maximum identifiability score of its constituent marks. The analysis stopped short of true shot-to-shot comparison of features, although this was done for some sequences of well-marked (identifiability score 3) bullets.

For centerfire cartridges, they observed an approximately 10–50–40 percent division across identifiability grades 1, 2, and 3, respectively. Breech face marks generally showed higher identifiability scores than firing pin marks, which Uchiyama et al. (1988:378) attribute to the greater surface area of the breech face marks; however, for firings from a .38 Special Smith & Wesson (for which "the surface of the breech face is rather smooth and the firing pin is large and has irregular markings"), firing pin marks outperformed breech face. Identifiability scores dropped markedly for rimfire cartridges, with only about 5 percent having score 3 and 35 percent score 1; none of the breech face markings for rimfire casings was judged to have identifiability level 3. For bullets, identifiability level 3 ranged from 20 to 60 percent across the different gun/caliber combinations, and Uchiyama et al. (1988) judged that none of the test-fired bullets fell into identifiability level 1.

Blackwell and Framan (1980:16) cite discussions with an examiner at the Los Angeles Police Department in suggesting a "reproducibility spectrum," a continuum of manufacturing standards and firearms user practices that can affect the reproducibility of individual marks. At one extreme are police officers, for whom a firearm is such a vital part of their equipment

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

that they "[develop] pride and interest in maintaining it in superior working condition." However, this "constant attention to cleaning and polishing" serves to "completely obliterate many, if not all, of the original identifying imperfections in the bore." "Many officers mount their pistols in a drill press and actually wire-brush the bore to the point that individual features originally in the bore are removed, and new ones created." Military small arms represent the other end of the spectrum:

> These firearms, because of the nature of mass production, frequently retain their identifying characteristics for the life of the firearm. During manufacture, the bores are not carefully polished or lead lapped and the small blemishes that cause striations are retained virtually unchanged. Subsequent perfunctory or even diligent cleaning frequently does not obliterate them.

"The firearms that most frequently find their way into the firearms identification laboratory" fall in between these two extremes.

From the available studies of the reproducibility and endurance of firearms toolmarks, it is difficult to conclude that any of the markings are inherently more reliable than others. De Kinder (2002a:200) argued that "the breech face of the firearm seems to provide the most stable trace on the components of the fired round" and hence suggested that it might be the primary mark collected in a large-scale reference ballistic image database (RBID). However, he also observed that "important similarities were seen between marks left by the breech faces of subsequently manufactured firearms"—that is, the breech face may be prone to subclass carry-over effects—and so an RBID would likely have to include other marks like the firing pin. Likewise, Tulleners (2001:3-2) wrote that, "for automated imaging, the only areas used are the firing pin impressions, breech face marks, and ejector marks" because "these are the marks that are typically repeatable." However, "in most cases the firing pin may not leave sufficient detail for analysis and most examiners rely on the breech face marks" to make identifications (Tulleners, 2001:3-2).

3-D CHALLENGING SITUATIONS IN FIREARMS IDENTIFICATION

Over the course of years of analysis, forensic firearms examiners encounter numerous situations that complicate identification. These may be deliberate measures taken by the shooter—countermeasures to identification—but they may also be mechanical problems in firing. Smith (1971) cataloged 24 such situations, which he dubbed "jokers" in the field of firearms identification. He suggested that the top 10 such complications, "in the approximate order of frequency of occurrence," are:

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

- automatic pistol bullets fired from revolvers;
- pistol bullets fired from rifles by using adapters;
- pistol bullets fired from rifles after being handloaded into rifle cartridge cases;
- revolver-type bullets fired from automatic pistols;
- replacement of barrel of an automatic pistol with another;
- replacement of firing pin in automatic pistol;
- refiling of breech face of automatic pistol or revolver;
- refiling firing pin of automatic pistol or revolver;
- replacing revolver barrel (which is more difficult than with more modular semiautomatics); and
- relining a pistol or rifle barrel with a new rifled liner.

Other complications include "firing a bullet of one caliber through an arm chambered for a larger caliber" ("such a bullet will show sketchy and erratic rifling marks which will be of little help in establishing identification") and "firing a pistol or revolver cartridge through a smooth bored barrel" ("the bullet will obviously show no rifling marks").

In this section, we briefly review what has been discussed in the firearms identification literature about some of these challenging situations. It is not an exhaustive list but covers particular topics that are more germane to RBIDs containing images from new firearms.

3–D.1 Condition of Evidence: Damage, Corrosion, and Cleanliness

In forensic laboratories, firearms can be discharged into water tanks (or other nondestructive trap mechanisms) so that bullets may be recovered with no damage other than those left by the firing process; similarly, cartridge casings may be quickly and safely retrieved following controlled test firings. A basic, fundamental challenge of firearms identification is that crime scenes are not necessarily such controlled settings. The task of pattern matching between pieces of bullet or cartridge case evidence—considering which microscopically fine markings may be unique to the source firearm, filtering out other marks, and evaluating various possible alignments of the exhibits (including, for bullets, all possible rotations of the exhibit pairs)—is already a difficult one. But it can be made more difficult by the nonpristine nature of crime scene evidence. Bullets can strike wood, asphalt, human tissue and bone, or other substances and, consequently, can be seriously warped, deformed, or fragmented; they can be lodged such that even their recovery for analysis can cause damage. Likewise, cartridge casings expelled onto the ground may be crushed underfoot or exposed to the elements. The possible differences between pristine exhibits and crime-scene samples are a continuing challenge for conventional firearms identification and ballistic

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

imaging techniques, particularly in the context of an RBID for which the basic point is the comparison of crime scene evidence with a pristine sample from a gun in brand-new condition. Because the basic theory underlying firearms identification is that fine microscopic imperfections on the surface of internal parts of a firearm impart those marks on bullets and cartridge cases fired in them, it also follows that abrasion and erosion of the firearm's internal parts can change the unique marks left on ballistics evidence. Gun users vary in the degree of care and maintenance they give to their firearms, from meticulous cleaning to neglect. Hence, guns generally—and the subset of guns used in crime—are subject to different levels of residue and dirt build-up and to different levels of corrosion. Corrosion "is the rusting or the eating away of the metal by some chemical action. This condition is usually due to firing ammunition loaded with corrosive primers and to improper care of a gun between the times it is used" (American Institute of Applied Science, 1982:81).

Fouling and barrel cleanliness are prominent concerns in the analysis of bullet striations, given the tendency for residue and metal scrapings to build up in the barrel. It might be expected to be a relatively minor concern for the markings on cartridge cases, but Molnar (1977:21) advised examiners that this is not necessarily the case. "An examination of the breech face is in order" in cases where "you are having trouble with a firearm that is not reproducing breech face marks on the primer or cartridge cases on your tests," he wrote. "On many occasions the fouling of previous shots have built up to such an extent that the accumulated crud obliterates the breech face mark configurations to such an extent that their impressions on the primers are affected and sometimes precluded. On small caliber guns with low chamber pressures, even a few unburned powder granules adhering to the breech face can cause amazing differences in registrations, even altering some characteristics." Tulleners (2001:3-2) makes a similar observation, noting that "dirt or lead build up on the breech face can reduce the detail of breech face impressions."

Hess and Moran (2006:112) observed that, "periodically, firearms examiners and [IBIS] technicians receive requests to examine firearms that have been oxidized (rusted) and/or corroded due to a variety of factors." This corrosion can be so pronounced as to make it difficult to operate and test fire the weapon. Moreover, "any test firing conducted while the firearm is in this condition risks permanent alteration of the weapon's signature on these working surfaces for purposes of IBIS entry and future comparison," and test-fired evidence from a corroded weapon may not match evidence already on file in databases. They conclude that, "given the backlog that most agencies are facing in this time of budget restraints, increasing caseloads, and understaffing in firearms units across the country, the probability that firearms received in corroded condition will not be test

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

fired at all is likely," missing possible hits. Corrosion is also problematic because some means of dealing with it—including scrubbing with metal or other brushes—may also damage the weapon for the purposes of generating matchable marks.

Corrosion is a concern not only for the internal parts of firearms, but also for recovered ballistics evidence. Though it is certainly ideal to process and collect evidence from crime scenes rapidly, such is not always possible. Bullet and cartridge case evidence may be exposed to the elements for days, weeks, or months until they are found and recovered, and bullet evidence may be irretrievable from shooting victims because rapid extraction could be harmful to their health. See Larrison (2006) for a study of the rate of degradation of bullets and cartridges—monitored every 6 months over 2 years—in four different and demanding environmental conditions: soil, water, open air, and an animal carcass.

3-D.2 Countermeasures

Smith's (1971) listing of "jokers," which introduced this section, includes some deliberate countermeasures that might be taken by criminals—perhaps after firing a lethal shot—to try to mislead investigators. Aside from Smith's rough ordering of situations by frequency and the rough impressions formed by examiners over their years of experience, there are no firm and systematic data on the frequency with which criminals deliberately alter firearms parts (or attempt to obliterate serial numbers) in order to avoid detection.

Some countermeasures, like crude filing of the barrel, are relatively easy to perform (if not always effective).[14] As Smith (1971) articulates in fleshing out his list of problematic situations, some countermeasures are particularly rare because they are inherently more difficult to perform. The barrel of a revolver, for instance, is a more integrated part of the firearm assembly than the more modular barrel of a semiautomatic, so swapping out a revolver barrel requires special tools and considerable knowledge.

With expert knowledge, the range of countermeasures that might be taken is immense. For instance, Schecter et al. (1996:97) concluded that it was possible to replace the entire breech block of a SIG Sauer P226 9mm Luger pistol, so that "only the ejector will remain to give possible individual marks on the cartridge case base area from the 'original' weapon." However, the registration of "good ejector and chamber marks on weapons

[14]Of course, it is possible for quick measures to be very effective at changing toolmarks. At the committee's December 2004 meeting, firearms examiner Lucien Haag shared an evocative presentation entitled "'New' Bores and Breechfaces in 60 Seconds," which suggests two quick ways in which a knowledgeable user could rapidly alter the striations left by the barrel or the breech face markings left on cartridge casings.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

of this quality can be poor to non-existent," and this technique would not be immediately obvious on inspection of the weapon. But the issue is how often people who use guns in crime would go to such lengths, akin to the proverbial question of why more criminals do not wear gloves while committing crimes (given the ease of leaving fingerprints).

Smith (1971:18) argued that replacing pistol barrels "may happen not infrequently;" he personally reported having seen two such cases in criminal cases.[15] He, however, "never personally encountered [a case of replacing a firing pin in an automatic pistol], and it is obvious that such replacement of other parts, (extractor and ejector), refiling of breech face exists, still the possibility of the replacement of this part alone must be kept in mind" (Smith, 1971:19). Refiling the breech face is problematic, but "much refiling would leave the breech surface bright & fresh in appearance"; for full concealment, "it would be much simpler to discard the arm entirely and replace it with another, rather than go to the effort" to make it appear that an arm with a refiled breech face had not been altered (Smith, 1971:19).

It should be noted that while some countermeasures may successfully alter the "signature" markings left on ballistics evidence, they also serve to create new sets of markings—and, in some instances, prominent signs of the alteration—that can be used to match to evidence from later cases. Konior (2006) describes a case in which three cartridge casings and a pistol were recovered in investigating a homicide. The evidence casings did not appear to match test firings from the firearm; the latter all showed much greater levels of flowback around the firing pin impression. Subsequent analysis determined that an attempt had been made to alter the firearm by drilling the entire length of the pistol's barrel; however, the person attempting the modification apparently inserted the drill bit into the firing pin aperture, widening the hole but also damaging the tip of the firing pin. The flowback and a new distinctive mark in the firing pin impression could be attributed to this attempted modification.

3–D.3 "Settle-In" Effect

From the standpoint of establishing an RBID, a phenomenon of extreme interest is what might be called a "settle-in" or "breaking-in" effect: the notion that it takes several firings for a firearm's unique, characteristic markings to stabilize. When the settle-in effect has been documented, it

[15] In this context, Smith (1971:18) notes that the interchangeability of barrels was made vivid "in the famous Sacco-Vanzetti case." Specifically, "the barrel of the fatal arm was, following a demonstration before the court by an expert for the defense, found present in one of the two other arms of the same type which had been introduced as exhibits, all three having been disassembled and reassembled in the course of the demonstration."

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

has been almost exclusively in the context of the striations left on bullets and not on markings left on cartridge cases. This—in addition to the time-intensive process of firing into a water tank or other nondestructive trap and retrieving individual bullets—is a major reason that the restriction of RBIDs to cartridge case entries is sensible.

Murdock (1981:90) analyzed 10 test-fired bullets from each of three new and consecutively rifled barrels. He found that, "in general, the comparison between the first, second, and third firing from any one barrel failed to result in an identification. Some good agreement was present, however. The third, fourth, and fifth test firings from any one barrel could, however, generally be identified as having been fired through the same barrel." From this, "it became obvious that each barrel needed to have a few bullets fired through it before it began marking in a reproducible, identifiable manner." Similar work by Hall (1983:43) using a set of consecutively reamed polygonal barrels noted "rapid change during the first few shots," so that firings 1 and 2 from the same barrel looked much different compared to each other than did firings 19 and 20. Hall found a "lack of identifications where bullets from any of the first five shots were compared to any others." Matty (1985:65) noted similar behavior but was not as precise in suggesting the number of firings after which individual characteristics were discernible; instead, he observed that "it was not possible to make a conclusive match between test bullets #1 and #2 [from the same barrel, but] bullets #9 and #10 . . . were very similar in appearance."

From these and other works, Bonfanti and De Kinder (1999a:5) concluded that "about five to nine shots" are needed "so that [barrels] transfer a signature to a bullet." They note that the studies of consecutively manufactured barrels that they summarize in their review meet this standard. However, at least one of those studies—work by Lutz (1970:25) using two new and consecutively manufactured .38 Special Smith & Wesson barrels—began with the barrels in a completely unfired state and downplays any settle-in effect. Indeed, Lutz described the completely unfired nature of the barrels as the key advantage of the study, as it "offer[s] the ultimate as far as similarities between two successive barrels. It is certain that the similar markings visible now would become less prominent after being subjected to normal firing, cleaning, and wear." Even though all the test firings Lutz examined were among the first 12 uses of the barrel, "sufficient matching individual striae were noted on the bullets to enable the examiners to easily identify the barrel of origin for each of the bullets. Similarities in class characteristics were noted; however, microscopic comparison of the bullets revealed that each barrel had caused different markings to such an extent that each land and groove impression on each of the bullets had a great number of individual identifying striae."

Though a prominent settle-in effect for the breech face or firing pin—

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

the prominent markings on cartridge cases—has not been documented, there may be structural or design features that may cause a similar effect. The Thompson (1996) investigation of highly similar marks resulting from different Lorcin L9 9mm pistols (see Section 2–D.1) included some firings from guns right off the manufacturing line, with no previous proof firing. It was noted that the "breech face impression . . . can change considerably shot-to-shot [in early firings] due to the paint wearing/chipping off."

3–E COMMENTARY

As detailed in Chapter 1, it is not the function of this committee to assess the general validity of firearms identification and toolmark examination nor their admissibility in court proceedings. The discussion in this chapter on the nature of toolmark evidence and the context in which it is applied, as well as an overview of existing research among firearms examiners on the uniqueness and reproducibility of toolmarks, is presented to frame the discussion in the rest of this report. For instance, understanding situations that may pose particular challenges for associating two images of evidence requires some knowledge of situations that are generally known to be complex in the field; likewise, recommendations for the setup and maintenance of any ballistic imaging system that would do harm to the maintenance of clear chain of custody—so important in the legal context of toolmark evidence—would be ill-advised. However, as we also note in Chapter 1, we understand that some readers may try to infer a position—a leaning, one way or the other—based on the preceding analysis.

Accordingly, we believe it important to make the committee's finding clear and unambiguous:

Finding: The validity of the fundamental assumptions of uniqueness and reproducibility of firearms-related toolmarks has not yet been fully demonstrated.

There is one baseline level of credibility, however, that must be demonstrated lest any discussion of ballistic imaging be rendered moot—namely, that there is at least some "signal" that may be detected. In other words, the creation of toolmarks must not be so random and volatile that there is no reason to believe that any similar and matchable marks exist on two exhibits fired from the same gun. The existing research, and the field's general acceptance in legal proceedings for several decades, is more than adequate testimony to that baseline level. Beyond that level, we neither endorse nor oppose the fundamental assumptions. Our review in this chapter is not—and is not meant to be—a full weighing of evidence for or against

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

the assumptions, but it is ample enough to suggest that they are not fully settled, mechanically or empirically.

Another point follows directly: *Additional general research on the uniqueness and reproducibility of firearms-related toolmarks would have to be done if the basic premises of firearms identification are to be put on a more solid scientific footing.* A designed program of experiments covering a full range of sources of variability is important to test the fundamental assumptions, as well as to better document phenomena like "settle-in" effects. In such a program, it could be useful to study the level of agreement of marks generated by the whole system of parts that make up a firearm, rather than treating each mark type in isolation. For example, in a large number of test firings, how comparable is the quality of breech face marking with firing pin impressions, and how do those compare with the clarity of striations etched on bullets? Fully assessing the assumptions underlying firearms identification would require careful attention to statistical experimental design issues, as well as intensive work on the underlying physics, engineering, and metallurgy of firearms, but is essential to the long-term viability of this type of forensic evidence.

A third point is important in reading this report—stopping short of commenting on whether firearms toolmark evidence should be admissible: *Conclusions drawn in firearms identification should not be made to imply the presence of a firm statistical basis when none has been demonstrated.* Specifically, as described in Section 3–B.4, examiners tend to cast their assessments in bold absolutes, commonly asserting that a match can be made "to the exclusion of all other firearms in the world." Such comments cloak an inherently subjective assessment of a match with an extreme probability statement that has no firm grounding and unrealistically implies an error rate of zero. Thornton and Peterson (2002:24–25) note the basic flaw in this reasoning:

> Since the basis of all forensic identification is probability theory, examiners can never really assert a conclusion of an "identification to the exclusion of all others in the world," but at best can only assert a very small (objective or subjective) probability of a coincidental match. . . . It is ironic that those areas of forensic science that have real underlying data offer more modest statements of individualization, while those limited to subjective or impressionistic data make the strongest statements, sometimes of absolute certainty.

As described in Box 3-4, recent court decisions in which admissibility of firearms toolmark evidence was in question have generally accepted that the field has validity but have refused to accept "exclusion of all other firearms" arguments. The committee agrees with the basic point: statements

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

BOX 3-4
Recent Court Decisions: "To the Exclusion of All Other Guns"

As part of a larger trial on racketeering, assault, and gun charges, Judge Nancy Gertner of the U.S. District Court for Massachusetts rejected a motion to exclude ballistics evidence but strictly limited the scope of the testimony (*United States v. Green*, 405 F.Supp. 2d 104; 2005 U.S. Dist. LEXIS 34273). Fourteen .380 caliber shell casings were recovered from two sites in September 2000, six of them at the site of a shooting; about a year later, a loaded .38 caliber pistol was found in the front yard of a residence. As part of the trial, prosecutors wanted to introduce testimony from a Boston Police Department sergeant that all of the casings came from the same gun, namely, the recovered pistol. At a preliminary hearing, the sergeant indicated that he could make this determination "to the exclusion of every other firearm in the world."

Gertner's opinion noted that the "exclusion of every other firearm in the world" claim was "needless to say, extraordinary, particularly given [the sergeant's] data and methods": the examiner "took no notes, recorded no measurements, made no photographs, and drew no diagrams." After reviewing toolmark issues in some detail, the court concluded:

> [The examiner in question] is a seasoned observer of firearms and toolmarks; he may be able to identify marks that a lay observer would not. But while I will allow [him] to testify as to his observations, I will not allow him to conclude that the match he found by dint of the specific methodology he used permits "the exclusion of all other guns" as the source of the shell casings.

Separate rulings in *United States v. Monteiro*—also from the U.S. District Court for the District of Massachusetts, and coming before and after the *Green* ruling—adopted similar stances on testimony "to the exclusion of all other firearms." Defendants in *Monteiro* challenged the specific examiner (a Massachusetts State Police sergeant) as not being qualified in firearms identification; challenged firearms identification as unreliable under *Daubert*; and asserted that—even if firearms identification were reliable—that the examiner did not apply the techniques properly. The defense also challenged the validity of any identification because the examiner replaced—"among other parts"—"the firing pin, recoil spring, barrel, and trigger lever (but, significantly, not the breech face)" of the gun in order to get it back into firing condition.

Prior to *Green*, Judge Patti Saris ruled on a motion to exclude ballistics evidence (2005 U.S. Dist. LEXIS 39062), allowing testimony in part but giving the government "two weeks to ensure that its proffered firearms testimony comported with the established standards in the field." As in *Green*, no notes or photographs were made on the identification: Saris ruled that "until the basis for the identification is described in such a way that the procedure performed by [the sergeant] is reproducible and verifiable, it is inadmissible under Rule 702." Saris further

continued

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

BOX 3-4 Continued

directed that the identification be subjected to independent review and verification in order to be admissible.

Judge Saris' subsequent ruling on the general challenge to firearms identification (407 F.Supp.2d 351, 2006) concluded that "the underlying scientific principle behind firearm identification—that firearms transfer unique toolmarks to spent cartridge cases—is valid under *Daubert*. However, the process of deciding that a cartridge case was fired by a particular gun is based primarily on a visual inspection of patterns of toolmarks, and is largely a subjective determination based on experience and expertise." The court ruled that the government must demonstrate basic standards for the qualification of the examiner. However, like Judge Gertner, Saris precluded—in any event—any testimony of a match to the exclusion of all other guns in the world. Saris noted that "examiners testified to the effect that they could be 100 percent sure of a match," a statement that could not be sustained. An examiner may "testify to a reasonable degree of ballistic certainty," but "an expert may not assert any degree of statistical certainty, 100 percent or otherwise, as to a match."

Most recently, in *United States v. Diaz* (2007 U.S. Dist LEXIS 13152), Judge William Alsup of the U.S. District Court for the Northern District of California accepted that:

> the theory of firearm identification . . . is reliable under *Daubert*. While there is some subjectivity involved, it is the subjective judgment of trained professionals with a keen practiced eye for discerning the extent of matching patterns. . . . The record, however, does not support the conclusion that identifications can be made to the exclusion of all other firearms in the world. Thus, the examiners who testify in this case may only testify that a match has been made to a 'reasonable degree of certainty in the ballistics field.

In defense of firearms identification, Alsup remarked:

> It is important to note that—at least according to this record—there has never been a single documented decision in the United States where an incorrect firearms identification was used to convict a defendant. This is not to say that examiners do not make mistakes. The record demonstrates that examiners make mistakes even on proficiency tests. But, in view of the thousands of criminal defendants who have had an incentive to challenge firearms examiners' conclusions, it is significant that defendants cite no false-positive identification used against a criminal defendant in any American jurisdiction.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

on toolmark matches (including legal testimony) should be supported by the work that was done in the laboratory, by the notes and documentation made by examiners, and by proficiency testing or established error rates for individual examiners in the field and in that particular laboratory, but should not overreach to make extreme probability statements.

3–F ROLE OF IMAGING IN FIREARMS IDENTIFICATION

In the next several chapters, we explore the current state of ballistic imaging technology. As context for this discussion, we note that imaging and photography have a long and somewhat controversial history in traditional firearms identification.

Moran (2003) summarizes some of the historical debate over the use of comparison photographs, culling relevant quotations from source materials. Some of the pioneers of the field of firearms identification—Goddard, Burrard, and Hatcher—considered photography to be valuable, if not essential, Burrard going so far as to comment that "any evidence unsupported by photographs cannot be regarded as being anything more than an expression of opinion. Photographs are, accordingly, essential; and such as are deemed necessary must be taken through the microscope" (Moran, 2003:175). However, Hatcher sounded a note of concern: "There is a difference in the ability of the various experts to use the microscope and camera, so that in the hands of a very skilled operator they may show the correspondence or lack of correspondence very clearly, while in the hands of a poor or mediocre operator, they may show the same thing faintly, or may even fail to show them at all" (Moran, 2003:176). However, with the passage of time, the practice of using photographs to document identifications fell out of favor, so much so that a 1957 revision of Hatcher's 1935 text now stipulated that "photo micrographs are now rarely used," for a variety of reasons (Moran, 2003:177):

- Courts tended to accept examiners' testimony on identifications without the "visual proof," obviating the need to prepare the photographs.
- Preparation of the photographs took time, time that laboratories were unwilling to commit due to increased caseloads.
- Static views of an evidence match were deemed unsatisfactory, relative to the full range of panning and rotation possible during direct manipulation of the evidence.
- "These pictures were not understood by juries," and "a good deal of knowledge and experience are necessary to evaluate them."
- "Some men after years of working in Firearms Identification refuse to make a positive identification from pictures alone."

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

- Photographs depict striations and features that do not match as well as those that do, which could create doubt among jurors.

In subsequent decades, the use of photographs as part of documentation remained a matter of personal and agency tastes, with some favoring it and others opposing it: for example, Heard (1997:113) stated that "the use of comparison photomicrographs in a court of law to illustrate stria comparisons should be discouraged" (although he suggested that a video might be more informative). Ultimately, in 2005, the AFTE membership approved a "standardization of comparison documentation" stipulating that "photography is the preferred method of documentation" but noting that other forms of documentation (including "narrative descriptions") "may serve to satisfy the requirements of this standard." This standard, revised as of June 13, 2005, was promulgated in a 2006 issue of the *AFTE Journal* (Vol. 38, No. 1).

Prior to the use of automated ballistic imaging, law enforcement agencies such as the Los Angeles Police Department (LAPD) relied on cruder means—and a certain amount of luck—to make connections with evidence in their open case files. Quite literally, making those connections depended on reference to Polaroid photomicrographs, posted on a bulletin board or shared with colleagues, in order to jog memories and generate possibilities. As of 1994, the process used by the LAPD was to post Polaroid images on two walls in "a hallway that we pass through constantly. On one side are the 'unknowns,' like cartridge cases collected as evidence at a homicide scene. On the other side are 'knowns.' When we recovered a gun from a suspect or a crime scene, we test-fire it in the lab—that makes it a known. . . . When we get a new known, we compare it to all the unknowns. When we get a new unknown, we compare it to all the knowns and all the unknowns," and the pictures are added to the hallway for future reference (Maruoka, 1994b:214).[16] The next chapter begins to describe efforts to go beyond Polaroids in the hallway: to use computer imaging to make it possible to more readily draw connections with exhibits in other open cases.[17]

[16]The Maruoka article is, in fact, a reprint in the *AFTE Journal* of a profile written for the Polaroid Corporation's *Instant Evidence* newsletter for law enforcement officials, circulated in 1993. As such, it touts the specific Polaroid equipment and film used for the standard imaging.

[17]As an example of the way a large-scale search of exhibits is conducted using conventional methods, without imaging assistance, Grooß (1995:29, 30) describes a series of three murders in West Germany in 1984–1985. Cartridge cases from the second and third crimes were easily matched by examiners but the cases from the first crime bore only limited similarity in markings to the others. Still, the headstamp information on the casings from all three crimes, and the bullet evidence, strongly suggested that a member of the police might be the killer. So strong was this suspicion to investigators that all 7,862 Walther P5 duty pistols then in use by the police forces throughout the state of Baden-Württemberg were test fired and the cartridges

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

compared with the crime scene exhibits. "As the comparison work in this specific case [was done] using conventional microscopes," it "was very complicated and time-consuming"; up to 3 firearms examiners at a time worked continuously on the comparisons. Ultimately, test-fired casings from the 3,704th pistol in sequence matched the casings from the second and third murders; this led investigators to an officer in Stuttgart who was ultimately found dead in southern Italy, having also murdered his wife and sons. Grooß concluded that the experience was strong testament to "the individuality of marks on fired bullets and cartridge cases": that the German examiners were able to observe "marks . . . which left no doubt that they were identical to those observed on the evidence ammunition," against a backdrop of "approximately 4000 pistols of the same manufacturer, same model, approximately the same age and same degree of wear." Apparently, the comparisons with test-fired exhibits were halted with the positive result on the 3,704th pistol, even though the linkage to the casings from the first murder was unclear.

Even when the officer's pistol was recovered and test fired with a variety of ammunition brands, no casing could be generated that matched the evidence from the first murder. It was originally suspected that the pistol "got a new blue finish" (a refurbishing process that may affect the marks left by the gun) at a time between the first and second murder, which might explain the differences. However, "a more careful examination showed that the pistol had been blued in the period between the second and third murder" (why this did not impede the ability to match the second and third crimes is left unspecified). It was also speculated that the officer might have deliberately planted a different casing at the first crime scene to mislead detectives.

Copyright © National Academy of Sciences. All rights reserved.

Ballistic Imaging
http://www.nap.edu/catalog/12162.html

Copyright © National Academy of Sciences. All rights reserved.

STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES

A PATH FORWARD

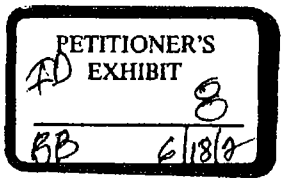
Committee on Identifying the Needs of the Forensic Science Community

Committee on Science, Technology, and Law
Policy and Global Affairs

Committee on Applied and Theoretical Statistics
Division on Engineering and Physical Sciences

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu



Copyright © National Academy of Sciences. All rights reserved.

THE NATIONAL ACADEMIES PRESS 500 Fifth Street, N.W. Washington, DC 20001

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This study was supported by Contract No. 2006-DN-BX-0001 between the National Academy of Sciences and the National Institute of Justice. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the organizations or agencies that provided support for the project.

Library of Congress Cataloging-in-Publication Data

Strengthening forensic science in the United States : a path forward : summary / Committee on Identifying the Needs of the Forensic Science Community, Committee on Science, Technology, and Law Policy and Global Affairs, Committee on Applied and Theoretical Statistics, Division on Engineering and Physical Sciences.

p. cm.

Includes index.

ISBN-13: 978-0-309-13135-3 (hardcover)

ISBN-10: 0-309-13135-9 (hardcover)

ISBN-13: 978-0-309-13131-5 (pbk.)

ISBN-10: 0-309-13131-6 (pbk.)

1. Forensic sciences—United States. 2. Criminal investigation—United States. 3. Evidence, Criminal—United States. I. National Research Council (U.S.). Committee on Identifying the Needs of the Forensic Science Community. II. National Research Council (U.S.). Committee on Science, Technology, and Law Policy and Global Affairs. III. National Research Council (U.S.). Committee on Applied and Theoretical Statistics.

HV8073.S7347 2009

363.250973—dc22

2009011443

Additional copies of this report are available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, *http://www.nap.edu*.

Copyright 2009 by the National Academy of Sciences. All rights reserved.

Printed in the United States of America

Copyright © National Academy of Sciences. All rights reserved.

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

www.national-academies.org

Copyright © National Academy of Sciences. All rights reserved.

Copyright © National Academy of Sciences. All rights reserved.

COMMITTEE ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIENCE COMMUNITY

HARRY T. EDWARDS, (*Co-chair*), Judge, U.S. Court of Appeals for the District of Columbia Circuit

CONSTANTINE GATSONIS, (*Co-chair*), Director, Center for Statistical Sciences, Brown University

MARGARET A. BERGER, Suzanne J. and Norman Miles Professor of Law, Brooklyn Law School

JOE S. CECIL, Project Director, Program on Scientific and Technical Evidence, Federal Judicial Center

M. BONNER DENTON, Professor of Chemistry, University of Arizona

MARCELLA F. FIERRO, Medical Examiner of Virginia (ret.)

KAREN KAFADAR, Rudy Professor of Statistics and Physics, Indiana University

PETE M. MARONE, Director, Virginia Department of Forensic Science

GEOFFREY S. MEARNS, Dean, Cleveland-Marshall College of Law, Cleveland State University

RANDALL S. MURCH, Associate Director, Research Program Development, Virginia Polytechnic Institute and State University

CHANNING ROBERTSON, Ruth G. and William K. Bowes Professor, Dean of Faculty and Academic Affairs, and Professor, Department of Chemical Engineering, Stanford University

MARVIN E. SCHECHTER, Attorney

ROBERT SHALER, Director, Forensic Science Program, Professor, Biochemistry and Molecular Biology Department, Eberly College of Science, The Pennsylvania State University

JAY A. SIEGEL, Professor, Forensic and Investigative Sciences Program, Indiana University-Purdue University

SARGUR N. SRIHARI, SUNY Distinguished Professor, Department of Computer Science and Engineering and Director, Center of Excellence for Document Analysis and Recognition (CEDAR), University at Buffalo, State University of New York

SHELDON M. WIEDERHORN (NAE), Senior NIST Fellow, National Institute of Standards and Technology

ROSS E. ZUMWALT, Chief Medical Examiner, Office of the Medical Examiner of the State of New Mexico

Copyright © National Academy of Sciences. All rights reserved.

Staff

ANNE-MARIE MAZZA, Study Director
SCOTT T. WEIDMAN, Director, Board on Mathematical Sciences and Their Applications
JOHN SISLIN, Program Officer, Board on Higher Education and Workforce
DAVID PADGHAM, Program Officer, Computer Science and Telecommunications Board (until 5/08)
STEVEN KENDALL, Senior Program Associate
KATIE MAGEE, Senior Program Assistant (until 9/07)
KATHI E. HANNA, Consultant Writer
SARA D. MADDOX, Editor
ROBIN ACKERMAN, Christine Mirzayan Science and Technology Policy Fellow
GEMAYEL JEAN-PAUL, Christine Mirzayan Science and Technology Policy Fellow
JOHNALYN D. LYLES, Christine Mirzayan Science and Technology Policy Fellow
SANDRA OTTENSMANN, Christine Mirzayan Science and Technology Policy Fellow
DEIRDRE PARSONS, Christine Mirzayan Science and Technology Policy Fellow
SARAH RYKER, Christine Mirzayan Science and Technology Policy Fellow
SUNBIN SONG, Christine Mirzayan Science and Technology Policy Fellow

Copyright © National Academy of Sciences. All rights reserved.

COMMITTEE ON SCIENCE, TECHNOLOGY, AND LAW

DONALD KENNEDY (NAS/IOM), *(Co-chair)*, President Emeritus and Bing Professor of Environmental Science Emeritus, Stanford University; Emeritus Editor-in-Chief, *Science*

RICHARD A. MERRILL (IOM), *(Co-chair)*, Daniel Caplin Professor of Law Emeritus, University of Virginia Law School

FREDERICK R. ANDERSON, JR., Partner, McKenna, Long, & Aldridge LLP

MARGARET A. BERGER, Suzanne J. and Norman Miles Professor of Law, Brooklyn Law School

ARTHUR I. BIENENSTOCK, Special Assistant to the President for SLAC and Federal Research Policy, Stanford University

BARBARA E. BIERER, Senior Vice President for Research, Brigham and Women's Hospital

ELIZABETH H. BLACKBURN (NAS/IOM), Morris Herzstein Professor of Biology and Physiology, Department of Biochemistry and Biophysics, University of California, San Francisco

JOE S. CECIL, Project Director, Program on Scientific and Technical Evidence, Federal Judicial Center

RICHARD F. CELESTE, President, Colorado College

JOEL E. COHEN (NAS), Abby Rockefeller Mauzé Professor and Head, Laboratory of Populations, The Rockefeller University and Columbia University

KENNETH W. DAM, Max Pam Professor Emeritus of American and Foreign Law and Senior Lecturer, University of Chicago Law School

ROCHELLE COOPER DREYFUSS, Pauline Newman Professor of Law and Director, Engelberg Center on Innovation Law and Policy, New York University School of Law

ALICE P. GAST (NAE), President, Lehigh University

LAWRENCE O. GOSTIN (IOM), Associate Dean for Research and Academic Programs, Linda D. and Timothy J. O'Neill Professor of Global Health Law, Georgetown University; Professor of Public Health, The Johns Hopkins University

GARY W. HART, Wirth Chair Professor, School of Public Affairs, University of Colorado, Denver

BENJAMIN W. HEINEMAN, JR., Senior Fellow, Harvard Law School and Harvard Kennedy School of Government

DAVID BROCK HORNBY, Judge, U.S. District Court, District of Maine

DAVID KORN (IOM), Vice Provost for Research, Harvard University

RICHARD A. MESERVE (NAE), President, Carnegie Institution of Washington

Copyright © National Academy of Sciences. All rights reserved.

DUNCAN T. MOORE (NAE), Professor, The Institute of Optics, University of Rochester
ALAN B. MORRISON, Visiting Professor, Washington College of Law, American University
HARRIET RABB, Vice President and General Counsel, Rockefeller University
PAUL D. RHEINGOLD, Senior Partner, Rheingold, Valet, Rheingold, Shkolnik & McCartney LLP
BARBARA ROTHSTEIN, Director, Federal Judicial Center
JONATHAN M. SAMET (IOM), Founding Director, Institute for Global Health and Chairman, Department of Preventive Medicine, University of Southern California
DAVID S. TATEL, Judge, U.S. Court of Appeals for the District of Columbia Circuit

Staff

ANNE-MARIE MAZZA, Director
STEVEN KENDALL, Senior Program Associate

Copyright © National Academy of Sciences. All rights reserved.

COMMITTEE ON APPLIED AND THEORETICAL STATISTICS

KAREN KAFADAR, (*Chair*), Rudy Professor of Statistics and Physics, Indiana University
AMY BRAVERMAN, MISR Co-Investigator, Statistics and Data Analysis, Earth and Space Sciences Division, Jet Propulsion Laboratory
CONSTANTINE GATSONIS, Director, Center for Statistical Sciences, Brown University
MICHAEL GOODCHILD (NAS), Professor, Department of Geography, University of California, Santa Barbara
KATHRYN B. LASKEY, Professor, Department of Systems Engineering and Operations Research, George Mason University
MICHAEL LESK (NAE), Professor, Library and Information Sciences, Rutgers University
THOMAS A. LOUIS, Professor, Department of Biostatistics, Bloomberg School of Public Health, The Johns Hopkins University
MICHAEL A. NEWTON, Professor, Department of Biostatistics and Medical Informatics, University of Wisconsin, Madison
MICHAEL L. STEIN, Professor, Department of Statistics, The University of Chicago

Staff

SCOTT WEIDMAN, Director
NEAL GLASSMAN, Senior Program Officer
BARBARA WRIGHT, Administrative Assistant

Copyright © National Academy of Sciences. All rights reserved.

Copyright © National Academy of Sciences. All rights reserved.

Acknowledgments

ACKNOWLEDGMENT OF PRESENTERS

The committee gratefully acknowledges the contributions of the following individuals who made thoughtful presentations before it:

Chris Asplen, *Gordon Thomas Honeywell Government Affairs*; Peter D. Barnett, *Forensic Science Associates*; Richard E. Bisbing, *McCrone Associates, Inc.*, and *Scientific Working Group on Materials Analysis (SWGMAT)*; Joseph P. Bono, *U.S. Secret Service*; Michael R. Bromwich, *Fried, Frank, Harris, Shriver & Jacobson LLP*; Bruce Budowle, *Federal Bureau of Investigation*; James Burans, *U.S. Department of Homeland Security*; Thomas Cantwell, *U.S. Department of Defense*; Larry Chelko, *U.S. Army Criminal Investigation Laboratory*; John Collins, *DuPage County Sheriff's Office Crime Laboratory*; Charles Cooke, *Office of the Director of National Intelligence*; Robin Cotton, *Boston University School of Medicine*; Joseph A. DiZinno, *Federal Bureau of Investigation*; James Downs, *National Association of Medical Examiners* and *Consortium of Forensic Science Organizations* and *Georgia Bureau of Investigation*; Itiel Dror, *University of Southampton*; Arthur Eisenberg, *Forensic Quality Services*; Barry A. J. Fisher, *Los Angeles County Sheriff's Department*; Eric Friedberg, *Stroz Friedberg, LLC*; Robert E. Gaensslen, *University of Illinois at Chicago*; Brandon L. Garrett, *University of Virginia*; Michael D. Garris, *National Institute of Standards and Technology*; Ed German, *U.S. Army* (ret.); Paul C. Giannelli, *Case Western Reserve University School of Law*; Bruce A. Goldberger, *American Academy of Forensic Sciences*; Hank

Copyright © National Academy of Sciences. All rights reserved.

Greely, *Stanford University*; Barbara Guttman, *National Institute of Standards and Technology*; David W. Hagy, *U.S. Department of Justice*; Randy Hanzlick, *Fulton County Medical Examiner's Center* and *Emory University School of Medicine*; Carol Henderson, *National Clearinghouse for Science, Technology and the Law* and *Stetson University*; Matthew J. Hickman, *U.S. Department of Justice*; Peter T. Higgins, *The Higgins-Hermansen Group*; Max M. Houck, *West Virginia University*; Vici Inlow, *U.S. Secret Service*; Jan L. Johnson, *Illinois State Police*; Jay Kadane, *Carnegie Mellon University*; David Kaye, *Arizona State University*; Peter D. Komarinski, *Komarinski & Associates, LLC*; Roger G. Koppl, *Farleigh Dickinson University*; Glenn Langenburg, *Minnesota Bureau of Criminal Apprehension*; Deborah Leben, *U.S. Secret Service*; John Lentini, *Scientific Fire Analysis, LLC*; Alan I. Leshner, *American Association for the Advancement of Science*; William MacCrehan, *National Institute of Standards and Technology*; Bill Marbaker, *American Society of Crime Laboratory Directors*; Kenneth F. Martin, *Massachusetts State Police*; Carole McCartney, *University of Leeds*; Stephen B. Meagher, *Federal Bureau of Investigation* and *Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST)*; Jennifer Mnooken, *University of California, Los Angeles Law School*; John E. Moalli, *Exponent*; John Morgan, *U.S. Department of Justice*; Michael Murphy, *Las Vegas Office of the Coroner*; Peter Neufeld, *The Innocence Project*; John Onstwedder III, *Illinois State Police*; Garry F. Peterson, *Hennepin County Medical Examiner's Office* and *National Association of Medical Examiners*; Joseph L. Peterson, *California State University, Los Angeles*; Peter Pizzola, *New York Police Department Crime Laboratory*; Joe Polski, *Consortium of Forensic Science Organizations* and *International Association for Identification*; Larry Quarino, *Cedar Crest College*; Irma Rios, *City of Houston Crime Lab*; Michael Risinger, *Seton Hall Law School*; Michael J. Saks, *Sandra Day O'Connor College of Law, Arizona State University*; Nelson A. Santos, *Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG)*; David R. Senn, *The University of Texas Health Science Center at San Antonio*; Robert Stacey, *American Society of Crime Laboratory Directors, Laboratory Accreditation Board*; David Stoney, *Stoney Forensic, Inc.*; Peter Striupaitis, *International Association for Identification* and *Scientific Working Group for Firearms and Toolmarks (SWGGUN)*; Rick Tontarski, *U.S. Army Criminal Investigation Laboratory*; Richard W. Vorder Bruegge, *Federal Bureau of Investigation*; Victor W. Weedn; and Tom Witt, *West Virginia University.*

ACKNOWLEDGMENT OF REVIEWERS

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with pro-

Copyright © National Academy of Sciences. All rights reserved.

cedures approved by the National Academies' Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

We wish to thank the following individuals for their review of this report: R. Stephen Berry, University of Chicago; Christophe Champod, Universite de Lausanne, Switzerland; William Chisum, Retired, National Crime Investigation and Training; Joel Cohen, Rockefeller University; Peter DeForest, John Jay College of Criminal Justice; Stephen Fienberg, Carnegie Mellon University; Barry Fisher, Los Angeles County Sheriff's Department; Mark Flomenbaum, Boston University; Ross Gardner, Gardner Forensic Consulting; Paul Giannelli, Case Western Reserve University; Randy Hanzlick, Emory University; Keith Inman, Forensic Analytical Sciences, Inc.; Dan Kahan, Yale Law School; Roger Kahn, Harris County Medical Examiner's Office; Elizabeth Loftus, University of California, Irvine; C. Owen Lovejoy, Kent State University; Kenneth Melson, George Washington University; Michael Murphy, Office of the Coroner/Medical Examiner, Las Vegas, Nevada; Hyla Napadensky, Retired, Napadensky Energetics, Inc.; Joseph Peterson, California State University, Los Angeles; William Press, University of Texas, Austin; Jed Rakoff, U.S. District Court Southern District of New York; Carl Selavka, U.S. Army Criminal Investigation Laboratory; David Stoney, Stoney Forensic, Inc.; and Charles Wellford, University of Maryland.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by John Bailar, University of Chicago, and Royce Murray, University of North Carolina, Chapel Hill. Appointed by the National Academies, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

Copyright © National Academy of Sciences. All rights reserved.

Copyright © National Academy of Sciences. All rights reserved.

Contents

Preface xix

Summary 1
Introduction, 1
Findings and Recommendations, 14

1 **Introduction** 35
What Is Forensic Science?, 38
Pressures on the Forensic Science System, 39
Organization of This Report, 53

2 **The Forensic Science Community and the Need for Integrated Governance** 55
Crime Scene Investigation, 56
Forensic Science Laboratories and Service Providers, 57
Case Backlogs, 61
NIJ's Coverdell Forensic Science Improvement Grant Program, 62
Forensic Services Beyond the Traditional Laboratory, 64
Federal Forensic Science Activities, 65
Research Funding, 71
Professional Associations, 75
Conclusions and Recommendation, 77

Copyright © National Academy of Sciences. All rights reserved.

3 **The Admission of Forensic Science Evidence in Litigation Law and Science** 85
Law and Science, 86
The *Frye* Standard and Rule 702 of the Federal Rules of Evidence, 88
The *Daubert* Decision and the Supreme Court's Construction of Rule 702, 90
The 2000 Amendment of Rule 702, 92
An Overview of Judicial Dispositions of *Daubert*-Type Questions, 95
Some Examples of Judicial Dispositions of Questions Relating to Forensic Science Evidence, 99
Conclusion, 110

4 **The Principles of Science and Interpreting Scientific Data** 111
Fundamental Principles of the Scientific Method, 112
Conclusion, 125

5 **Descriptions of Some Forensic Science Disciplines** 127
Biological Evidence, 128
Analysis of Controlled Substances, 134
Friction Ridge Analysis, 136
Other Pattern/Impression Evidence: Shoeprints and Tire Tracks, 145
Toolmark and Firearms Identification, 150
Analysis of Hair Evidence, 156
Analysis of Fiber Evidence, 162
Questioned Document Examination, 164
Analysis of Paint and Coatings Evidence, 167
Analysis of Explosives Evidence and Fire Debris, 171
Forensic Odontology, 174
Bloodstain Pattern Analysis, 177
An Emerging Forensic Science Discipline: Digital and Multimedia Analysis, 179
Conclusions, 183

6 **Improving Methods, Practice, and Performance in Forensic Science** 183
Independence of Forensic Science Laboratories, 183
Uncertainties and Bias, 184
Reporting Results, 185
The Need for Research, 187
Conclusions and Recommendations, 188

Copyright © National Academy of Sciences. All rights reserved.

7 **Strengthening Oversight of Forensic Science Practice** 193
Accreditation, 195
Standards and Guidelines for Quality Control, 201
Proficiency Testing, 206
Certification, 208
Oversight as a Requirement of Paul Coverdell Forensic Science Improvement Grants, 211
Codes of Ethics, 212
Conclusions and Recommendations, 213

8 **Education and Training in Forensic Science** 217
Status of Forensic Science Education, 218
Challenges and Opportunities to Improve Forensic Science Education, 224
Research as a Component of Forensic Science Education Programs, 230
Status of Training, 231
Education in the Legal System, 234
Conclusions and Recommendation, 237

9 **Medical Examiner and Coroner Systems: Current and Future Needs** 241
Medical Examiners and Coroners (ME/C), 243
ME/C Jurisdiction, 244
ME/C Missions, 244
Variations in ME/C Systems, 245
Qualifications of Coroners and Medical Examiners, 247
ME/C Administration and Oversight, 249
ME/C Staffing and Funding, 249
The Movement to Convert Coroner Systems to Medical Examiner Systems, 251
Utilization of Best Practices, 252
Potential Scientific Advances That May Assist ME/Cs, 253
The Shortage of Medical Examiners and Forensic Pathologists, 256
Standards and Accreditation for Death Investigation Systems, 258
Quality Control and Quality Assurance, 259
Continuing Medical Education, 259
Homeland Security, 260
Forensic Pathology Research, 261
Common Methods of Sample and Data Collection, 263
Conclusions and Recommendation, 265

Copyright © National Academy of Sciences. All rights reserved.

10 **Automated Fingerprint Identification Systems** 269
Interoperability Challenges, 273
Conclusions and Recommendation, 276

11 **Homeland Security and the Forensic Science Disciplines** 279
Conclusion and Recommendation, 285

Appendixes

A Biographical Information of Committee and Staff 287

B Committee Meeting Agendas 303

Index 315

Copyright © National Academy of Sciences. All rights reserved.

Preface

Recognizing that significant improvements are needed in forensic science, Congress directed the National Academy of Sciences to undertake the study that led to this report. There are scores of talented and dedicated people in the forensic science community, and the work that they perform is vitally important. They are often strapped in their work, however, for lack of adequate resources, sound policies, and national support. It is clear that change and advancements, both systemic and scientific, are needed in a number of forensic science disciplines—to ensure the reliability of the disciplines, establish enforceable standards, and promote best practices and their consistent application.

In adopting this report, the aim of our committee is to chart an agenda for progress in the forensic science community and its scientific disciplines. Because the work of forensic science practitioners is so obviously wide-reaching and important—affecting criminal investigation and prosecution, civil litigation, legal reform, the investigation of insurance claims, national disaster planning and preparedness, homeland security, and the advancement of technology—the committee worked with a sense of great commitment and spent countless hours deliberating over the recommendations that are included in the report. These recommendations, which are inexorably interconnected, reflect the committee's strong views on policy initiatives that must be adopted in any plan to improve the forensic science disciplines and to allow the forensic science community to serve society more effectively.

The task Congress assigned our committee was daunting and required serious thought and the consideration of an extremely complex and decentralized system, with various players, jurisdictions, demands, and limitations. Throughout our lengthy deliberations, the committee heard testimony

Copyright © National Academy of Sciences. All rights reserved.

from the stakeholder community, ensuring that the voices of forensic practitioners were heard and their concerns addressed. We also heard from professionals who manage forensic laboratories and medical examiner/coroner offices; teachers who are devoted to training the next generation of forensic scientists; scholars who have conducted important research in a number of forensic science fields; and members of the legal profession and law enforcement agencies who understand how forensic science evidence is collected, analyzed, and used in connection with criminal investigations and prosecutions. We are deeply grateful to all of the presenters who spoke to the committee and/or submitted papers for our consideration. These experts and their work served the committee well.

In considering the testimony and evidence that was presented to the committee, what surprised us the most was the consistency of the message that we heard:

> **The forensic science system, encompassing both research and practice, has serious problems that can only be addressed by a national commitment to overhaul the current structure that supports the forensic science community in this country. This can only be done with effective leadership at the highest levels of both federal and state governments, pursuant to national standards, and with a significant infusion of federal funds.**

The recommendations in this report represent the committee's studied opinion on how best to achieve this critical goal.

We had the good fortune to serve as co-chairs of the committee entrusted with addressing Congress' charge. The committee, formed under the auspices of the National Academies' Committee on Science, Technology, and Law and Committee on Applied and Theoretical Statistics, was composed of many talented professionals, some expert in various areas of forensic science, others in law, and still others in different fields of science and engineering. They listened, read, questioned, vigorously discussed the findings and recommendations offered in this report, and then worked hard to complete the research and writing required to produce the report. We are indebted to our colleagues for all the time and energy they gave to this effort. We are also most grateful to the staff, Anne-Marie Mazza, Scott Weidman, Steven Kendall, and the consultant writer, Kathi Hanna, for their superb work and dedication to this project; to staff members David Padgham and John Sislin, and editor, Sara Maddox, for their assistance; and to Paige Herwig, Laurie Richardson, and Judith A. Hunt for their sterling contributions in checking source materials and assisting with the final production of the report.

Harry T. Edwards and Constantine Gatsonis
Committee Co-chairs

Copyright © National Academy of Sciences. All rights reserved.

Summary

INTRODUCTION

On November 22, 2005, the Science, State, Justice, Commerce, and Related Agencies Appropriations Act of 2006 became law.[1] Under the terms of the statute, Congress authorized "the National Academy of Sciences to conduct a study on forensic science, as described in the Senate report."[2] The Senate Report to which the Conference Report refers states:

> While a great deal of analysis exists of the requirements in the discipline of DNA, there exists little to no analysis of the remaining needs of the community outside of the area of DNA. Therefore . . . the Committee directs the Attorney General to provide [funds] to the National Academy of Sciences to create an independent Forensic Science Committee. This Committee shall include members of the forensics community representing operational crime laboratories, medical examiners, and coroners; legal experts; and other scientists as determined appropriate.[3]

The Senate Report also sets forth the charge to the Forensic Science Committee, instructing it to:

(1) assess the present and future resource needs of the forensic science community, to include State and local crime labs, medical examiners, and coroners;

[1] P.L. No. 109-108, 119 Stat. 2290 (2005).
[2] H.R. Rep. No. 109-272, at 121 (2005) (Conf. Rep.).
[3] S. Rep. No. 109-88, at 46 (2005).

Copyright © National Academy of Sciences. All rights reserved.

(2) make recommendations for maximizing the use of forensic technologies and techniques to solve crimes, investigate deaths, and protect the public;
(3) identify potential scientific advances that may assist law enforcement in using forensic technologies and techniques to protect the public;
(4) make recommendations for programs that will increase the number of qualified forensic scientists and medical examiners available to work in public crime laboratories;
(5) disseminate best practices and guidelines concerning the collection and analysis of forensic evidence to help ensure quality and consistency in the use of forensic technologies and techniques to solve crimes, investigate deaths, and protect the public;
(6) examine the role of the forensic community in the homeland security mission;
(7) [examine] interoperability of Automated Fingerprint Information Systems [AFIS]; and
(8) examine additional issues pertaining to forensic science as determined by the Committee.[4]

In the fall of 2006, a committee was established by the National Academy of Sciences to implement this congressional charge. As recommended in the Senate Report, the persons selected to serve included members of the forensic science community, members of the legal community, and a diverse group of scientists. Operating under the project title "Identifying the Needs of the Forensic Science Community," the committee met on eight occasions: January 25-26, April 23-24, June 5-6, September 20-21, and December 6-7, 2007, and March 24-25, June 23-24, and November 14-15, 2008. During these meetings, the committee heard expert testimony and deliberated over the information it heard and received. Between meetings, committee members reviewed numerous published materials, studies, and reports related to the forensic science disciplines, engaged in independent research on the subject, and worked on drafts of the final report.

Experts who provided testimony included federal agency officials; academics and research scholars; private consultants; federal, state, and local law enforcement officials; scientists; medical examiners; a coroner; crime laboratory officials from the public and private sectors; independent investigators; defense attorneys; forensic science practitioners; and leadership of professional and standard setting organizations (see the Acknowledgments and Appendix B for a complete listing of presenters).

[4] Ibid.

Copyright © National Academy of Sciences. All rights reserved.

The issues covered during the committee's hearings and deliberations included:

(a) the fundamentals of the scientific method as applied to forensic practice—hypothesis generation and testing, falsifiability and replication, and peer review of scientific publications;
(b) the assessment of forensic methods and technologies—the collection and analysis of forensic data; accuracy and error rates of forensic analyses; sources of potential bias and human error in interpretation by forensic experts; and proficiency testing of forensic experts;
(c) infrastructure and needs for basic research and technology assessment in forensic science;
(d) current training and education in forensic science;
(e) the structure and operation of forensic science laboratories;
(f) the structure and operation of the coroner and medical examiner systems;
(g) budget, future needs, and priorities of the forensic science community and the coroner and medical examiner systems;
(h) the accreditation, certification, and licensing of forensic science operations, medical death investigation systems, and scientists;
(i) Scientific Working Groups (SWGs) and their practices;
(j) forensic science practices—
pattern/experience evidence
- fingerprints (including the interoperability of AFIS)
- firearms examination
- toolmarks
- bite marks
- impressions (tires, footwear)
- bloodstain pattern analysis
- handwriting
- hair

analytical evidence
- DNA
- coatings (e.g., paint)
- chemicals (including drugs)
- materials (including fibers)
- fluids
- serology
- fire and explosive analysis

digital evidence;
(k) the effectiveness of coroner systems as compared with medical examiner systems;

Copyright © National Academy of Sciences. All rights reserved.

(l) the use of forensic evidence in criminal and civil litigation—
- o the collection and flow of evidence from crime scenes to courtrooms
- o the manner in which forensic practitioners testify in court
- o cases involving the misinterpretation of forensic evidence
- o the adversarial system in criminal and civil litigation
- o lawyers' use and misuse of forensic evidence
- o judges' handling of forensic evidence;

(m) forensic practice and projects at various federal agencies, including NIST, the FBI, DHS, U.S. Secret Service, NIJ, DEA, and DOD;
(n) forensic practice in state and local agencies;
(o) nontraditional forensic service providers; and
(p) the forensic science community in the United Kingdom.

The testimonial and documentary evidence considered by the committee was detailed, complex, and sometimes controversial. Given this reality, the committee could not possibly answer every question that it confronted, nor could it devise specific solutions for every problem that it identified. Rather, it reached a consensus on the most important issues now facing the forensic science community and medical examiner system and agreed on 13 specific recommendations to address these issues.

Challenges Facing the Forensic Science Community

For decades, the forensic science disciplines have produced valuable evidence that has contributed to the successful prosecution and conviction of criminals as well as to the exoneration of innocent people. Over the last two decades, advances in some forensic science disciplines, especially the use of DNA technology, have demonstrated that some areas of forensic science have great additional potential to help law enforcement identify criminals. Many crimes that may have gone unsolved are now being solved because forensic science is helping to identify the perpetrators.

Those advances, however, also have revealed that, in some cases, substantive information and testimony based on faulty forensic science analyses may have contributed to wrongful convictions of innocent people. This fact has demonstrated the potential danger of giving undue weight to evidence and testimony derived from imperfect testing and analysis. Moreover, imprecise or exaggerated expert testimony has sometimes contributed to the admission of erroneous or misleading evidence.

Further advances in the forensic science disciplines will serve three important purposes. First, further improvements will assist law enforcement officials in the course of their investigations to identify perpetrators with higher reliability. Second, further improvements in forensic science practices

Copyright © National Academy of Sciences. All rights reserved.

should reduce the occurrence of wrongful convictions, which reduces the risk that true offenders continue to commit crimes while innocent persons inappropriately serve time. Third, any improvements in the forensic science disciplines will undoubtedly enhance the Nation's ability to address the needs of homeland security.

Numerous professionals in the forensic science community and the medical examiner system have worked for years to achieve excellence in their fields, aiming to follow high ethical norms, develop sound professional standards, ensure accurate results in their practices, and improve the processes by which accuracy is determined. Although the work of these dedicated professionals has resulted in significant progress in the forensic science disciplines in recent decades, major challenges still face the forensic science community. It is therefore unsurprising that Congress instructed this committee to, among other things, "assess the present and future resource needs of the forensic science community," "make recommendations for maximizing the use of forensic technologies and techniques," "make recommendations for programs that will increase the number of qualified forensic scientists and medical examiners," and "disseminate best practices and guidelines concerning the collection and analysis of forensic evidence to help ensure quality and consistency in the use of forensic technologies and techniques." These are among the pressing issues facing the forensic science community. The best professionals in the forensic science disciplines invariably are hindered in their work because these and other problems persist.

The length of the congressional charge and the complexity of the material under review made the committee's assignment challenging. In undertaking it, the committee first had to gain an understanding of the various disciplines within the forensic science community, as well as the community's history, its strengths and weaknesses, and the roles of the people and agencies that constitute the community and make use of its services. In so doing, the committee was able to better comprehend some of the major problems facing the forensic science community and the medical examiner system. A brief review of some of these problems is illuminating.[5]

Disparities in the Forensic Science Community

There are great disparities among existing forensic science operations in federal, state, and local law enforcement jurisdictions and agencies. This is true with respect to funding, access to analytical instrumentation, the availability of skilled and well-trained personnel, certification, accreditation, and

[5] In this report, the "forensic science community," broadly speaking, is meant to include forensic pathology and medicolegal death investigation, which is sometimes referred to as "the medical examiner system" or "the medicolegal death investigation system."

Copyright © National Academy of Sciences. All rights reserved.

oversight. As a result, it is not easy to generalize about current practices within the forensic science community. It is clear, however, that any approach to overhauling the existing system needs to address and help minimize the community's current fragmentation and inconsistent practices.

Although the vast majority of criminal law enforcement is handled by state and local jurisdictions, these entities often are sorely lacking in the resources (money, staff, training, and equipment) necessary to promote and maintain strong forensic science laboratory systems. By comparison, federal programs are often much better funded and staffed. It is also noteworthy that the resources, the extent of services, and the amount of expertise that medical examiners and forensic pathologists can provide vary widely in different jurisdictions. As a result, the depth, reliability, and overall quality of substantive information arising from the forensic examination of evidence available to the legal system vary substantially across the country.

Lack of Mandatory Standardization, Certification, and Accreditation

The fragmentation problem is compounded because operational principles and procedures for many forensic science disciplines are not standardized or embraced, either between or within jurisdictions. There is no uniformity in the certification of forensic practitioners, or in the accreditation of crime laboratories. Indeed, most jurisdictions do not require forensic practitioners to be certified, and most forensic science disciplines have no mandatory certification programs. Moreover, accreditation of crime laboratories is not required in most jurisdictions. Often there are no standard protocols governing forensic practice in a given discipline. And, even when protocols are in place (e.g., SWG standards), they often are vague and not enforced in any meaningful way. In short, the quality of forensic practice in most disciplines varies greatly because of the absence of adequate training and continuing education, rigorous mandatory certification and accreditation programs, adherence to robust performance standards, and effective oversight.[6] These shortcomings obviously pose a continuing and serious threat to the quality and credibility of forensic science practice.

The Broad Range of Forensic Science Disciplines

The term "forensic science" encompasses a broad range of forensic disciplines, each with its own set of technologies and practices. In other words, there is wide variability across forensic science disciplines with regard to

[6] See, e.g., P.C. Giannelli. 2007. Wrongful convictions and forensic science: The need to regulate crime labs. 86 N.C. L. Rev. 163 (2007); B. Schmitt and J. Swickard. 2008. "Detroit Police Lab Shut Down After Probe Finds Errors." *Detroit Free Press*. September 25.

Copyright © National Academy of Sciences. All rights reserved.

techniques, methodologies, reliability, types and numbers of potential errors, research, general acceptability, and published material. Some of the forensic science disciplines are laboratory based (e.g., nuclear and mitochondrial DNA analysis, toxicology and drug analysis); others are based on expert interpretation of observed patterns (e.g., fingerprints, writing samples, toolmarks, bite marks, and specimens such as hair). The "forensic science community," in turn, consists of a host of practitioners, including scientists (some with advanced degrees) in the fields of chemistry, biochemistry, biology, and medicine; laboratory technicians; crime scene investigators; and law enforcement officers. There are very important differences, however, between forensic laboratory work and crime scene investigations. There are also sharp distinctions between forensic practitioners who have been trained in chemistry, biochemistry, biology, and medicine (and who bring these disciplines to bear in their work) and technicians who lend support to forensic science enterprises. Many of these differences are discussed in the body of this report.

The committee decided early in its work that it would not be feasible to develop a detailed evaluation of each discipline in terms of its scientific underpinning, level of development, and ability to provide evidence to address the major types of questions raised in criminal prosecutions and civil litigation. However, the committee solicited testimony on a broad range of forensic science disciplines and sought to identify issues relevant across definable classes of disciplines. As a result of listening to this testimony and reviewing related written materials, the committee found substantial evidence indicating that the level of scientific development and evaluation varies substantially among the forensic science disciplines.

Problems Relating to the Interpretation of Forensic Evidence

Often in criminal prosecutions and civil litigation, forensic evidence is offered to support conclusions about "individualization" (sometimes referred to as "matching" a specimen to a particular individual or other source) or about classification of the source of the specimen into one of several categories. With the exception of nuclear DNA analysis, however, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source. In terms of scientific basis, the analytically based disciplines generally hold a notable edge over disciplines based on expert interpretation. But there are important variations among the disciplines relying on expert interpretation. For example, there are more established protocols and available research for fingerprint analysis than for the analysis of bite marks. There also are significant variations within each discipline. For example, not all fingerprint evidence is

Copyright © National Academy of Sciences. All rights reserved.

equally good, because the true value of the evidence is determined by the quality of the latent fingerprint image. These disparities between and within the forensic science disciplines highlight a major problem in the forensic science community: The simple reality is that the interpretation of forensic evidence is not always based on scientific studies to determine its validity. This is a serious problem. Although research has been done in some disciplines, there is a notable dearth of peer-reviewed, published studies establishing the scientific bases and validity of many forensic methods.[7]

The Need for Research to Establish Limits and Measures of Performance

In evaluating the accuracy of a forensic analysis, it is crucial to clarify the type of question the analysis is called on to address. Thus, although some techniques may be too imprecise to permit accurate identification of a specific individual, they may still provide useful and accurate information about questions of classification. For example, microscopic hair analysis may provide reliable evidence on some characteristics of the individual from which the specimen was taken, but it may not be able to reliably match the specimen with a specific individual. However, the definition of the appropriate question is only a first step in the evaluation of the performance of a forensic technique. A body of research is required to establish the limits and measures of performance and to address the impact of sources of variability and potential bias. Such research is sorely needed, but it seems to be lacking in most of the forensic disciplines that rely on subjective assessments of matching characteristics. These disciplines need to develop rigorous protocols to guide these subjective interpretations and pursue equally rigorous research and evaluation programs. The development of such research programs can benefit significantly from other areas, notably from the large body of research on the evaluation of observer performance in diagnostic medicine and from the findings of cognitive psychology on the potential for bias and error in human observers.[8]

---

[7] Several articles, for example, have noted the lack of scientific validation of fingerprint identification methods. See, e.g., J.J. Koehler. Fingerprint error rates and proficiency tests: What they are and why they matter. 59 HASTINGS L.J. 1077 (2008); L. Haber and R.N. Haber. 2008. Scientific validation of fingerprint evidence under *Daubert*. *Law, Probability and Risk* 7(2):87; J.L. Mnookin. 2008. The validity of latent fingerprint identification: Confessions of a fingerprinting moderate. *Law, Probability and Risk* 7(2):127.

[8] The findings of forensic science experts are vulnerable to cognitive and contextual bias. See, e.g., I.E. Dror, D. Charlton, and A.E. Péron. 2006. Contextual information renders experts vulnerable to making erroneous identifications. *Forensic Science International* 156:74, 77. ("Our study shows that it is possible to alter identification decisions on the same fingerprint, solely by presenting it in a different context."); I.E. Dror and D. Charlton. 2006. Why experts make errors. *Journal of Forensic Identification* 56(4):600; Giannelli, *supra* note 6, pp. 220-222. Unfortunately, at least to date, there is no good evidence to indicate that the forensic

Copyright © National Academy of Sciences. All rights reserved.

The Admission of Forensic Science Evidence in Litigation

Forensic science experts and evidence are used routinely in the service of the criminal justice system. DNA testing may be used to determine whether sperm found on a rape victim came from an accused party; a latent fingerprint found on a gun may be used to determine whether a defendant handled the weapon; drug analysis may be used to determine whether pills found in a person's possession were illicit; and an autopsy may be used to determine the cause and manner of death of a murder victim. In order for qualified forensic science experts to testify competently about forensic evidence, they must first find the evidence in a usable state and properly preserve it. A latent fingerprint that is badly smudged when found cannot be usefully saved, analyzed, or explained. An inadequate drug sample may be insufficient to allow for proper analysis. And, DNA tests performed on a contaminated or otherwise compromised sample cannot be used reliably to identify or eliminate an individual as the perpetrator of a crime. These are important matters involving the proper processing of forensic evidence. The law's greatest dilemma in its heavy reliance on forensic evidence, however, concerns the question of whether—and to what extent—there is *science* in any given forensic science discipline.

Two very important questions should underlie the law's admission of and reliance upon forensic evidence in criminal trials: (1) the extent to which a particular forensic discipline is founded on a reliable scientific methodology that gives it the capacity to accurately analyze evidence and report findings and (2) the extent to which practitioners in a particular forensic discipline rely on human interpretation that could be tainted by error, the threat of bias, or the absence of sound operational procedures and robust performance standards. These questions are significant. Thus, it matters a great deal whether an expert is qualified to testify about forensic evidence and whether the evidence is sufficiently reliable to merit a fact finder's reliance on the truth that it purports to support. Unfortunately, these important questions do not always produce satisfactory answers in judicial decisions pertaining to the admissibility of forensic science evidence proffered in criminal trials.

In 1993, in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,[9] the Supreme Court ruled that, under Rule 702 of the Federal Rules of Evidence (which covers both civil trials and criminal prosecutions in the federal courts), a "trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable."[10] The Court indicated

science community has made a sufficient effort to address the bias issue; thus, it is impossible for the committee to fully assess the magnitude of the problem.

[9] 509 U.S. 579 (1993).

[10] Ibid., p. 589.

Copyright © National Academy of Sciences. All rights reserved.

that the subject of an expert's testimony should be scientific knowledge, so that "evidentiary reliability will be based upon scientific validity."[11] The Court also emphasized that, in considering the admissibility of evidence, a trial judge should focus "solely" on the expert's "principles and methodology," and "not on the conclusions that they generate."[12] In sum, *Daubert*'s requirement that an expert's testimony pertain to "scientific knowledge" established a standard of "evidentiary reliability."[13]

In explaining this evidentiary standard, the *Daubert* Court pointed to several factors that might be considered by a trial judge: (1) whether a theory or technique can be (and has been) tested; (2) whether the theory or technique has been subjected to peer review and publication; (3) the known or potential rate of error of a particular scientific technique; (4) the existence and maintenance of standards controlling the technique's operation; and (5) a scientific technique's degree of acceptance within a relevant scientific community.[14] In the end, however, the Court emphasized that the inquiry under Rule 702 is "a flexible one."[15] The Court expressed confidence in the adversarial system, noting that "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence."[16] The Supreme Court has made it clear that trial judges have great discretion in deciding on the admissibility of evidence under Rule 702, and that appeals from *Daubert* rulings are subject to a very narrow abuse-of-discretion standard of review.[17] Most importantly, in *Kumho Tire Co., Ltd. v. Carmichael*, the Court stated that "whether *Daubert*'s specific factors are, or are not, reasonable measures of reliability in a particular case is a matter that the law grants the trial judge broad latitude to determine."[18]

---

[11] Ibid., pp. 590 and 591 n.9 (emphasis omitted).

[12] Ibid., p. 595. In *General Electric Co. v. Joiner*, 522 U.S. 136, 146 (1997), the Court added: "[C]onclusions and methodology are not entirely distinct from one another. Trained experts commonly extrapolate from existing data. But nothing in *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert."

[13] *Daubert*, 509 U.S. at 589, 590 n.9, 595.

[14] Ibid., pp. 593-94.

[15] Ibid., p. 594. *In Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137 (1999), the Court confirmed that the *Daubert* factors do not constitute a definitive checklist or test. *Kumho Tire* importantly held that Rule 702 applies to both scientific and nonscientific expert testimony; the Court also indicated that the *Daubert* factors might be applicable in a trial judge's assessment of the reliability of nonscientific expert testimony, depending upon "the particular circumstances of the particular case at issue." Ibid., at 150.

[16] *Daubert*, 509 U.S. at 596.

[17] See *Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 142-143 (1997).

[18] *Kumho Tire*, 526 U.S. at 153.

Copyright © National Academy of Sciences. All rights reserved.

Daubert and its progeny have engendered confusion and controversy. In particular, judicial dispositions of *Daubert*-type questions in criminal cases have been criticized by some lawyers and scholars who thought that the Supreme Court's decision would be applied more rigorously.[19] If one focuses solely on reported federal appellate decisions, the picture is not appealing to those who have preferred a more rigorous application of *Daubert*. Federal appellate courts have not with any consistency or clarity imposed standards ensuring the application of scientifically valid reasoning and reliable methodology in criminal cases involving *Daubert* questions. This is not really surprising, however. The Supreme Court itself described the *Daubert* standard as "flexible." This means that, beyond questions of relevance, *Daubert* offers appellate courts no clear substantive standard by which to review decisions by trial courts. As a result, trial judges exercise great discretion in deciding whether to admit or exclude expert testimony, and their judgments are subject only to a highly deferential "abuse of discretion" standard of review. Although it is difficult to get a clear picture of how trial courts handle *Daubert* challenges, because many evidentiary rulings are issued without a published opinion and without an appeal, the vast majority of the *reported* opinions in criminal cases indicate that trial judges rarely exclude or restrict expert testimony offered by prosecutors; most *reported* opinions also indicate that appellate courts routinely deny appeals contesting trial court decisions admitting forensic evidence against criminal defendants.[20] But the reported opinions do not offer in any way a complete sample of federal trial court dispositions of *Daubert*-type questions in criminal cases.

The situation appears to be very different in civil cases. Plaintiffs and defendants, equally, are more likely to have access to expert witnesses in civil cases, while prosecutors usually have an advantage over most defendants in offering expert testimony in criminal cases. And, ironically, the appellate courts appear to be more willing to second-guess trial court judgments on the admissibility of purported scientific evidence in civil cases than in criminal cases.[21]

---

[19] See, e.g., P.J. Neufeld. 2005. The (near) irrelevance of *Daubert* to criminal justice: And some suggestions for reform. *American Journal of Public Health* 95(Supp.1):S107.

[20] Ibid., p. S109.

[21] See, e.g., *McClain v. Metabolife Int'l, Inc.*, 401 F.3d 1233 (11th Cir. 2005); *Chapman v. Maytag Corp.*, 297 F.3d 682 (7th Cir. 2002); *Goebel v. Denver & Rio Grande W. R.R. Co.*, 215 F.3d 1083 (10th Cir. 2000); *Smith v. Ford Motor Co.*, 215 F.3d 713 (7th Cir. 2000); *Walker v. Soo Line R.R. Co.*, 208 F.3d 581 (7th Cir. 2000); 1 D.L. Faigman, M.J. Saks, J. Sanders, and E.K. Cheng. 2007-2008. *Modern Scientific Evidence: The Law and Science of Expert Testimony.* Eagan, MN: Thomson/West, § 1.35, p. 105 (discussing studies suggesting that courts "employ *Daubert* more lackadaisically in criminal trials—especially in regard to prosecution evidence—than in civil cases—especially in regard to plaintiff evidence").

Copyright © National Academy of Sciences. All rights reserved.

Prophetically, the *Daubert* decision observed that "there are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory. Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly."[22] But because accused parties in criminal cases are convicted on the basis of testimony from forensic science experts, much depends upon whether the evidence offered is reliable. Furthermore, in addition to protecting innocent persons from being convicted of crimes that they did not commit, we are also seeking to protect society from persons who have committed criminal acts. Law enforcement officials and the members of society they serve need to be assured that forensic techniques are *reliable*. Therefore, we must limit the risk of having the reliability of certain forensic science methodologies judicially certified before the techniques have been properly studied and their accuracy verified by the forensic science community. "[T]here is no evident reason why ['rigorous, systematic'] research would be infeasible."[23] However, some courts appear to be loath to insist on such research as a condition of admitting forensic science evidence in criminal cases, perhaps because to do so would likely "demand more by way of validation than the disciplines can presently offer."[24]

The adversarial process relating to the admission and exclusion of scientific evidence is not suited to the task of finding "scientific truth." The judicial system is encumbered by, among other things, judges and lawyers who generally lack the scientific expertise necessary to comprehend and evaluate forensic evidence in an informed manner, trial judges (sitting alone) who must decide evidentiary issues without the benefit of judicial colleagues and often with little time for extensive research and reflection, and the highly deferential nature of the appellate review afforded trial courts' *Daubert* rulings. Given these realities, there is a tremendous need for the forensic science community to improve. Judicial review, by itself, will not cure the infirmities of the forensic science community.[25] The development

[22] *Daubert*, 509 U.S. at 596-97.

[23] J. Griffin and D.J. LaMagna. 2002. *Daubert* challenges to forensic evidence: Ballistics next on the firing line. *The Champion*, September-October:20, 21 (quoting P. Giannelli and E. Imwinkelried. 2000. Scientific evidence: The fallout from Supreme Court's decision in *Kumho Tire*. *Criminal Justice Magazine* 14(4):12, 40).

[24] Ibid. See, e.g., *United States v. Crisp*, 324 F.3d 261, 270 (4th Cir. 2003) (noting "that while further research into fingerprint analysis would be welcome, to postpone present in-court utilization of this bedrock forensic identifier pending such research would be to make the best the enemy of the good." (internal quotation marks omitted)).

[25] See J.L. Mnookin. Expert evidence, partisanship, and epistemic competence. 73 BROOK. L. REV. 1009, 1033 (2008) ("[S]o long as we have our adversarial system in much its present form, we are inevitably going to be stuck with approaches to expert evidence that are imperfect, conceptually unsatisfying, and awkward. It may well be that the real lesson is this: those who believe that we might ever fully resolve—rather than imperfectly manage—the

Copyright © National Academy of Sciences. All rights reserved.

of scientific research, training, technology, and databases associated with DNA analysis have resulted from substantial and steady federal support for both academic research and programs employing techniques for DNA analysis. Similar support must be given to all credible forensic science disciplines if they are to achieve the degrees of reliability needed to serve the goals of justice. With more and better educational programs, accredited laboratories, certified forensic practitioners, sound operational principles and procedures, and serious research to establish the limits and measures of performance in each discipline, forensic science experts will be better able to analyze evidence and coherently report their findings in the courts. The current situation, however, is seriously wanting, both because of the limitations of the judicial system and because of the many problems faced by the forensic science community.

Political Realities

Most forensic science methods, programs, and evidence are within the regulatory province of state and local law enforcement entities or are covered by statutes and rules governing state judicial proceedings. Thus, in assessing the strengths, weaknesses, and future needs of forensic disciplines, and in making recommendations for improving the use of forensic technologies and techniques, the committee remained mindful of the fact that Congress cannot directly fix all of the deficiencies in the forensic science community. Under our federal system of government, Congress does not have free reign to amend state criminal codes, rules of evidence, and statutes governing civil actions; nor may it easily and directly regulate local law enforcement practices, state and local medical examiner units, or state policies covering the accreditation of crime laboratories and the certification of forensic practitioners.

Congress' authority to act is significant, however. Forensic science programs in federal government entities—whether within DOJ, DHS, DOD, or the Department of Commerce (DOC)—are funded by congressional appropriations. If these programs are required to operate pursuant to the highest standards, they will provide an example for the states. More importantly, Congress can promote "best practices" and strong educational, certification, accreditation, ethics, and oversight programs in the states by offering funds that are contingent on meeting appropriate standards of practice. There is every reason to believe that offers of federal funds with "strings attached" can effect significant change in the forensic science com-

deep structural tensions surrounding both partisanship and epistemic competence that permeate the use of scientific evidence within our legal system are almost certainly destined for disappointment.").

Copyright © National Academy of Sciences. All rights reserved.

munity, because so many state and local programs currently are suffering for want of adequate resources. In the end, however, the committee recognized that state and local authorities must be willing to enforce change if it is to happen.

In light of the foregoing issues, the committee exercised caution before drawing conclusions and avoided being too prescriptive in its recommendations. It also recognized that, given the complexity of the issues and the political realities that may pose obstacles to change, some recommendations will have to be implemented creatively and over time in order to be effective.

FINDINGS AND RECOMMENDATIONS

The Fragmented System: Symptoms and Cures

The forensic science disciplines currently are an assortment of methods and practices used in both the public and private arenas. Forensic science facilities exhibit wide variability in capacity, oversight, staffing, certification, and accreditation across federal and state jurisdictions. Too often they have inadequate educational programs, and they typically lack mandatory and enforceable standards, founded on rigorous research and testing, certification requirements, and accreditation programs. Additionally, forensic science and forensic pathology research, education, and training lack strong ties to our research universities and national science assets. In addition to the problems emanating from the fragmentation of the forensic science community, the most recently published *Census of Crime Laboratories* conducted by BJS describes unacceptable case backlogs in state and local crime laboratories and estimates the level of additional resources needed to handle these backlogs and prevent their recurrence. Unfortunately, the backlogs, even in DNA case processing, have grown dramatically in recent years and are now staggering in some jurisdictions. The most recently published BJS *Special Report of Medical Examiners and Coroners' Offices* also depicts a system with disparate and often inadequate educational and training requirements, resources, and capacities—in short, a system in need of significant improvement.

Existing data suggest that forensic laboratories are underresourced and understaffed, which contributes to case backlogs and likely makes it difficult for laboratories to do as much as they could to (1) inform investigations, (2) provide strong evidence for prosecutions, and (3) avoid errors that could lead to imperfect justice. Being underresourced also means that the tools of forensic science—and the knowledge base that underpins the analysis and interpretation of evidence—are not as strong as they could be, thus hindering the ability of the forensic science disciplines to excel at

Copyright © National Academy of Sciences. All rights reserved.

informing investigations, providing strong evidence, and avoiding errors in important ways. NIJ is the only federal agency that provides direct support to crime laboratories to alleviate the backlog, and those funds are minimal. The forensic science system is underresourced also in the sense that it has only thin ties to an academic research base that could support the forensic science disciplines and fill knowledge gaps. There are many hard-working and conscientious people in the forensic science community, but this underresourcing inherently limits their ability to do their best work. Additional resources surely will be necessary to create high-quality, self-correcting systems.

However, increasing the staff within existing crime laboratories and medical examiners' offices is only part of the solution. What also is needed is an upgrading of systems and organizational structures, better training, the widespread adoption of uniform and enforceable best practices, and mandatory certification and accreditation programs. The forensic science community and the medical examiner/coroner system must be upgraded if forensic practitioners are to be expected to serve the goals of justice.

Of the various facets of underresourcing, the committee is most concerned about the knowledge base. Adding more dollars and people to the enterprise might reduce case backlogs, but it will not address fundamental limitations in the capabilities of forensic science disciplines to discern valid information from crime scene evidence. For the most part, it is impossible to discern the magnitude of those limitations, and reasonable people will differ on their significance.

Forensic science research is not well supported, and there is no unified strategy for developing a forensic science research plan across federal agencies. Relative to other areas of science, the forensic disciplines have extremely limited opportunities for research funding. Although the FBI and NIJ have supported some research in forensic science, the level of support has been well short of what is necessary for the forensic science community to establish strong links with a broad base of research universities. Moreover, funding for academic research is limited and requires law enforcement collaboration, which can inhibit the pursuit of more fundamental scientific questions essential to establishing the foundation of forensic science. The broader research community generally is not engaged in conducting research relevant to advancing the forensic science disciplines.

The forensic science enterprise also is hindered by its extreme disaggregation—marked by multiple types of practitioners with different levels of education and training and different professional cultures and standards for performance and a reliance on apprentice-type training and a guild-like structure of disciplines, which work against the goal of a single forensic science profession. Many forensic scientists are given scant opportunity for professional activities, such as attending conferences or

Copyright © National Academy of Sciences. All rights reserved.

publishing their research, which could help strengthen the professional community and offset some of the disaggregation. The fragmented nature of the enterprise raises the worrisome prospect that the quality of evidence presented in court, and its interpretation, can vary unpredictably according to jurisdiction.

Numerous professional associations are organized around the forensic science disciplines, and many of them are involved in training and education (see Chapter 8) and are developing standards and accreditation and certification programs (see Chapter 7). The efforts of these groups are laudable. However, except for the largest organizations, it is not clear how these associations interact or the extent to which they share requirements, standards, or policies. Thus, there is a need for more consistent and harmonized requirements.

In the course of its deliberations and review of the forensic science enterprise, it became obvious to the committee that, although congressional action will not remedy all of the deficiencies in forensic science methods and practices, truly meaningful advances will not come without significant concomitant leadership from the federal government. The forensic science enterprise lacks the necessary governance structure to pull itself up from its current weaknesses. Of the many professional societies that serve the enterprise, none is dominant, and none has clearly articulated the need for change or presented a vision for accomplishing it. And clearly no municipal or state forensic office has the mandate to lead the entire enterprise. The major federal resources—NIJ and the FBI Laboratory—have provided modest leadership, for which they should be commended: NIJ has contributed a helpful research program and the FBI Laboratory has spearheaded the SWGs. But again, neither entity has recognized, let alone articulated, a need for change or a vision for achieving it. Neither has the full confidence of the larger forensic science community. And because both are part of a prosecutorial department of the government, they could be subject to subtle contextual biases that should not be allowed to undercut the power of forensic science.

The forensic science enterprise needs strong governance to adopt and promote an aggressive, long-term agenda to help strengthen the forensic science disciplines. Governance must be strong enough—and independent enough—to identify the limitations of forensic science methodologies, and must be well connected with the Nation's scientific research base to effect meaningful advances in forensic science practices. The governance structure must be able to create appropriate incentives for jurisdictions to adopt and adhere to best practices and promulgate the necessary sanctions to discourage bad practices. It must have influence with educators in order to effect improvements to forensic science education. It must be able to identify standards and enforce them. A governance entity must be geared toward

Copyright © National Academy of Sciences. All rights reserved.

(and be credible within) the law enforcement community, but it must have strengths that extend beyond that area. Oversight of the forensic science community and medical examiner system will sweep broadly into areas of criminal investigation and prosecution, civil litigation, legal reform, investigation of insurance claims, national disaster planning and preparedness, homeland security, certification of federal, state, and local forensic practitioners, public health, accreditation of public and private laboratories, research to improve forensic methodologies, education programs in colleges and universities, and advancing technology.

The committee considered whether such a governing entity could be established within an existing federal agency. The National Science Foundation (NSF) was considered because of its strengths in leading research and its connections to the research and education communities. NSF is surely capable of building and sustaining a research base, but it has very thin ties to the forensic science community. It would be necessary for NSF to take many untested steps if it were to assume responsibility for the governance of applied fields of science. The committee also considered NIST. In the end analysis, however, NIST did not appear to be a viable option. It has a good program of research targeted at forensic science and law enforcement, but the program is modest. NIST also has strong ties to industry and academia, and it has an eminent history in standard setting and method development. But its ties to the forensic science community are still limited, and it would not be seen as a natural leader by the scholars, scientists, and practitioners in the field. In sum, the committee concluded that neither NSF nor NIST has the breadth of experience or institutional capacity to establish an effective governance structure for the forensic science enterprise.

There was also a strong consensus in the committee that no existing or new division or unit within DOJ would be an appropriate location for a new entity governing the forensic science community. DOJ's principal mission is to enforce the law and defend the interests of the United States according to the law. Agencies within DOJ operate pursuant to this mission. The FBI, for example, is the investigative arm of DOJ and its principal missions are to produce and use intelligence to protect the Nation from threats and to bring to justice those who violate the law. The work of these law enforcement units is critically important to the Nation, but the scope of the work done by DOJ units is much narrower than the promise of a strong forensic science community. Forensic science serves more than just law enforcement; and when it does serve law enforcement, it must be equally available to law enforcement officers, prosecutors, *and* defendants in the criminal justice system. The entity that is established to govern the forensic science community cannot be principally beholden to law enforcement. The potential for conflicts of interest between the needs of law enforcement and the broader needs of forensic science are too great. In addition, the com-

Copyright © National Academy of Sciences. All rights reserved.

mittee determined that the research funding strategies of DOJ have not adequately served the broad needs of the forensic science community. This is understandable, but not acceptable when the issue is whether an agency is best suited to support and oversee the Nation's forensic science community. In sum, the committee concluded that advancing *science* in the forensic science enterprise is not likely to be achieved within the confines of DOJ.

Furthermore, there is little doubt that some existing federal entities are too wedded to the current "fragmented" forensic science community, which is deficient in too many respects. Most notably, these existing agencies have failed to pursue a rigorous research agenda to confirm the evidentiary reliability of methodologies used in a number of forensic science disciplines. These agencies are not good candidates to oversee the overhaul of the forensic science community in the United States.

Finally, some existing federal agencies with other missions occasionally have undertaken projects affecting the forensic science community. These entities are better left to continue the good work that defines their principal missions. More responsibility is not better for these existing entities, nor would it be better for the forensic science community or the Nation.

The committee thus concluded that the problems at issue are too serious and important to be subsumed by an existing federal agency. It also concluded that no existing federal agency has the capacity or appropriate mission to take on the roles and responsibilities needed to govern and improve the forensic science enterprise.

The committee believes that what is needed to support and oversee the forensic science community is a new, strong, and independent entity that could take on the tasks that would be assigned to it in a manner that is as objective and free of bias as possible—one with no ties to the past and with the authority and resources to implement a fresh agenda designed to address the problems found by the committee and discussed in this report. A new organization should not be encumbered by the assumptions, expectations, and deficiencies of the existing fragmented infrastructure, which has failed to address the needs and challenges of the forensic science disciplines.

This new entity must be an independent federal agency established to address the needs of the forensic science community, and it must meet the following minimum criteria:

- It must have a culture that is strongly rooted in science, with strong ties to the national research and teaching communities, including federal laboratories.
- It must have strong ties to state and local forensic entities as well as to the professional organizations within the forensic science community.

Copyright © National Academy of Sciences. All rights reserved.

- It must not be in any way committed to the existing system, but should be informed by its experiences.
- It must not be part of a law enforcement agency.
- It must have the funding, independence, and sufficient prominence to raise the profile of the forensic science disciplines and push effectively for improvements.
- It must be led by persons who are skilled and experienced in developing and executing national strategies and plans for standard setting; managing accreditation and testing processes; and developing and implementing rulemaking, oversight, and sanctioning processes.

No federal agency currently exists that meets all of these criteria.

Recommendation 1:

To promote the development of forensic science into a mature field of multidisciplinary research and practice, founded on the systematic collection and analysis of relevant data, Congress should establish and appropriate funds for an independent federal entity, the National Institute of Forensic Science (NIFS). NIFS should have a full-time administrator and an advisory board with expertise in research and education, the forensic science disciplines, physical and life sciences, forensic pathology, engineering, information technology, measurements and standards, testing and evaluation, law, national security, and public policy. NIFS should focus on:

(a) establishing and enforcing best practices for forensic science professionals and laboratories;
(b) establishing standards for the mandatory accreditation of forensic science laboratories and the mandatory certification of forensic scientists and medical examiners/forensic pathologists—and identifying the entity/entities that will develop and implement accreditation and certification;
(c) promoting scholarly, competitive peer-reviewed research and technical development in the forensic science disciplines and forensic medicine;
(d) developing a strategy to improve forensic science research and educational programs, including forensic pathology;
(e) establishing a strategy, based on accurate data on the forensic science community, for the efficient allocation of available funds to give strong support to forensic methodologies and practices in addition to DNA analysis;

Copyright © National Academy of Sciences. All rights reserved.

(f) funding state and local forensic science agencies, independent research projects, and educational programs as recommended in this report, with conditions that aim to advance the credibility and reliability of the forensic science disciplines;
(g) overseeing education standards and the accreditation of forensic science programs in colleges and universities;
(h) developing programs to improve understanding of the forensic science disciplines and their limitations within legal systems; and
(i) assessing the development and introduction of new technologies in forensic investigations, including a comparison of new technologies with former ones.

The benefits that will flow from a strong, independent, strategic, coherent, and well-funded federal program to support and oversee the forensic science disciplines in this country are clear: The Nation will (1) bolster its ability to more accurately identify true perpetrators and exclude those who are falsely accused; (2) improve its ability to effectively respond to, attribute, and prosecute threats to homeland security; and (3) reduce the likelihood of convictions resting on inaccurate data. Moreover, establishing the scientific foundation of the forensic science disciplines, providing better education and training, and requiring certification and accreditation will position the forensic science community to take advantage of current and future scientific advances.

The creation of a new federal entity undoubtedly will pose challenges, not the least of which will be budgetary constraints. The committee is not in a position to estimate how much it will cost to implement the recommendations in this report; this is a matter best left to the expertise of the Congressional Budget Office. What is clear, however, is that Congress must take aggressive action if the worst ills of the forensic science community are to be cured. Political and budgetary concerns should not deter bold, creative, and forward-looking action, because the country cannot afford to suffer the consequences of inaction. It will also take time and patience to implement the recommendations in this report. But this is true with any large, complex, important, and challenging enterprise.

The committee strongly believes that the greatest hope for success in this enterprise will come with the creation of the National Institute of Forensic Science (NIFS) to oversee and direct the forensic science community. The remaining recommendations in this report are crucially tied to the creation of NIFS. However, each recommendation is a separate, essential piece of the plan to improve the forensic science community in the United States. Therefore, even if the creation of NIFS is forestalled, the committee

Copyright © National Academy of Sciences. All rights reserved.

vigorously supports the adoption of the core ideas and principles embedded in each of the following recommendations.

Standardized Terminology and Reporting

The terminology used in reporting and testifying about the results of forensic science investigations must be standardized. Many terms are used by forensic scientists in scientific reports and in court testimony that describe findings, conclusions, and degrees of association between evidentiary material (e.g., hairs, fingerprints, fibers) and particular people or objects. Such terms include, but are not limited to "match," "consistent with," "identical," "similar in all respects tested," and "cannot be excluded as the source of." The use of such terms can and does have a profound effect on how the trier of fact in a criminal or civil matter perceives and evaluates scientific evidence. Although some forensic science disciplines have proposed reporting vocabulary and scales, the use of the recommended language is not standard practice among forensic science practitioners.

As a general matter, laboratory reports generated as the result of a scientific analysis should be complete and thorough. They should contain, at minimum, "methods and materials," "procedures," "results," "conclusions," and, as appropriate, sources and magnitudes of uncertainty in the procedures and conclusions (e.g., levels of confidence). Some forensic science laboratory reports meet this standard of reporting, but many do not. Some reports contain only identifying and agency information, a brief description of the evidence being submitted, a brief description of the types of analysis requested, and a short statement of the results (e.g., "the greenish, brown plant material in item #1 was identified as marijuana"), and they include no mention of methods or any discussion of measurement uncertainties.

Many clinical and testing disciplines outside the forensic science disciplines have standards, templates, and protocols for data reporting. A good example is the ISO/IEC 17025 standard (commonly called "ISO 17025"). ISO 17025 is an international standard published by the International Organization for Standardization (ISO) that specifies the general requirements for the competence to carry out tests and/or calibrations. These requirements have been used by accrediting agencies to determine what a laboratory must do to secure accreditation. In addition, some SWGs in the forensic disciplines have scoring systems for reporting findings, but these systems are neither uniformly nor consistently used. In other words, although appropriate standards exist, they are not always followed. Forensic reports, and any courtroom testimony stemming from them, must include clear characterizations of the limitations of the analyses, including measures

Copyright © National Academy of Sciences. All rights reserved.

of uncertainty in reported results and associated estimated probabilities where possible.

Recommendation 2:

The National Institute of Forensic Science (NIFS), after reviewing established standards such as ISO 17025, and in consultation with its advisory board, should establish standard terminology to be used in reporting on and testifying about the results of forensic science investigations. Similarly, it should establish model laboratory reports for different forensic science disciplines and specify the minimum information that should be included. As part of the accreditation and certification processes, laboratories and forensic scientists should be required to utilize model laboratory reports when summarizing the results of their analyses.

More and Better Research

As noted above, some forensic science disciplines are supported by little rigorous systematic research to validate the discipline's basic premises and techniques. There is no evident reason why such research cannot be conducted. Much more federal funding is needed to support research in the forensic science disciplines and forensic pathology in universities and private laboratories committed to such work.

The forensic science and medical examiner communities will be improved by opportunities to collaborate with the broader science and engineering communities. In particular, there is an urgent need for collaborative efforts to (1) develop new technical methods or provide in-depth grounding for advances developed in the forensic science disciplines; (2) provide an interface between the forensic science and medical examiner communities and basic sciences; and (3) create fertile ground for discourse among the communities. NIFS should recommend, implement, and guide strategies for supporting such initiatives.

Recommendation 3:

Research is needed to address issues of accuracy, reliability, and validity in the forensic science disciplines. The National Institute of Forensic Science (NIFS) should competitively fund peer-reviewed research in the following areas:

(a) Studies establishing the scientific bases demonstrating the validity of forensic methods.

Copyright © National Academy of Sciences. All rights reserved.

(b) The development and establishment of quantifiable measures of the reliability and accuracy of forensic analyses. Studies of the reliability and accuracy of forensic techniques should reflect actual practice on realisticcase scenarios, averaged across a representative sample of forensic scientists and laboratories. Studies also should establish the limits of reliability and accuracy that analytic methods can be expected to achieve as the conditions of forensic evidence vary. The research by which measures of reliability and accuracy are determined should be peer reviewed and published in respected scientific journals.
(c) The development of quantifiable measures of uncertainty in the conclusions of forensic analyses.
(d) Automated techniques capable of enhancing forensic technologies.

To answer questions regarding the reliability and accuracy of a forensic analysis, the research needs to distinguish between average performance (achieved across individual practitioners and laboratories) and individual performance (achieved by the specific practitioner and laboratory). Whether a forensic procedure is sufficient under the rules of evidence governing criminal and civil litigation raises difficult legal issues that are outside the realm of scientific inquiry. (Some of the legal issues are addressed in Chapter 3.)

Best Practices and Standards

Although there have been notable efforts to achieve standardization and develop best practices in some forensic science disciplines and the medical examiner system, most disciplines still lack best practices or any coherent structure for the enforcement of operating standards, certification, and accreditation. Standards and codes of ethics exist in some fields, and there are some functioning certification and accreditation programs, but none are mandatory. In short, oversight and enforcement of operating standards, certification, accreditation, and ethics are lacking in most local and state jurisdictions.

Scientific and medical assessment conducted in forensic investigations should be independent of law enforcement efforts either to prosecute criminal suspects or even to determine whether a criminal act has indeed been committed. Administratively, this means that forensic scientists should function independently of law enforcement administrators. The best science is conducted in a scientific setting as opposed to a law enforcement setting. Because forensic scientists often are driven in their work by a need to answer a particular question related to the issues of a particular case,

Copyright © National Academy of Sciences. All rights reserved.

they sometimes face pressure to sacrifice appropriate methodology for the sake of expediency.

Recommendation 4:

> To improve the scientific bases of forensic science examinations and to maximize independence from or autonomy within the law enforcement community, Congress should authorize and appropriate incentive funds to the National Institute of Forensic Science (NIFS) for allocation to state and local jurisdictions for the purpose of removing all public forensic laboratories and facilities from the administrative control of law enforcement agencies or prosecutors' offices.

Recommendation 5:

> The National Institute of Forensic Science (NIFS) should encourage research programs on human observer bias and sources of human error in forensic examinations. Such programs might include studies to determine the effects of contextual bias in forensic practice (e.g., studies to determine whether and to what extent the results of forensic analyses are influenced by knowledge regarding the background of the suspect and the investigator's theory of the case). In addition, research on sources of human error should be closely linked with research conducted to quantify and characterize the amount of error. Based on the results of these studies, and in consultation with its advisory board, NIFS should develop standard operating procedures (that will lay the foundation for model protocols) to minimize, to the greatest extent reasonably possible, potential bias and sources of human error in forensic practice. These standard operating procedures should apply to all forensic analyses that may be used in litigation.

Recommendation 6:

> To facilitate the work of the National Institute of Forensic Science (NIFS), Congress should authorize and appropriate funds to NIFS to work with the National Institute of Standards and Technology (NIST), in conjunction with government laboratories, universities, and private laboratories, and in consultation with Scientific Working Groups, to develop tools for advancing measurement, validation, reliability, information sharing, and proficiency testing in forensic science and to establish protocols for forensic examina-

Copyright © National Academy of Sciences. All rights reserved.

tions, methods, and practices. Standards should reflect best practices and serve as accreditation tools for laboratories and as guides for the education, training, and certification of professionals. Upon completion of its work, NIST and its partners should report findings and recommendations to NIFS for further dissemination and implementation.

Quality Control, Assurance, and Improvement

In a field such as medical diagnostics, a health care provider typically can track a patient's progress to see whether the original diagnosis was accurate and helpful. For example, widely accepted programs of quality control ensure timely feedback involving the diagnoses that result from mammography. Other examples of quality assurance and improvement—including the development of standardized vocabularies, ontologies, and scales for interpreting diagnostic tests and developing standards for accreditation of services—pervade diagnostic medicine. This type of systematic and routine feedback is an essential element of any field striving for continuous improvement. The forensic science disciplines likewise must become a self-correcting enterprise, developing and implementing feedback loops that allow the profession to discover past mistakes. A particular need exists for routine, mandatory proficiency testing that emulates a realistic, representative cross-section of casework, for example, DNA proficiency testing.

Recommendation 7:

Laboratory accreditation and individual certification of forensic science professionals should be mandatory, and all forensic science professionals should have access to a certification process. In determining appropriate standards for accreditation and certification, the National Institute of Forensic Science (NIFS) should take into account established and recognized international standards, such as those published by the International Organization for Standardization (ISO). No person (public or private) should be allowed to practice in a forensic science discipline or testify as a forensic science professional without certification. Certification requirements should include, at a minimum, written examinations, supervised practice, proficiency testing, continuing education, recertification procedures, adherence to a code of ethics, and effective disciplinary procedures. All laboratories and facilities (public or private) should be accredited, and all forensic science professionals should be certified, when eligible, within a time period established by NIFS.

Copyright © National Academy of Sciences. All rights reserved.

Recommendation 8:

> **Forensic laboratories should establish routine quality assurance and quality control procedures to ensure the accuracy of forensic analyses and the work of forensic practitioners. Quality control procedures should be designed to identify mistakes, fraud, and bias; confirm the continued validity and reliability of standard operating procedures and protocols; ensure that best practices are being followed; and correct procedures and protocols that are found to need improvement.**

Codes of Ethics

A number of forensic science organizations—such as AAFS, the Midwestern Association of Forensic Scientists, ASCLD, and NAME—have adopted codes of ethics. The codes that exist are sometimes comprehensive, but they vary in content. While there is no reason to doubt that many forensic scientists understand their ethical obligations and practice in an ethical way, there are no consistent mechanisms for enforcing any of the existing codes of ethics. Many jurisdictions do not require certification in the same way that, for example, states require lawyers to be licensed. Therefore, few forensic science practitioners face the threat of official sanctions or loss of certification for serious ethical violations. And it is unclear whether and to what extent forensic science practitioners are required to adhere to ethics standards as a condition of employment.

Recommendation 9:

> **The National Institute of Forensic Science (NIFS), in consultation with its advisory board, should establish a national code of ethics for all forensic science disciplines and encourage individual societies to incorporate this national code as part of their professional code of ethics. Additionally, NIFS should explore mechanisms of enforcement for those forensic scientists who commit serious ethical violations. Such a code could be enforced through a certification process for forensic scientists.**

Insufficient Education and Training

Forensic science examiners need to understand the principles, practices, and contexts of scientific methodology, as well as the distinctive features of their specialty. Ideally, training should move beyond apprentice-like

Copyright © National Academy of Sciences. All rights reserved.

transmittal of practices to education based on scientifically valid principles. In addition to the practical experience and learning acquired during an internship, a trainee should acquire rigorous interdisciplinary education and training in the scientific areas that constitute the basis for the particular forensic discipline and instruction on how to document and report the analysis. A trainee also should have working knowledge of basic quantitative calculations, including statistics and probability, as needed for the applicable discipline.

To correct some of the existing deficiencies, it is crucially important to improve undergraduate and graduate forensic science programs. Legitimization of practices in forensic disciplines must be based on established scientific knowledge, principles, and practices, which are best learned through formal education. Apprenticeship has a secondary role, and under no circumstances can it supplant the need for the scientific basis of education in and the practice of forensic science.

In addition, lawyers and judges often have insufficient training and background in scientific methodology, and they often fail to fully comprehend the approaches employed by different forensic science disciplines and the reliability of forensic science evidence that is offered in trial. Such training is essential, because any checklist for the admissibility of scientific or technical testimony is imperfect. Conformance with items on a checklist can suggest that testimony is reliable, but it does not guarantee it. Better connections must be established and promoted between experts in the forensic science disciplines and law schools, legal scholars, and practitioners. The fruits of any advances in the forensic science disciplines should be transferred directly to legal scholars and practitioners (including civil litigators, prosecutors, and criminal defense counsel), federal, state, and local legislators, members of the judiciary, and law enforcement officials, so that appropriate adjustments can be made in criminal and civil laws and procedures, model jury instructions, law enforcement practices, litigation strategies, and judicial decisionmaking. Law schools should enhance this connection by offering courses in the forensic science disciplines, by offering credit for forensic science courses taken in other colleges, and by developing joint degree programs. And judges need to be better educated in forensic science methodologies and practices.

Recommendation 10:

To attract students in the physical and life sciences to pursue graduate studies in multidisciplinary fields critical to forensic science practice, Congress should authorize and appropriate funds to the National Institute of Forensic Science (NIFS) to work with appropriate organizations and educational institutions to improve and

Copyright © National Academy of Sciences. All rights reserved.

develop graduate education programs designed to cut across organizational, programmatic, and disciplinary boundaries. To make these programs appealing to potential students, they must include attractive scholarship and fellowship offerings. Emphasis should be placed on developing and improving research methods and methodologies applicable to forensic science practice and on funding research programs to attract research universities and students in fields relevant to forensic science. NIFS should also support law school administrators and judicial education organizations in establishing continuing legal education programs for law students, practitioners, and judges.

The Medicolegal Death Investigation System

Although steps have been taken to transform the medicolegal death investigation system, the shortage of resources and lack of consistent educational and training requirements (particularly in the coroner system)[26] prevent the system from taking full advantage of tools—such as CT scans and digital X-rays—that the medical system and other scientific disciplines have to offer. In addition, more rigorous efforts are needed in the areas of accreditation and adherence to standards. Currently, requirements for practitioners vary from nothing more than age and residency requirements to certification by the American Board of Pathology in forensic pathology.

Funds are needed to assess the medicolegal death investigation system to determine its status and needs, using as a benchmark the current requirements of NAME relating to professional credentials, standards, and accreditation. And funds are needed to modernize and improve the medicolegal death investigation system. As it now stands, medical examiners and coroners (ME/Cs) are essentially ineligible for direct federal funding and grants from DOJ, DHS, or the Department of Health and Human Services (through the National Institutes of Health). The Paul Coverdell National Forensic Science Improvement Act is the only federal grant program that names medical examiners and coroners as eligible for grants. However, ME/Cs must compete with public safety agencies for Coverdell grants; as a result, the funds available to ME/Cs are inadequate. The simple reality is that the program has not been sufficiently funded to provide significant improvements in ME/C systems.

In addition to direct funding, there are other initiatives that should be pursued to improve the medicolegal death investigation system. The Association of American Medical Colleges and other appropriate profes-

[26] Institute of Medicine. 2003. *Workshop on the Medicolegal Death Investigation System.* Washington, DC: The National Academies Press.

Copyright © National Academy of Sciences. All rights reserved.

sional organizations should organize collaborative activities in education, training, and research to strengthen the relationship between the medical examiner community and its counterparts in the larger academic medical community. Medical examiner offices with training programs affiliated with medical schools should be eligible to compete for funds. Funding should be available to support pathologists seeking forensic fellowships. In addition, forensic pathology fellows could be allowed to apply for medical school loan forgiveness if they stay full time at a medical examiner's office for a reasonable period of time.

Additionally, NIFS should seek funding from Congress to support the joint development of programs to include medical examiners and medical examiner offices in national disaster planning, preparedness, and consequence management, involving the Centers for Disease Control and Prevention (CDC) and DHS. Uniform statewide and interstate standards of operation would be needed to assist in the management of cross-jurisdictional and interstate events. NIFS should support a federal program underwriting the development of software for use by ME/C systems for the management of multisite, multiple fatality events.

NIFS should work with groups such as the National Conference of Commissioners on Uniform State Laws, the American Law Institute, and NAME, in collaboration with other appropriate professional groups, to update the 1954 Model Post-Mortem Examinations Act and draft legislation for a modern model death investigation code. An improved code might, for example, include the elements of a competent medical death investigation system and clarify the jurisdiction of the medical examiner with respect to organ donation.

The foregoing ideas must be developed further before any concrete plans can be pursued. There are, however, a number of specific recommendations, which, if adopted, will help to modernize and improve the medicolegal death investigation system. These recommendations deserve the immediate attention of Congress and NIFS.

Recommendation 11:

To improve medicolegal death investigation:

(a) Congress should authorize and appropriate incentive funds to the National Institute of Forensic Science (NIFS) for allocation to states and jurisdictions to establish medical examiner systems, with the goal of replacing and eventually eliminating existing coroner systems. Funds are needed to build regional medical examiner offices, secure necessary equipment, improve administration, and ensure the

Copyright © National Academy of Sciences. All rights reserved.

education, training, and staffing of medical examiner offices. Funding could also be used to help current medical examiner systems modernize their facilities to meet current Centers for Disease Control and Prevention-recommended autopsy safety requirements.

(b) Congress should appropriate resources to the National Institutes of Health (NIH) and NIFS, jointly, to support research, education, and training in forensic pathology. NIH, with NIFS participation, or NIFS in collaboration with content experts, should establish a study section to establish goals, to review and evaluate proposals in these areas, and to allocate funding for collaborative research to be conducted by medical examiner offices and medical universities. In addition, funding, in the form of medical student loan forgiveness and/or fellowship support, should be made available to pathology residents who choose forensic pathology as their specialty.

(c) NIFS, in collaboration with NIH, the National Association of Medical Examiners, the American Board of Medicolegal Death Investigators, and other appropriate professional organizations, should establish a Scientific Working Group (SWG) for forensic pathology and medicolegal death investigation. The SWG should develop and promote standards for best practices, administration, staffing, education, training, and continuing education for competent death scene investigation and postmortem examinations. Best practices should include the utilization of new technologies such as laboratory testing for the molecular basis of diseases and the implementation of specialized imaging techniques.

(d) All medical examiner offices should be accredited pursuant to NIFS-endorsed standards within a timeframe to be established by NIFS.

(e) All federal funding should be restricted to accredited offices that meet NIFS-endorsed standards or that demonstrate significant and measurable progress in achieving accreditation within prescribed deadlines.

(f) All medicolegal autopsies should be performed or supervised by a board certified forensic pathologist. This requirement should take effect within a timeframe to be established by NIFS, following consultation with governing state institutions.

Copyright © National Academy of Sciences. All rights reserved.

AFIS and Database Interoperability

Great improvement is necessary in AFIS interoperability. Crimes may go unsolved today simply because it is not possible for investigating agencies to search across all the databases that might hold a suspect's fingerprints or that may contain a match for an unidentified latent print from a crime scene. It is also possible that some individuals have been wrongly convicted because of the limitations of fingerprint searches.

At present, serious practical problems pose obstacles to the achievement of nationwide AFIS interoperability. These problems include convincing AFIS equipment vendors to cooperate and collaborate with the law enforcement community and researchers to create and use baseline standards for sharing fingerprint data and create a common interface. Second, law enforcement agencies lack the resources needed to transition to interoperable AFIS implementations. Third, coordinated jurisdictional agreements and public policies are needed to allow law enforcement agencies to share fingerprint data more broadly.

Given the disparity in resources and information technology expertise available to local, state, and federal law enforcement agencies, the relatively slow pace of interoperability efforts to date, and the potential gains from increased AFIS interoperability, the committee believes that a broad-based emphasis on achieving nationwide fingerprint data interoperability is needed.

Recommendation 12:

Congress should authorize and appropriate funds for the National Institute of Forensic Science (NIFS) to launch a new broad-based effort to achieve nationwide fingerprint data interoperability. To that end, NIFS should convene a task force comprising relevant experts from the National Institute of Standards and Technology and the major law enforcement agencies (including representatives from the local, state, federal, and, perhaps, international levels) and industry, as appropriate, to develop:

(a) standards for representing and communicating image and minutiae data among Automated Fingerprint Identification Systems. Common data standards would facilitate the sharing of fingerprint data among law enforcement agencies at the local, state, federal, and even international levels, which could result in more solved crimes, fewer wrongful identifications, and greater efficiency with respect to fingerprint searches; and

Copyright © National Academy of Sciences. All rights reserved.

(b) **baseline standards—to be used with computer algorithms—to map, record, and recognize features in fingerprint images, and a research agenda for the continued improvement, refinement, and characterization of the accuracy of these algorithms (including quantification of error rates).**

These steps toward AFIS interoperability must be accompanied by federal, state, and local funds to support jurisdictions in upgrading, operating, and ensuring the integrity and security of their systems; retraining current staff; and training new fingerprint examiners to gain the desired benefits of true interoperability. Additionally, greater scientific benefits can be realized through the availability of fingerprint data or databases for research purposes (using, of course, all the modern security and privacy protections available to scientists when working with such data). Once created, NIFS might also be tasked with the maintenance and periodic review of the new standards and procedures.

Forensic Science Disciplines and Homeland Security

Good forensic science and medical examiner practices are of clear value from a homeland security perspective, because of their roles in bringing criminals to justice and in dealing with the effects of natural and human-made mass disasters. Forensic science techniques (e.g., the evaluation of DNA fragments) enable more thorough investigations of crime scenes that have been damaged physically. Routine and trustworthy collection of digital evidence, and improved techniques and timeliness for its analysis, can be of great potential value in identifying terrorist activity. Therefore, the forensic science community has a role to play in homeland security. However, to capitalize on this potential, the forensic science and medical examiner communities must be well interfaced with homeland security efforts, so that they can contribute when needed. To be successful, this interface will require the establishment of good working relationships between federal, state, and local jurisdictions, the creation of strong security programs to protect data transmittals between jurisdictions, the development of additional training for forensic scientists and crime scene investigators, and the promulgation of contingency plans that will promote efficient team efforts on demand. Policy issues relating to the enforcement of homeland security are not within the scope of the committee's charge and, thus, are beyond the scope of the report. It can hardly be doubted, however, that improvements in the forensic science community and medical examiner system could greatly enhance the capabilities of homeland security.

Copyright © National Academy of Sciences. All rights reserved.

Recommendation 13:

Congress should provide funding to the National Institute of Forensic Science (NIFS) to prepare, in conjunction with the Centers for Disease Control and Prevention and the Federal Bureau of Investigation, forensic scientists and crime scene investigators for their potential roles in managing and analyzing evidence from events that affect homeland security, so that maximum evidentiary value is preserved from these unusual circumstances and the safety of these personnel is guarded. This preparation also should include planning and preparedness (to include exercises) for the interoperability of local forensic personnel with federal counterterrorism organizations.

Copyright © National Academy of Sciences. All rights reserved.

Copyright © National Academy of Sciences. All rights reserved.

1

Introduction

The world of crime is a complex place. Crime takes place in the workplace, schools, homes, places of business, motor vehicles, on the streets, and, increasingly, on the Internet. Crimes are committed at all hours of the day and night and in all regions of the country, in rural, suburban, and urban environments. In many cases, a weapon is used, such as a handgun, knife, or blunt object. Sometimes the perpetrator is under the influence of alcohol or illicit drugs. In other cases, no one is physically hurt, but property is damaged or stolen—for example, when burglary, theft, and motor vehicle theft occur. In recent years, information technology has provided the opportunity for identity theft and other types of cybercrime. A crime scene often is rich in information that reveals the nature of the criminal activity and the identities of those persons involved. Perpetrators and victims may leave behind blood, saliva, skin cells, hair, fingerprints, footprints, tire prints, clothing fibers, digital and photographic images, audio data, handwriting, and the residual effects and debris of arson, gunshots, and unlawful entry. Some crimes transcend borders, such as those involving homeland security, for which forensic evidence can be gathered.

Crime scene investigators, with varying levels of training and experience, search for and collect evidence at the scene, preserve and secure it in tamper-evident packaging, label it, and send it to an appropriate agency—normally a crime laboratory, where it may be analyzed by forensic examiners. If a death was sudden, unexpected, or resulted from violence, a medicolegal investigator (e.g., coroner, medical examiner, forensic pathologist, physician's assistant) will be responsible for determining whether a

Copyright © National Academy of Sciences. All rights reserved.

homicide, suicide, or accident occurred and will certify the cause and manner of death.

Crime scene evidence moves through a chain of custody in which, depending on their physical characteristics (e.g., blood, fiber, handwriting), samples are analyzed according to any of a number of analytical protocols, and results are reported to law enforcement and court officials. When evidence is analyzed, typically forensic science "attempts to uncover the actions or happenings of an event . . . by way of (1) identification (categorization), (2) individualization, (3) association, and (4) reconstruction."[1] Evidence also is analyzed for the purpose of excluding individuals or sources.

Not all forensic services are performed in traditional crime laboratories by trained forensic scientists. Some forensic tests might be conducted by a sworn law enforcement officer with no scientific training or credentials, other than experience. In smaller jurisdictions, members of the local police or sheriff's department might conduct the analyses of evidence, such as latent print examinations and footwear comparisons. In the United States, if evidence is sent to a crime laboratory, that facility might be publicly or privately operated, although private laboratories typically do not visit crime scenes to collect evidence or serve as the first recipient of physical evidence. Public crime laboratories are organized at the city, county, state, or federal level. A law enforcement agency that does not operate its own crime laboratory typically has access to a higher-level laboratory (e.g., at the state or county level) or a private laboratory for analysis of evidence.

According to a 2005 census by the Bureau of Justice Statistics (BJS),[2] 389 publicly funded forensic crime laboratories were operating in the United States in 2005: These included 210 state or regional laboratories, 84 county laboratories, 62 municipal laboratories, and 33 federal laboratories, and they received evidence from nearly 2.7 million criminal cases[3] in 2005. These laboratories are staffed by individuals with a wide range of training and expertise, from scientists with Ph.D.s to technicians who have been trained largely on the job. No data are available on the size and depth of the private forensic laboratories, except for private DNA laboratories.

In general, a traditional crime laboratory has been defined as constituting "a single laboratory or system comprised of scientists analyzing evidence

[1] K. Inman and N. Rudin. 2002. The origin of evidence. *Forensic Science International* 126:11-16.

[2] M.R. Durose. 2008. *Census of Publicly Funded Forensic Crime Laboratories, 2005*. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics. Available at www.ojp.usdoj.gov/bjs/pub/pdf/cpffcl05.pdf.

[3] Ibid., p. 9. "A 'case' is defined as evidence submitted from a single criminal investigation. A case may include multiple 'requests' for forensic services. For example, one case may include a request for biology screening and a request for latent prints."

Copyright © National Academy of Sciences. All rights reserved.

in one or more of the following disciplines: controlled substances, trace, biology (including DNA), toxicology, latent prints, questioned documents, firearms/toolmarks, or crime scene."[4] More recently, increasing numbers of laboratories specialize in the analysis of evidence in one area, for example, DNA or digital evidence. (See Chapter 5 for a more complete description and discussion of the forensic science disciplines.)

The capacity and quality of the current forensic science system have been the focus of increasing attention by Congress, the courts, and the media. New doubts about the accuracy of some forensic science practices have intensified with the growing number of exonerations resulting from DNA analysis (and the concomitant realization that guilty parties sometimes walk free). Greater expectations for precise forensic science evidence raised by DNA testing have forced new scrutiny on other forensic techniques. Emerging scientific advances that could benefit forensic investigation elicit concerns about resources, training, and capacity for implementing new techniques. A crisis in backlogged cases, caused by crime laboratories lacking sufficient resources and qualified personnel, raises concerns about the effectiveness and efficiency of the criminal justice system. When backlogs prolong testing time, issues involving speedy trials may arise. In addition, backlogs discourage law enforcement personnel and organizations from submitting evidence. Laboratories also may restrict submissions of evidence to reduce backlogs. All of these concerns, and more, provide the background against which this report is set.

Finally, if evidence and laboratory tests are mishandled or improperly analyzed; if the scientific evidence carries a false sense of significance; or if there is bias, incompetence, or a lack of adequate internal controls for the evidence introduced by the forensic scientists and their laboratories, the jury or court can be misled, and this could lead to wrongful conviction or exoneration. If juries lose confidence in the reliability of forensic testimony, valid evidence might be discounted, and some innocent persons might be convicted or guilty individuals acquitted.

Recent years have seen a number of concerted efforts by forensic science organizations to strengthen the foundations of many areas of testimony. However, substantial improvement is necessary in the forensic science disciplines to enhance law enforcement's ability to identify those who have or have not committed a crime and to prevent the criminal justice system from erroneously convicting or exonerating the persons who come before it.

[4] Ibid., p. 24.

Copyright © National Academy of Sciences. All rights reserved.

WHAT IS FORENSIC SCIENCE?

Although there are numerous ways by which to categorize the forensic science disciplines, the committee found the categorization used by the National Institute of Justice to be useful:

1. general toxicology;
2. firearms/toolmarks;
3. questioned documents;
4. trace evidence;
5. controlled substances;
6. biological/serology screening (including DNA analysis);
7. fire debris/arson analysis;
8. impression evidence;
9. blood pattern analysis;
10. crime scene investigation;
11. medicolegal death investigation; and
12. digital evidence.[5]

Some of these disciplines are discussed in Chapter 5. Forensic pathology is considered a subspecialty of medicine and is considered separately in Chapter 9.

The term "forensic science" encompasses a broad range of disciplines, each with its own distinct practices. The forensic science disciplines exhibit wide variability with regard to techniques, methodologies, reliability, level of error, research, general acceptability, and published material (see Chapters 4 through 6). Some of the disciplines are laboratory based (e.g., nuclear and mitochondrial DNA analysis, toxicology, and drug analysis); others are based on expert interpretation of observed patterns (e.g., fingerprints, writing samples, toolmarks, bite marks). Some activities require the skills and analytical expertise of individuals trained as scientists (e.g., chemists or biologists); other activities are conducted by scientists as well as by individuals trained in law enforcement (e.g., crime scene investigators, blood spatter analysts, crime reconstruction specialists), medicine (e.g., forensic pathologists), or laboratory methods (e.g., technologists). Many of the processes used in the forensic science disciplines are largely empirical applications of science—that is, they are not based on a body of knowledge that recognizes the underlying limitations of the scientific principles and methodologies used for problem solving and discovery. It is therefore important to focus on ways to improve, systematize, and monitor the activities and practices

[5] National Institute of Justice. 2006. *Status and Needs of Forensic Science Service Providers: A Report to Congress*. Available at www.ojp.usdoj.gov/nij/pubs-sum/213420.htm.

Copyright © National Academy of Sciences. All rights reserved.

in the forensic science disciplines and related areas of inquiry. Thus, in this report, the term "forensic science" is used with regard to a broad array of activities, with the recognition that some of these activities might not have a well-developed research base, are not informed by scientific knowledge, or are not developed within the culture of science.

PRESSURES ON THE FORENSIC SCIENCE SYSTEM

As mentioned above, a number of factors have combined in the past few decades to place increasing demands on an already overtaxed, inconsistent, and underresourced forensic science infrastructure. These factors have not only stressed the system's capacity, but also have raised serious questions and concerns about the validity and reliability of some forensic methods and techniques and how forensic evidence is reported to juries and courts.

The Case Backlog—Insufficient Resources

According to the 2005 BJS census report, a typical publicly funded crime laboratory ended the year with a backlog of about 401 requests for services, received another 4,328 such requests, and completed 3,980 of them. Roughly half of all requests were in the area of controlled substances. The average backlog has risen since the 2002 census,[6] with nearly 20 percent of all requests backlogged by year end. The Department of Justice (DOJ) defines a case as backlogged if it remains in the laboratory 30 days or more without the development of a report or analysis. Federal, state, and local laboratories reported a combined backlog of 435,879 requests for forensic analysis.[7] According to the census, a typical laboratory performing DNA testing in 2005 started the year with a backlog of 86 requests, received 337 new requests, completed 265 requests, and finished the year with 152 backlogged requests.

The backlog is exacerbated further by increased requests for quick laboratory results by law enforcement and prosecutors. Witnesses before the committee testified that prosecutors increasingly rely on laboratories to provide results prior to approving charges and have increased requests for additional work on the back end of a case, just before trial.[8] Backlogs are compounded by rising police agency requests for testing (e.g., for DNA evidence found on guns and from nonviolent crime scenes). Laboratories

[6] J.L. Peterson and M.J. Hickman. 2005. *Census of Publicly Funded Forensic Crime Laboratories, 2002*. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics. Available at www.ojp.usdoj.gov/bjs/pub/pdf/cpffcl02.pdf.

[7] Durose, op. cit.

[8] J.L. Johnson, Laboratory Director, Illinois State Police, Forensic Science Center at Chicago. Presentation to the committee. January 25, 2007.

Copyright © National Academy of Sciences. All rights reserved.

are thus challenged to balance requests for analyses of "older" and "cold" cases with new cases and must make choices to allocate resources by prioritizing the evidence to be analyzed. In California, voters passed Proposition 69, requiring that a DNA sample be obtained from all convicted felons. This increased the workload and resulted in 235,000 backlogged cases by the end of 2005.[9]

These backlogs can result in prolonged incarceration for innocent persons wrongly charged and awaiting trial and delayed investigation of those who are not yet charged, and they can contribute to the release of guilty suspects who go on to commit further crimes.

The Ascendancy of DNA Analysis and a New Standard

In the 1980s, the opportunity to use the techniques of DNA technologies to identify individuals for forensic and other purposes became apparent. Early concerns about the use of DNA for forensic casework included the following: (1) whether the detection methods were scientifically valid—that is, whether they correctly identified true matches and true nonmatches and (2) whether DNA analysis of forensic samples is reliable—that is, whether it yields reproducible results under defined conditions of use. A 1990 report by the congressional Office of Technology Assessment concluded that DNA tests were both reliable and valid in the forensic context but required a strict set of standards and quality control measures before they could be widely adopted.[10]

In 1990, the Federal Bureau of Investigation (FBI) established guidelines for DNA analysis and proficiency testing and four years later created the Combined DNA Index System (CODIS), which allows federal, state, and local crime laboratories to exchange and compare DNA profiles electronically, thereby linking crimes to each other and to convicted offenders.

In 1992, the National Research Council (NRC) issued *DNA Technology in Forensic Science*, which concluded that, "No laboratory should let its results with a new DNA typing method be used in court, unless it has undergone . . . proficiency testing via blind trials."[11] In addition, the report cautioned that numerous questions must be answered about using DNA evidence in a forensic context that rarely had to be considered by scientists engaged in DNA research—for example, questions involving contamination, degradation, and a number of statistical issues. While confirming that

[9] Durose, op. cit.

[10] U.S. Congress, Office of Technology Assessment. 1990. *Genetic Witness: Forensic Uses of DNA Tests*. OTA-BA-438. Washington, DC: U.S. Government Printing Office, NTIS order #PB90-259110.

[11] National Research Council. 1992. *DNA Technology in Forensic Science*. Washington, DC: National Academy Press, p. 55.

Copyright © National Academy of Sciences. All rights reserved.

the science behind DNA analysis is valid, a subsequent NRC report in 1996 recommended new ways of interpreting DNA evidence to help answer a key question for jurors—the likelihood that two matching samples can come from different people.[12] This 1996 report recommended a set of statistical calculations that takes population structure into account, which enhanced the validity of the test. The report also called for independent retesting and made recommendations to improve laboratory performance and accountability through, for example, adherence to high-quality standards, accreditation, and proficiency testing.

Since then, the past two decades have seen tremendous growth in the use of DNA evidence in crime scene investigations. Currently more than 175 publicly funded forensic laboratories and approximately 30 private laboratories conduct hundreds of thousands of DNA analyses annually in the United States. In addition, most countries in Europe and Asia have forensic DNA programs. In 2003, President George W. Bush announced a 5-year, $1 billion initiative to improve the use of DNA in the criminal justice system. Called the *President's DNA Initiative*, the program pushed for increased funding, training, and assistance to ensure that DNA technology "reaches its full potential to solve crimes, protect the innocent, and identify missing persons."[13]

Thus, DNA analysis—originally developed in research laboratories in the context of life sciences research—has received heightened scrutiny and funding support. That, combined with its well-defined precision and accuracy, has set the bar higher for other forensic science methodologies, because it has provided a tool with a higher degree of reliability and relevance than any other forensic technique. However, DNA evidence comprises only about 10 percent of case work and is not always relevant to a particular case.[14] Even if DNA evidence is available, it will assist in solving a crime only if it supports an evidential hypothesis that makes guilt or innocence more likely. For example, the fact that DNA evidence of a victim's husband is found in the house in which the couple lived and where the murder took place proves nothing. The fact that the husband's DNA is found under the fingernails of the victim who put up a struggle may have a very different significance. Thus, it is essential to articulate the reasoning process and the context associated with the evidence that is being evaluated.

[12] National Research Council. 1996. *The Evaluation of Forensic DNA Evidence: An Update*. Washington, DC: National Academy Press.

[13] See www.dna.gov/info/e_summary.

[14] The American Society of Crime Laboratory Directors. 2004. *180 Day Study: Status and Needs of U.S. Crime Labs*. p. 7, table 2.

Copyright © National Academy of Sciences. All rights reserved.

Questionable or Questioned Science

The increased use of DNA analysis as a more reliable approach to matching crime scene evidence with suspects and victims has resulted in the reevaluation of older cases that retained biological evidence that could be analyzed by DNA. The number of exonerations resulting from the analysis of DNA has grown across the country in recent years, uncovering a disturbing number of wrongful convictions—some for capital crimes—and exposing serious limitations in some of the forensic science approaches commonly used in the United States.

According to The Innocence Project, there have been 223 postconviction DNA exonerations in the United States since 1989 (as of November 2008).[15] Some have contested the percentage of exonerated defendants whose convictions allegedly were based on faulty science. Although the Innocence Project figures are disputed by forensic scientists who have reexamined the data, even those who are critical of the conclusions of The Innocence Project acknowledge that faulty forensic science has, on occasion, contributed to the wrongful conviction of innocent persons.[16]

The fact is that many forensic tests—such as those used to infer the source of toolmarks or bite marks—have never been exposed to stringent scientific scrutiny. Most of these techniques were developed in crime laboratories to aid in the investigation of evidence from a particular crime scene, and researching their limitations and foundations was never a top priority. There is some logic behind the application of these techniques; practitioners worked hard to improve their methods, and results from other evidence have combined with these tests to give forensic scientists a degree of confidence in their probative value. Before the first offering of the use of DNA in forensic science in 1986, no concerted effort had been made to determine the reliability of these tests, and some in the forensic science and law enforcement communities believed that scientists' ability to withstand cross-examination in court when giving testimony related to these tests was sufficient to demonstrate the tests' reliability. However, although the precise error rates of these forensic tests are still unknown, comparison of their results with DNA testing in the same cases has revealed that some of these analyses, as currently performed, produce erroneous results. The

[15] The Innocence Project. *Fact Sheet: Facts on Post-Conviction DNA Exonerations*. Available at www.innocenceproject.org/Content/351.php. See also B.L. Garrett. Judging innocence. 108 COLUM. L. REV. 55 (2008) (discussing the results of an empirical study of the types of faulty evidence that was admitted in more than 200 cases for which DNA testing subsequently enabled postconviction exonerations).

[16] See J. Collins and J. Jarvis. 2008. The wrongful conviction of forensic science. *Crime Lab Report*. July 16. Available at www.crimelabreport.com/library/pdf/wrongful_conviction.pdf. See also N. Rudin and K. Inman. 2008. Who speaks for forensic science? *News of the California Association of Criminalists*. Available at www.cacnews.org/news/4thq08.pdf, p. 10.

Copyright © National Academy of Sciences. All rights reserved.

conclusions of forensic examiners may or may not be right—depending on the case—but each wrongful conviction based on improperly interpreted evidence is serious, both for the innocent person and also for society, because of the threat that may be posed by a guilty person going free. Some non-DNA forensic tests do not meet the fundamental requirements of science, in terms of reproducibility, validity, and falsifiability (see Chapters 4 through 6).

Even fingerprint analysis has been called into question. For nearly a century, fingerprint examiners have been comparing partial latent fingerprints found at crime scenes to inked fingerprints taken directly from suspects. Fingerprint identifications have been viewed as exact means of associating a suspect with a crime scene print and rarely were questioned.[17] Recently, however, the scientific foundation of the fingerprint field has been questioned, and the suggestion has been made that latent fingerprint identifications may not be as reliable as previously assumed.[18] The question is less a matter of whether each person's fingerprints are permanent and unique—uniqueness is commonly assumed—and more a matter of whether one can determine with adequate reliability that the finger that left an imperfect impression at a crime scene is the same finger that left an impression (with different imperfections) in a file of fingerprints. In October 2007, Baltimore County Circuit Judge Susan M. Souder refused to allow a fingerprint analyst to testify that a latent print was made by the defendant in a death penalty trial. In her ruling, Judge Souder found the traditional method of fingerprint analysis to be "a subjective, untested, unverifiable identification procedure that purports to be infallible."[19]

Some forensic science methods have as their goal the "individualization" of specific types of evidence (typically shoe and tire impressions, dermal ridge prints, toolmarks and firearms, and handwriting). Analysts using such methods believe that unique markings are acquired by a source item in random fashion and that such uniqueness is faithfully transmitted from the source item to the evidence item being examined (or in the case of handwriting, that individuals acquire habits that result in unique handwriting). When the evidence and putative source items are compared, a conclusion of individualization implies that the evidence originated from that source,

[17] R. Epstein. Fingerprints meet *Daubert:* The myth of fingerprint "science" is revealed. 75 *Southern California Law Review* 605 (2002).

[18] S.A. Cole. 2002. *Suspect Identities: A History of Fingerprinting and Criminal Identification.* Boston: Harvard University Press; Epstein, op. cit.

[19] *State of Maryland v. Bryan Rose.* In the Circuit Court for Baltimore County. Case No. K06-545.

Copyright © National Academy of Sciences. All rights reserved.

to the exclusion of all other possible sources.[20,21] The determination of uniqueness requires measurements of object attributes, data collected on the population frequency of variation in these attributes, testing of attribute independence, and calculations of the probability that different objects share a common set of observable attributes.[22] Importantly, the results of research must be made public so that they can be reviewed, checked by others, criticized, and then revised, and this has not been done for some of the forensic science disciplines.[23] As recently as September 2008, the Detroit Police crime laboratory was shut down following a Michigan State Police audit that found a 10 percent error rate in ballistic evidence.[24]

The forensic science community has had little opportunity to pursue or become proficient in the research that is needed to support what it does. Few sources of funding exist for independent forensic research (see Chapter 2). Most of the studies are commissioned by DOJ and conducted by crime laboratories with little or no participation by the traditional scientific community. In addition, most disciplines in the profession are hindered by a lack of enforceable standards for interpretation of data (see Chapter 7).

Errors and Fraud

In recent years, the integrity of crime laboratories increasingly has been called into question, with some highly publicized cases highlighting the sometimes lax standards of laboratories that have generated questionable or fraudulent evidence and that have lacked quality control measures that would have detected the questionable evidence. In one notorious case, a state-mandated review of analyses conducted by West Virginia State Police laboratory employee Fred Zain revealed that the convictions of more than 100 people were in doubt because Zain had repeatedly falsified evidence in criminal prosecutions. At least 10 men had their convictions overturned as a result.[25] Subsequent reviews questioned whether Zain was ever qualified to perform scientific examinations.[26]

Other scandals, such as one involving the Houston Crime Laboratory

[20] M.J. Saks and J.J. Koehler. 2005. The coming paradigm shift in forensic identification science. *Science* 309:892-895.

[21] W.J. Bodziak. 1999. *Footwear Impression Evidence–Detection, Recovery, and Examination.* 2nd ed. Boca Raton, FL: CRC Press.

[22] Ibid. See also NRC, 1996, op. cit.

[23] P.C. Giannelli. Wrongful convictions and forensic science: The need to regulate crime labs. 86 N.C. L. REV. 163 (2007).

[24] B. Schmitt and J. Swickard. 2008. Detroit Police lab shut down after probe finds errors. *Detroit Free Press* on-line. September 25.

[25] *In the Matter of an Investigation of the West Virginia State Police Crime Laboratory, Serology Division* (WVa 1993) 438 S.E.2d 501(Zaine I); and 445 S.E.2d 165 (Zain II).

[26] Ibid.

Copyright © National Academy of Sciences. All rights reserved.

in 2003, highlight the sometimes blatant lack of proper education and training of forensic examiners. In the Houston case, several DNA experts went public with accusations that the DNA/Serology Unit of the Houston Police Department Crime Laboratory was performing grossly incompetent work and was presenting findings in a misleading manner designed to unfairly help prosecutors obtain convictions. An audit by the Texas Department of Public Safety confirmed serious inadequacies in the laboratory's procedures, including "routine failure to run essential scientific controls, failure to take adequate measures to prevent contamination of samples, failure to adequately document work performed and results obtained, and routine failure to follow correct procedures for computing statistical frequencies."[27,28]

The Innocence Project has documented instances of both intentional and unintentional laboratory errors that have lead to wrongful convictions, including:

- In the laboratory—contamination and mislabeling of evidence.
- In information provided in forensics reports—falsified results (including "drylabbing," i.e., providing conclusions from tests that were never conducted), and misinterpretation of evidence.
- In the courtroom—suppression of exculpatory evidence; providing a statistical exaggeration of the results of a test conducted on evidence; and providing false testimony about test results.[29]

Saks and Koehler have written that the testimony of forensic scientists is one of many problems in criminal cases today.[30] They cite the norms of science, which emphasize "methodological rigor, openness, and cautious interpretation of data," as norms that often are absent from the forensic science disciplines.

Although cases of fraud appear to be rare, perhaps of more concern is the lack of good data on the accuracy of the analyses conducted in forensic science disciplines and the significant potential for bias that is present in some cases. For example, the FBI was accused of bias in the case of the Madrid bombing suspect Brandon Mayfield (see Box 1-1). In that case, the Inspector General of DOJ launched an investigation. The FBI conducted its

[27] *Quality Assurance Audit for Forensic DNA and Convicted Offender DNA Databasing Laboratories. An Audit of the Houston Police Department Crime Laboratory-DNA/Serology Section, December 12-13, 2002*. Available at www.scientific.org/archive/Audit'%20Document--Houston.pdf.

[28] See also M.R. Bromwich. 2007. *Final Report of the Independent Investigator for the Houston Police Department Crime Laboratory and Property Room*. Available at www.hpdlabinvestigation.org.

[29] The Innocence Project. Available at www.innocenceproject.org/Content/312.php.

[30] Saks and Koehler, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

Box 1-1
FBI Statement on Brandon Mayfield Case

"After the March terrorist attacks on commuter trains in Madrid, digital images of partial latent fingerprints obtained from plastic bags that contained detonator caps were submitted by Spanish authorities to the FBI for analysis. The submitted images were searched through the Integrated Automated Fingerprint Identification System (IAFIS). An IAFIS search compares an unknown print to a database of millions of known prints. The result of an IAFIS search produces a short list of potential matches. A trained fingerprint examiner then takes the short list of possible matches and performs an examination to determine whether the unknown print matches a known print in the database.

Using standard protocols and methodologies, FBI fingerprint examiners determined that the latent fingerprint was of value for identification purposes. This print was subsequently linked to Brandon Mayfield. That association was independently analyzed and the results were confirmed by an outside experienced fingerprint expert.

Soon after the submitted fingerprint was associated with Mr. Mayfield, Spanish authorities alerted the FBI to additional information that cast doubt on the findings. As a result, the FBI sent two fingerprint examiners to Madrid, who compared the image the FBI had been provided to the image the Spanish authorities had.

Upon review it was determined that the FBI identification was based on an image of substandard quality, which was particularly problematic because of the remarkable number of points of similarity between Mr. Mayfield's prints and the print details in the images submitted to the FBI."

The FBI's Latent Fingerprint Unit has reviewed its practices and adopted new guidelines for all examiners receiving latent print images when the original evidence is not included.

SOURCE: FBI. May 24, 2004, Press Release. Available at www.fbi.gov/pressrel/pressrel04/mayfield052404.htm.

own review by a panel of independent experts. The reviews concluded that the problem was not the quality of the digital images reviewed, but rather the bias and "circular reasoning" of the FBI examiners.[31]

Parts of the forensic science community have resisted the implications of the mounting criticism of the reliability of forensic analyses by investigative units such as Inspector General reports, The Innocence Project,

[31] U.S. Department of Justice, Office of the Inspector General. 2006. *A Review of the FBI's Handling of the Brandon Mayfield Case.* Also see R.B. Stacey. 2005. *Report on the Erroneous Fingerprint Individualization in the Madrid Train Bombing Case.* Available at www.fbi.gov/hq/lab/fsc/current/special_report/2005_special_report.htm.

Copyright © National Academy of Sciences. All rights reserved.

and studies in the published literature. In testimony before the committee, it was clear that some members of the forensic science community will not concede that there could be less than perfect accuracy either in given laboratories or in specific disciplines, and experts testified to the committee that disagreement remains regarding even what constitutes an error. For example, if the limitations of a given technology lead to an examiner declaring a "match" that is found by subsequent technology (e.g., DNA analysis) to be a "mismatch," there is disagreement within the forensic science community about whether the original determination constitutes an error.[32] Failure to acknowledge uncertainty in findings is common: Many examiners claim in testimony that others in their field would come to the exact same conclusions about the evidence they have analyzed. Assertions of a "100 percent match" contradict the findings of proficiency tests that find substantial rates of erroneous results in some disciplines (i.e., voice identification, bite mark analysis).[33,34]

As an example, in a FBI publication on the correlation of microscopic and mitochondrial DNA hair comparisons, the authors found that even competent hair examiners can make significant errors.[35] In this study, the authors found that in 11 percent of the cases in which the hair examiners declared two hairs to be "similar," subsequent DNA testing revealed that the hairs did not match, which refers either to the competency or the relative ability of the two divergent techniques to identify differences in hair samples, as well as to the probative value of each test.

The insistence by some forensic practitioners that their disciplines employ methodologies that have perfect accuracy and produce no errors has hampered efforts to evaluate the usefulness of the forensic science disciplines. And, although DNA analysis is considered the most reliable forensic tool available today, laboratories nonetheless can make errors working with either nuclear DNA or mtDNA—errors such as mislabeling samples, losing samples, or misinterpreting the data.

Standard setting, accreditation of laboratories, and certification of individuals aim to address many of these problems, and although many laboratories have excellent training and quality control programs, even

---

[32] N. Benedict. 2004. Fingerprints and the *Daubert* standard for admission of scientific evidence: Why fingerprints fail and a proposed remedy. *Arizona Law Review* 46:519; M. Houck, Director of Forensic Science Initiative, West Virginia University. Presentation to the committee. January 25, 2007.

[33] D.L. Faigman, D. Kaye, M.J. Saks, and J. Sanders. 2002. *Modern Scientific Evidence: The Law and Science of Expert Testimony*. St. Paul, MN: Thompson/West.

[34] C.M. Bowers. 2002. The scientific status of bitemark comparisons. In: D.L. Faigman (ed.). *Science in the Law: Forensic Science Issues*. St. Paul, MN: West Publishing.

[35] M. Houck and B. Budowle. 2002. Correlation of microscopic and mitochondrial DNA hair comparisons. *Journal of Forensic Sciences* 47(5):964-967; see also Bromwich, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

accredited laboratories make mistakes. Furthermore, accreditation is a voluntary program, except in a few jurisdictions in which it is required (New York, Oklahoma, and Texas)[36] (see Chapter 7).

The "CSI Effect"

Media attention has focused recently on what is being called the "CSI Effect," named for popular television shows (such as *Crime Scene Investigation*) that are focused on police forensic evidence investigation.[37] The fictional characters in these dramas often present an unrealistic portrayal of the daily operations of crime scene investigators and crime laboratories (including their instrumentation, analytical technologies, and capabilities). Cases are solved in an hour, highly technical analyses are accomplished in minutes, and laboratory and instrumental capabilities are often exaggerated, misrepresented, or entirely fabricated. In courtroom scenes, forensic examiners state their findings or a match (between evidence and suspect) with unfailing certainty, often demonstrating the technique used to make the determination. The dramas suggest that convictions are quick and no mistakes are made.

The CSI Effect specifically refers to the real-life consequences of exposure to Hollywood's version of law and order. Jurists and crime laboratory directors anecdotally report that jurors have come to expect the presentation of forensic evidence in every case, and they expect it to be conclusive. A recent study by Schweitzer and Saks found that compared to those who do not watch CSI, CSI viewers were "more critical of the forensic evidence presented at the trial, finding it less believable. Forensic science viewers expressed more confidence in their verdicts than did nonviewers."[38] Prosecutors and defense attorneys have reported jurors second guessing them in the courtroom, citing "reasonable doubt" and refusing to convict because they believed that other evidence was available and not adequately examined.[39]

Schweitzer and Saks found that the CSI Effect is changing the manner in which forensic evidence is presented in court, with some prosecutors believing they must make their presentation as visually interesting and appealing as such presentations appear to be on television. Some are concerned that the conclusiveness and finality of the manner in which forensic evidence is

[36] National Institute of Justice. 2006. *Status and Needs of Forensic Science Service Providers: A Report to Congress.* Available at www.ojp.usdoj.gov/nij/pubs-sum/213420.htm.

[37] See *U.S. News & World Report.* 2005. The CSI effect: How TV is driving jury verdicts all across America. April 25.

[38] N.J. Schweitzer and M.J. Saks. 2007. The CSI Effect: Popular fiction about forensic science affects public expectations about real forensic science. *Jurimetrics* 47:357.

[39] See *U.S. News & World Report*, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

presented on television results in jurors giving more or less credence to the forensic experts and their testimony than they should, raising expectations, and possibly resulting in a miscarriage of justice.[40] The true effects of the popularization of forensic science disciplines will not be fully understood for some time, but it is apparent that it has increased pressure and attention on the forensic science community in the use and interpretation of evidence in the courtroom.

Fragmented and Inconsistent Medicolegal Death Investigation

The medicolegal death investigation system is a fragmented organization of state and local entities called upon to investigate deaths and to certify the cause and manner of unnatural and unexplained deaths. About 1 percent of the U.S. population (about 2.6 million people) dies each year. Medical examiner and coroner offices receive nearly 1 million reports of deaths, constituting between 30 to 40 percent of all U.S. deaths in 2004, and accept about one half of those (500,000, or 1 in 5 deaths) for further investigation and certification.[41] In carrying out this role, medical examiners and coroners are required to decide the scope and course of a death investigation, which may include assessing the scene of death, examining the body, determining whether to perform an autopsy, and ordering other medical tests, forensic analyses, and procedures as needed. Yet the training and skill of medical examiners and coroners and the systems that support them vary greatly. Medical examiners may be physicians, pathologists, or forensic pathologists with jurisdiction within a county, district, or state. A coroner is an elected or appointed official who might not be a physician or have had any medical training. Coroners typically serve a single county.

Since 1877, in the United States, there have been efforts to replace the coroner system with a medical examiner system.[42] In fact, more than 80 years ago, the National Academy of Sciences identified concerns regarding the lack of standardization in death investigations and called for the abolishment of the coroner's office, noting that the office "has conclusively demonstrated its incapacity to perform the functions customarily required of it."[43] In its place, the report called for well-staffed offices of a medical

[40] Schweitzer and Saks, op. cit.; S.A. Cole and R. Dioso-Villa. 2007. CSI and its effects: Media, juries, and the burden of proof. *New England Law Review* 41(3):435.

[41] M.J. Hickman, K.A. Hughes, K.J. Strom, and J.D. Ropero-Miller. 2007. *Medical Examiner and Coroners' Offices, 2004*. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics. Available at www.ojp.usdoj.gov/bjs/pub/pdf/meco04.pdf.

[42] W.U. Spitz and R.S. Fisher. 1982. *Medicolegal Investigation of Death*, 2nd ed. Springfield, IL: Charles C. Thomas.

[43] National Research Council. 1928. *The Coroner and the Medical Examiner*. Washington, DC: National Academy Press.

Copyright © National Academy of Sciences. All rights reserved.

examiner, led by a pathologist. In strong terms, the 1928 committee called for the professionalization of death investigation, with medical science at its center.

Despite these calls, efforts to move away from a coroner system in the United States have stalled. Currently, 11 states have coroner-only systems, 22 states have medical examiner systems, and 18 states have mixed systems—in which some counties have coroners and others have medical examiners. Some of these states have a referral system, in which the coroner refers cases to medical examiners for autopsy.[44] According to a 2003 Institute of Medicine report, in addition to the variety of systems in the United States, the location and authority of the medical examiner or coroner office also varies, with 43 percent of the U.S. population served by a medical examiner or coroner housed in a separate city, county, or state government office. Other arrangements involve an office under public safety or law enforcement. The least common placement is under a forensic laboratory or health department.[45]

Variability also is evident in terms of accreditation of death investigation systems. As of August 2008, 54 of the medical examiner offices in the United States (serving 23 percent of the population) have been accredited by the National Association of Medical Examiners, the professional organization of physician medical examiners. Most of the country is served by offices lacking accreditation.[46] Similarly, requirements for training are not mandatory. About 36 percent of the population lives where minimal or no special training is required to conduct death investigations.[47] Recently, an 18-year-old high school student was elected a deputy coroner in Indiana after completing a short training course.[48]

Additionally, funding for programs supporting death investigations vary across the country, with the cost of county systems ranging from $0.62 to $5.54 per capita, and statewide systems from $0.32 to $3.20.[49] Most funding comes from tax revenues, and with such limited funds available, the salaries of medical examiners and skilled personnel are much lower than those of other physicians and medical personnel. Consequently, recruiting and retaining skilled personnel is a constant struggle.

At a time when natural disasters or man-made disasters could create

[44] R. Hanzlick and D. Combs. 1998. Medical examiner and coroner systems: History and trends. *Journal of the American Medical Association* 279(11):870-874.

[45] Institute of Medicine. 2003. *Medicolegal Death Investigation System: Workshop Report.* Washington, DC: The National Academies Press.

[46] Ibid.

[47] R. Hanzlick. 1996. Coroner training needs. A numeric and geographic analysis. *Journal of the American Medical Association* 276(21):1775-1778.

[48] See www.wthr.com/Global/story.asp?S=6534514&nav=menu188_2.

[49] IOM, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

great havoc in our country, the death investigation system is one that is of increasing importance. Deaths resulting from terrorism, with the exception of any suicide perpetrators, are homicides that require robust medicolegal death investigation systems to recover and identify remains, collect forensic evidence, and determine cause of death.

Incompatible Automated Fingerprint Identification Systems

In the late 1970s and early 1980s, law enforcement agencies across the Nation began adopting Automated Fingerprint Identification Systems (AFIS) to improve their efficiency and reduce the time needed to identify (or exclude) a given individual from a fingerprint. Before the use of AFIS, the fingerprint identification process involved numerous clerks and fingerprint examiners tediously sifting through thousands of classified and cataloged paper fingerprint cards.

AFIS was an enormous improvement in the way local, state, and federal law enforcement agencies managed fingerprints and identified people. AFIS searches are much faster than manual searches and often allow examiners to search across a larger pool of candidates and produce a shorter list of possible associations of crime scene prints and unidentified persons, living or dead.

Working with a system's software, fingerprint examiners can map the details of a given fingerprint—by features that consist of "minutiae" (e.g., friction ridge endings and ridge bifurcations)—and ask the system to search its database for other records that closely resemble this pattern. Depending on the size of the database being searched and the system's workload, an examiner often can get results back within minutes.

However, even though AFIS has been a significant improvement for the law enforcement community over the last few decades, AFIS deployments and performance (operational capacities) today are still far from optimal. Many law enforcement AFIS installations are stand-alone systems or are part of relatively limited regional networks with shared databases or information-sharing agreements. Today, systems from different vendors often are incompatible and hence cannot communicate. Indeed, different versions of similar systems from the same vendor often cannot effectively share fingerprint data with one another. In addition, many law enforcement agencies also access the FBI's Integrated Automated Fingerprint Identification System database (the "largest biometric database in the world"[50]) through an entirely separate stand-alone system—a fact that often forces fingerprint examiners to enter fingerprint data for one search multiple times in multiple states (at least once for each system being searched). Additionally, searches

[50] See www.fbi.gov/hq/cjisd/iafis.htm.

Copyright © National Academy of Sciences. All rights reserved.

between latent print to AFIS 10-print[51] files suffer by not being more fully automated: Examiners must manually encode a latent print before searching the AFIS 10-print database. Furthermore, the hit rate for latent prints searched against the AFIS database is approximately 40 percent (see Chapter 10). Much good work in recent years has improved the interoperability of AFIS installations and databases, but the pace of these efforts to date has been slow, and greater progress must be made toward achieving meaningful, nationwide AFIS interoperability.

The Growing Importance of the Forensic Science Disciplines to Homeland Security

Threats to food and transportation, concerns about nuclear and cyber security, and the need to develop rapid responses to chemical, nuclear, radiological, and biological threats underlie the need to ensure that there is a sufficient supply of adequately trained forensic specialists. At present, public crime laboratories are insufficiently prepared to handle mass disasters. In addition, demands will be increasing on the forensic science community to develop real-time plans and protocols for mass disaster responses by the network of crime laboratories and death investigation systems across the country—and internationally. The development and application of the forensic science disciplines to support intelligence, investigations, and operations aimed at the prevention, interdiction, disruption, attribution, and prosecution of terrorism has been an important component of both public health and what is now termed "homeland security" for at least two decades. With the development and deployment of enhanced capabilities came the integration of forensic science disciplines much earlier in the investigative process. As a result, the forensic science disciplines could be more fruitfully leveraged to generate investigative leads to test, direct, or redirect lines of investigation, not just in building a case for prosecution. Forensic science disciplines are essential components of the response to mass fatality events, whether natural or man made.

The Admission of Forensic Science Evidence in Litigation

As explained in Chapter 3, most forensic science disciplines are inextricably tethered to the legal system; many forensic fields (e.g., firearms analysis, latent fingerprint identification) are but handmaidens of the legal system, and they have no significant uses beyond law enforcement. There-

[51] AFIS 10-print records the fingers, thumbs, and a palm print on a large index card. These prints are carefully taken, clear, and easy to read, and they make up the bulk of the AFIS data available today.

Copyright © National Academy of Sciences. All rights reserved.

fore, any study of forensic science necessarily must include an assessment of the legal system that it serves. As already noted, and as further amplified in Chapters 4 and 5, the forensic science system exhibits serious shortcomings in capacity and quality; yet the courts continue to rely on forensic evidence without fully understanding and addressing the limitations of different forensic science disciplines.

The conjunction between the law and forensic science is explored in detail in Chapter 3. The bottom line is simple: In a number of forensic science disciplines, forensic science professionals have yet to establish either the validity of their approach or the accuracy of their conclusions, and the courts have been utterly ineffective in addressing this problem. For a variety of reasons—including the rules governing the admissibility of forensic evidence, the applicable standards governing appellate review of trial court decisions, the limitations of the adversary process, and the common lack of scientific expertise among judges and lawyers who must try to comprehend and evaluate forensic evidence—the legal system is ill-equipped to correct the problems of the forensic science community. In short, judicial review, by itself, is not the answer. Rather, tremendous resources must be devoted to improving the forensic science community. With more and better educational programs, accredited laboratories, certification of forensic practitioners, sound operational principles and procedures, and serious research to establish the limits and measures of performance in each discipline, forensic science experts will be better able to analyze evidence and coherently report their findings in the courts. This is particularly important in criminal cases in which we seek to protect society from persons who have committed criminal acts and to protect innocent persons from being convicted of crimes that they did not commit.

ORGANIZATION OF THIS REPORT

This report begins with a series of chapters describing the current forensic science system, the use of forensic science evidence in litigation, and science and the forensic science disciplines. It then addresses systemic areas for improvement with the goal of attaining a more rigorous and robust forensic science infrastructure, including standards and best practices, education, and training. Pursuant to its charge, in three chapters the committee addresses special issues in the areas of medicolegal death investigation (Chapter 9), AFIS (Chapter 10), and the interrelationships between homeland security and the forensic science disciplines (Chapter 11).

Copyright © National Academy of Sciences. All rights reserved.

Copyright © National Academy of Sciences. All rights reserved.

2

The Forensic Science Community and the Need for Integrated Governance

Forensic investigations involve intelligence and information gathering, crime scene investigation, laboratory analysis, interpretation of tests and results, and reporting and communication with members of law enforcement and the judicial system. Law enforcement agencies within the United States vary in organizational structure regarding how forensic science examinations are conducted and evidence is admitted into court (see Chapter 3). Variations are attributable to the geographical size and population served by the jurisdictional authority, the types and level of crimes encountered, the funding source, and local tradition. In general, however, the forensic science community includes crime scene investigators; state and local crime laboratories; medical examiners; private forensic laboratories; law enforcement identification units; resources such as registries and databases; professional organizations; prosecutors and defense attorneys; quality system providers (i.e., accrediting and certifying organizations); and federal agencies that conduct or support research as well as provide forensic science services and training. This chapter provides an overview of the major components of the forensic science community. Data about laboratories are based largely on two surveys conducted by the Bureau of Justice Statistics (BJS) in 2002 and 2005 of publicly funded crime laboratories[1] and a more

[1] J.L. Peterson and M.J. Hickman. 2005. *Census of Publicly Funded Forensic Crime Laboratories, 2002*. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics. Available at www.ojp.usdoj.gov/bjs/pub/pdf/cpffcl02.pdf; M.R. Durose. 2008. *Census of Publicly Funded Forensic Crime Laboratories, 2005*. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Statistics. Available at www.ojp.usdoj.gov/bjs/pub/pdf/cpffcl05.pdf.

Copyright © National Academy of Sciences. All rights reserved.

recent survey of "nontraditional forensic service providers" conducted by researchers at West Virginia University.[2]

In addition to forensic laboratories, about 3,200 medical examiner and coroner offices provided death investigation services across the United States in 2004.[3] These entities—which may comprise a coroner system, a medical examiner system, or a mixed system at the county or state level—conduct death scene investigations, perform autopsies, and determine the cause and manner of death when a person has died as a result of violence, under suspicious circumstances, without a physician in attendance, or in other circumstances. These offices are described in greater detail in Chapter 9. In addition, standard setting, accrediting, and certifying organizations are described in greater detail in Chapter 7, and education and training programs are described in Chapter 8.

The committee's first recommendation, appearing at the end of this chapter, calls for a more central, strategic, and integrated approach to forensic science at the national level.

CRIME SCENE INVESTIGATION

Evidence recovery and interpretation at the crime scene is the essential first step in forensic investigations. Several organizational approaches to crime scene investigation and subsequent forensic laboratory activity exist, sometimes involving a large number of personnel with varied educational backgrounds. Conversely, in some jurisdictions, a single forensic examiner might also be the same investigator who goes to the crime scene, collects evidence, processes the evidence, conducts the analyses, interprets the evidence, and testifies in court. In other jurisdictions, the investigators submit the evidence to a laboratory where scientists conduct the analyses and prepare the reports. Crime scene evidence collectors can include uniformed officers, detectives, crime scene investigators, criminalists, forensic scientists, coroners, medical examiners, hospital personnel, photographers, and arson investigators.[4] Thus, the nature and process of crime scene investiga-

[2] T.S. Witt, Director, Bureau of Business and Economic Research, West Virginia University. "Survey of Non-Traditional Forensic Service Providers." Presentation to the committee. December 6, 2007.

[3] R. Hanzlick, Fulton County Medical Examiner's Center and Emory University School of Medicine. 2007. "An Overview of Medical Examiner/Coroner Systems in the United States—Development, Current Status, Issues, and Needs." Presentation to the committee. June 5, 2007. The Bureau of Justice (2004) omits Louisiana and classifies Texas as a medical examiner state, and accordingly reports the total as 1,998. According to Hanzlick, many of Texas's 254 counties maintain justice of the peace/coroners offices. The total number includes Justices of the Peace in Texas.

[4] B. Fisher, Director, Scientific Services Bureau, Los Angeles County Sheriff's Department. Presentation to the committee. April 24, 2007.

Copyright © National Academy of Sciences. All rights reserved.

tion varies dramatically across jurisdictions, with the potential for inconsistent policies and procedures and bias. Some analysts say that the lack of standards and oversight can result in deliberate deception of suspects, witnesses, and the courts; fraud; and "honest mistakes" made because of haste, inexperience, or lack of a scientific background.[5]

In 1978, the U.S. Supreme Court held for the first time in *Monell v. Department of Social Services of the City of New York*[6] that a municipality can be held directly liable for violating a person's constitutional rights under 42 U.S.C. section 1983. Partly in response to this liability, most large cities and metropolitan areas created their own professionally trained crime scene units. However, in smaller suburban and rural communities, evidence from a crime scene may be collected and preserved by a patrol officer or investigator. Even in large metropolitan areas, most crime scene investigation units are composed of sworn officers.

Recognizing that some agencies did not have the resources to adequately train all personnel in crime scene processing, in 2000 the National Institute of Justice (NIJ) and its Technical Working Group on Crime Scene Investigation (TWGCSI) developed *Crime Scene Investigation: A Guide for Law Enforcement*, which stated that "successful implementation of this guide can be realized only if staff possess basic (and in some cases advanced) training in the fundamentals of investigating a crime scene."[7] However, there remains great variability in crime scene investigation practices, along with persistent concerns that the lack of standards and proper training at the crime scene can contribute to the difficulties of drawing accurate conclusions once evidence is subjected to forensic laboratory methods. (See Chapter 5 for a discussion of methodologies and Chapter 7 for further discussion of standards and ethics.)

FORENSIC SCIENCE LABORATORIES AND SERVICE PROVIDERS

The configuration of forensic laboratories varies by jurisdiction. Some are located within a state police department as part of a statewide system of laboratories and training programs. For example, in Illinois, state law mandates that the laboratory system provide forensic services to law enforcement agencies in all 102 counties (population 12.7 million). Although the forensic laboratory system is part of the Illinois State Police, 98 percent

[5] See J.I. Thornton. 2006. Crime reconstruction—ethos and ethics. In: W.J. Chisum and B.E. Turvey (eds.). *Crime Reconstruction*. Boston: Elsevier Science, pp. 37-50.

[6] 436 U.S. 658 (1978).

[7] Available at www.ncjrs.gov/pdffiles1/nij/178280.pdf, p. 2.

Copyright © National Academy of Sciences. All rights reserved.

of the casework completed is for the 1,200 local and county police agencies across the state.[8]

Not all forensic services are performed in traditional crime laboratories—they may be conducted by a sworn law enforcement officer with no scientific training (e.g., some latent print examiners). Thus, forensic service providers may be located in law enforcement agencies, may be crime scene investigators, or may be a for-profit entity. There are no good data on the entire universe of forensic science entities, although there have been efforts to gather data on publicly funded crime laboratories and nonlaboratory-based providers. The committee could find no data regarding for-profit forensic science service providers, except for DNA laboratories, of which there are approximately 30 in the United States.

Publicly Funded Laboratories

BJS has conducted two censuses of publicly funded forensic crime laboratories. The first census, administered in 2002, established baseline information on the operations and workload of the Nation's public crime laboratories.[9] The 2005 census documented changes in workload and backlog that have occurred since the 2002 census. According to the 2005 census, 389 publicly funded forensic crime laboratories were operating in the United States in 2005—210 state or regional laboratories, 84 county laboratories, 62 municipal laboratories, and 33 federal laboratories. The estimated budget for all 389 crime laboratories exceeded $1 billion, nearly half of which funded state laboratories. The BJS report cites a total of nearly 2.7 million new cases[10] in 2005, including a much larger number of separate requests for forensic services. Some laboratories are full-service facilities; others might conduct only the more common analyses of evidence (see Chapter 5).

Funding Sources

According to the 2005 BJS census, in addition to federal, state, or local support, 28 percent of publicly funded laboratories charged fees for service, and 65 percent reported receiving some funding from grants. However, funding for laboratories has not increased with increasing demands. Some

[8] J. Johnson, Illinois State Police Forensic Science Center at Chicago. Presentation to the committee. January 25, 2007.

[9] Peterson and Hickman, op. cit.

[10] Durose, op. cit. "A 'case' is defined as all physical evidence submitted from a single criminal investigation submitted for crime laboratory analysis," p. 9.

Copyright © National Academy of Sciences. All rights reserved.

laboratory directors appearing before the committee cited budget cuts as high as 22 percent over the past five years.[11]

Personnel and Equipment

The 2005 BJS census estimated that publicly funded crime laboratories employed more than 11,900 full-time equivalent (FTE) personnel in 2005. Most crime laboratories are relatively small: the median staff size in 2005 was 16. Distinctly different professional tracks exist within forensic laboratories, ranging from laboratory technicians and general examiners to scientists. According to the census data, analysts or examiners—persons who typically prepare evidence, conduct tests, interpret results, sign laboratory reports, and testify in court—comprised 58 percent of all crime laboratory FTEs in 2005. Technical support personnel, who typically assist analysts or examiners in preparing evidence and conducting tests, accounted for 10 percent of all FTEs. Thirteen percent of FTEs were managerial personnel, 8 percent were in clerical positions, and 6 percent were crime scene technicians. Similar ranges in the distribution of personnel are evident among laboratories by type of jurisdiction served. (The uncertainties in these reported percentages depend on the number of laboratories that responded to the FTE survey questions.) A 2006 NIJ report cited equipment shortages (which may include insufficient equipment maintenance) as a limiting factor in processing cases.[12] It cited equipment needs at the 50 largest laboratories in the disciplines of controlled substances, trace evidence, firearms, questioned documents, latent prints, toxicology, and arson. Evidence submission may or may not be automated, depending on the laboratory. Lack of automation increases the time the laboratory spends on logging in evidence.

A 2005 survey of public crime laboratories conducted by researchers at the State University of New York at Albany found that the number of FTEs in a laboratory ranged from 2 to 280, with an average of 34, the majority of whom have bachelor's degrees.[13] Because of the distinctly different professional tracks within larger laboratories, for example, technicians perform tests with defined protocols, and credentialed scientists conduct specialized testing and interpretation. Unlike many other professions, the forensic science disciplines have no organized control over entry into the profession, such as by degree, boards or exams, or licensure (see Chapter

[11] Johnson, op. cit.

[12] NIJ. 2006. *Status and Needs of Forensic Science Service Providers: A Report to Congress.* Available at www.ojp.usdoj.gov/nij/pubs-sum/213420.htm.

[13] W.S. Becker, W.M. Dale, A. Lambert, and D. Magnus. 2005. Letter to the editor—Forensic lab directors' perceptions of staffing issues. *Journal of Forensic Sciences* 50(5):1255-1257.

Copyright © National Academy of Sciences. All rights reserved.

7). Control mechanisms traditionally have been held through employment and job function.[14]

Of the laboratories surveyed by the State University of New York at Albany, only 21 percent reported having a sufficient number of FTEs to complete their workload. The authors concluded that "as total number of cases increases, scientists do not have proper equipment, enough time, adequate resources, enough information from the DA [district attorney], enough time to prepare for courtroom testimony, and the needed resources to provide courtroom testimony."[15] In addition, "as casework capacity increases, pressure to complete cases too quickly increases significantly, and pressure to extend opinions beyond the scientific method and pressure to get a particular result also increases significantly."[16]

The National Association of Medical Examiners (NAME) also reports acute personnel shortages in the death investigation system, with a critical need for significantly more board-certified forensic pathologists than are currently available. (See Chapter 9 for a discussion of the medicolegal death investigation system.)

Laboratory Functions

According to the 2002 BJS data, almost all public crime laboratories examine controlled substances (90 percent). Sixty-three percent examine firearms and toolmarks, 65 percent screen biological samples (usually in preparation for DNA analysis on selected exhibits), and 61 percent examine latent prints.[17] Fifty-nine percent of laboratories examine one or more forms of trace evidence (e.g., hairs, fibers, glass, or paint). Fewer laboratories examine questioned documents (26 percent) or conduct computer crime investigations (11 percent). As would be expected, larger laboratories are able to perform a broader range of examinations.

In terms of crime scene investigation, 62 percent of laboratories report having sent examiners directly to crime scenes, although most forensic examiners did not visit crime scenes. Twenty-five percent of the laboratories reported that laboratory personnel also served as crime scene investigators. However, more than half of laboratories (62 percent) reported that agencies or persons not affiliated with the laboratory handled most major investigations—usually a police unit with specialized evidence technicians

[14] D.S. Stoney. Chief Scientist, Stoney Forensic, Inc. Presentation to the committee. January 26, 2007.

[15] Becker, et al., op. cit., p. 1255.

[16] Ibid., p. 1256.

[17] Peterson and Hickman, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

or crime scene search officers who go onsite to take photographs and locate, preserve, label, and gather physical evidence.

CASE BACKLOGS

According to the 2005 BJS data, the Nation's 389 crime laboratories received an estimated 2.7 million new cases during 2005. Almost half were submitted to state laboratories. Laboratories serving local jurisdictions received about 1.3 million cases in 2005, including 727,000 cases received by county laboratories and 566,000 by municipal laboratories.

> An estimated 359,000 cases were backlogged (not completed within 30 days) at the end of 2005, compared to 287,000 at yearend 2002. This represents a 24 percent increase in backlogged cases between 2002 and 2005. State laboratories accounted for more than half of the backlog in both years. Among the 288 laboratories that reported this information, the median number of cases received in 2005 was about 4,100. Overall, laboratories ended the year with a median backlog of about 400 cases. Six percent of laboratories that received cases in 2005 reported having no backlog at yearend.[18]

In 2005, federal laboratories received the fewest cases.

Fifty-one percent of the laboratories reported outsourcing one or more types of forensic services to private laboratories in 2005, primarily DNA casework, toxicology, Combined DNA Index System (CODIS) samples, and controlled substances.

In a communication with the committee, Los Angeles County Sheriff's Department Crime Laboratory Director Barry Fisher warned that to manage backlogs, laboratories triage cases:

> Murders, rapes, aggravated assaults and the like have priority, as do cases going to court, cases where a suspect is being held on an arrest warrant, highly publicized cases, etc. Property crimes, such as burglaries, are often far down the list. This makes the likelihood of examining evidence from property crime cases unlikely. Oddly, the police and prosecutors are rarely consulted about how priorities are determined. The use of triage is the lab's best effort to manage its own scarce resources. Another factor at play in case management is that the "squeaky wheel gets the grease." This means that a persistent investigator who calls the lab often enough will get his case done more quickly than the investigator who just sends the case down to the lab expecting that it will be done.[19]

---

[18] Ibid., pp. 3, 4. The committee notes that the 30-day turnaround metric is an arbitrary metric useful for comparative purposes only.

[19] Letter to the committee from B.A.J. Fisher. June 12, 2007.

Copyright © National Academy of Sciences. All rights reserved.

Fisher also cautioned that backlog data are not entirely reliable, saying that one of the reasons for the lack of data is that laboratories count backlogs, case submissions, tests, output, and outcomes differently. Additionally, many laboratories lack automated information management systems to "capture the very data that might support their case for more assistance."[20] Finally, it is difficult to track cases for which forensic work has moved all the way through the criminal justice system: Police, prosecutors, and forensic laboratories use different tracking systems.

NIJ'S COVERDELL FORENSIC SCIENCE IMPROVEMENT GRANT PROGRAM

Through the Paul Coverdell National Forensic Science Improvement Act (P.L. 106-561), the Justice Department operates the Paul Coverdell Forensic Science Improvement Grants Program (the Coverdell program), which awards grants to states and units of local government to help improve the quality and timeliness of forensic science and medical examiner services.[21] The program provides funding for expenses related to facilities, personnel, equipment, computerization, supplies, accreditation, certification, and education and training. In 2004, the Justice for All Act (P.L. 108-405) expanded the Coverdell program, with the aim of reducing the backlog.

A state or unit of local government that receives a Coverdell grant must use the grant for one or more of three purposes:

(1) To carry out all or a substantial part of a program intended to improve the quality and timeliness of forensic science or medical examiner services in the state, including those services provided by laboratories operated by the state and those operated by units of local government within the state.
(2) To eliminate a backlog in the analysis of forensic science evidence, including, among other things, a backlog with respect to firearms examination, latent prints, toxicology, controlled substances, forensic pathology, questioned documents, and trace evidence.
(3) To train, assist, and employ forensic laboratory personnel as needed to eliminate such a backlog.[22]

---

[20] Ibid.

[21] P.L. 106-561 (December 21, 2000). An Act to improve the quality, timeliness, and credibility of forensic science services for criminal justice purposes and for other purposes. Cited as the Paul Coverdell National Forensic Sciences Improvement Act.

[22] See www.ojp.usdoj.gov/nij/topics/forensics/nfsia/welcome.htm.

Copyright © National Academy of Sciences. All rights reserved.

The expectation for those receiving grants is "demonstrated improvement over current operations in the quality and/or timeliness of forensic science or medical examiner services provided in the state, including services provided by laboratories operated by the state and services provided by laboratories operated by units of local government within the State."[23] The output measures for Coverdell awards are:

(1) Change in the number of days between submission of a sample to a forensic science laboratory and delivery of test results to a requesting office or agency.
(2) The number of backlogged forensic cases analyzed with Coverdell funds, if applicable to the grant.
(3) The number of forensic science or medical examiner personnel who completed appropriate training or educational opportunities with Coverdell funds, if applicable to the grant.[24]

States may be eligible for both "base" (formula) and competitive funds from NIJ for forensic science programs. Units of local government within states may be eligible for competitive funds and may apply directly to NIJ. The Coverdell law (42 U.S.C. § 3797k(4)) requires that, to request a grant, an applicant for Coverdell funds must submit:

- A certification and description regarding a plan for forensic science laboratories.
- A certification regarding use of generally accepted laboratory practices.
- A certification and description regarding costs of new facilities.
- A certification regarding external investigations into allegations of serious negligence or misconduct.

Program funding was $10 million in Fiscal Year (FY) 2004, $15 million in FY 2005, and $18.5 million in FY 2006. Funds may be used for personnel, computerization, laboratory equipment, supplies, accreditation, education, training, certification, or facilities.

FORENSIC SERVICES BEYOND THE TRADITIONAL LABORATORY

Many forensic examiners do not work in a traditional crime laboratory. Often they work within law enforcement offices in units called "identifica-

[23] Ibid.
[24] Ibid.

Copyright © National Academy of Sciences. All rights reserved.

tion units" or "fingerprint units." For example, a 2004 study conducted by the American Society of Crime Laboratory Directors (ASCLD) for NIJ reported that two-thirds of fingerprint identifications take place outside of traditional crime laboratories.[25] Insufficient data are available on the size and expertise of this population of forensic examiners who are not employed in publicly funded forensic science laboratories. Therefore, in 2006, a survey instrument modeled after the BJS census was developed by researchers at West Virginia University in collaboration with the International Association for Identification (IAI).[26] Its survey was sent to 5,353 IAI U.S. members in April 2007,[27] targeting forensic scientists working outside the crime laboratories surveyed by BJS.

Of the units responding to the IAI survey, most were publicly funded (e.g., city, borough, village, town, county, state, or federal), with half working at the local level. Units at the city, borough, village, or town level had a median annual budget of $168,850, compared to $387, 413 at the county level. Half are small units, with one to five full- and part-time employees. The units primarily conduct crime scene investigations, latent print and 10-print examinations, photography, and bloodstain pattern analyses. A smaller number are involved in other forensic functions, such as the analysis of digital evidence, footwear, tire track impressions, firearms, forensic art, questioned documents, polygraph tests, and dental evidence.

For the responding units, the mean number of cases received per year was 2,780. The mean backlog was 9.4 percent of the annual caseload, with the backlog for latent prints being higher, at 12.3 percent of the caseload. More than half of the units report outsourcing work, primarily firearms, latent print, and footwear analyses. Although 69 percent of respondents replied that they had some system for verifying results, only 15 percent are accredited.

FEDERAL FORENSIC SCIENCE ACTIVITIES

Several federal agencies either provide support for forensic infrastructure, certification, and training, or conduct or fund forensic science in support of their missions. Brief descriptions follow.

---

[25] American Society of Crime Laboratory Directors. 2004. *180-Day Study Report: Status and Needs United States Crime Laboratories*. Available at www.ncjrs.gov/pdffiles1/nij/grants/213422.pdf.

[26] Witt, op. cit.

[27] Ibid. Of the 815 surveys returned, 308 represented responses from active forensic service provider organizations (i.e., only 1 response per organization was included) outside of publicly funded crime laboratories.

Copyright © National Academy of Sciences. All rights reserved.

Federal Forensic Science Laboratories

The largest publicly funded forensic laboratory in the country is the Federal Bureau of Investigation (FBI) Laboratory in Quantico, Virginia. Other federal agencies have smaller crime laboratories, for example, the U.S. Secret Service, the U.S. Army, the Drug Enforcement Administration, the Bureau of Alcohol, Tobacco, Firearms, and Explosives (known as ATF), the U.S. Postal Service, the Internal Revenue Service, and the U.S. Fish and Wildlife Service. In addition, the Department of Commerce's National Institute of Standards and Technology (NIST) conducts research in support of standard setting for gunshot residue analysis, trace explosives detectors, DNA analysis, and more. Some of these efforts are described below.

The FBI Laboratory

The types of cases investigated by the FBI include terrorism, espionage, public corruption, civil rights, criminal organizations and enterprises, white collar crime, and violent crime. Investigative case work services include those involving:

- chemistry
- cryptanalysis and racketeering records
- DNA analysis
- explosives
- evidence response
- firearms-toolmarks
- hazardous materials
- investigative and prosecutive graphics
- latent prints
- photographic operations and imaging services
- questioned documents
- structural design
- trace evidence
- specialty units

According to the 2005 BJS report, the FBI Laboratory had approximately 600 employees in 2005, and it partners with state and local crime laboratories throughout the country. Its FY 2007 budget was $63 million. The FBI Laboratory provides a full range of forensic services and handles a large volume of fingerprint work, receiving approximately 50,000 fingerprint submissions every day. In July 1999, the FBI updated its fingerprint databases with the Integrated Automated Fingerprint Identification System (IAFIS). Previously, all prints arrived on paper fingerprint cards that had to

Copyright © National Academy of Sciences. All rights reserved.

be processed by hand. With the introduction of IAFIS, prints and pictures can be submitted electronically.

According to the 2005 BJS census, the FBI laboratory began 2003 with an estimated backlog of 3,062 requests for forensic services. About two-thirds of the backlog was attributable to latent print requests. During 2003, the FBI laboratory received 6,994 new requests and completed 7,403 requests. The estimated year end backlog was 2,653 requests, a 13 percent reduction over the previous year. Latent print requests comprised half of the year end 2003 backlog. No data were provided in the 2005 census.

By the end of the first quarter of 2004, the FBI Laboratory reported a total backlog of 2,585 requests. This included 1,216 latent print requests, or 47 percent of the total. The FBI Laboratory reported a need for additional equipment and 249 additional FTEs in order to have achieved a 30-day turnaround on all 2003 requests. The cost of the additional equipment was estimated to be $40 million. Based on starting salaries for analyst/examiners, the estimated cost of the additional FTEs exceeds $17.5 million.

The FBI Laboratory also has working partnerships with the forensic science community's Scientific Working Groups (SWGs) that are tasked with generating guidelines and standards for specific forensic disciplines (see Chapter 7). The FBI also provides training for the forensic science community and conducts and funds research (see later discussion).

In addition, the FBI collects and maintains data and materials for multiple databases and registries (see Box 2-1). The largest is CODIS, which is composed of three components: the forensic database, the missing persons database, and the convicted felon database. The FBI CODIS Unit is responsible for developing, providing, and supporting the CODIS Program to federal, state, and local crime laboratories in the United States and selected international law enforcement crime laboratories to foster the exchange and comparison of forensic DNA evidence from violent crime investigations. The CODIS Unit also provides administrative management and support to the FBI for various advisory boards, Department of Justice (DOJ) grant programs, and legislation regarding DNA.

U.S. Secret Service (Department of Homeland Security [DHS])

The U.S. Secret Service laboratory examines evidence, develops investigative leads, and provides expert courtroom testimony. As part of the 1994 Crime Bill (P.L. 103-322), Congress mandated that the U.S. Secret Service provide forensic/technical assistance in matters involving missing and exploited children. On April 30, 2003, President George W. Bush signed the PROTECT Act of 2003 (P.L. 108-21), known as the "Amber Alert Bill," which gave full authorization to the U.S. Secret Service in this area. The

Copyright © National Academy of Sciences. All rights reserved.

Box 2-1
FBI Databases and Reference Libraries

The CODIS Program consists of the development, enhancement, and support of software that enables forensic DNA laboratories to store, maintain, and search DNA profiles from crime scenes, offenders, and missing persons. Support of the CODIS software includes training for DNA analysts and help-desk services, as well as a yearly national meeting for all CODIS administrators. The unit also provides CODIS software to international law enforcement laboratories to assist them in establishing a DNA database program. Forty law enforcement laboratories in 25 countries now have the CODIS software. CODIS consists of a three-tiered hierarchy of databases: the NDIS [National DNA Index System], the State DNA Index System, and the Local DNA Index System. The highest level in the CODIS hierarchy is NDIS, which contains the DNA profiles contributed by participating federal, state, and local forensic DNA laboratories. There are more than 170 NDIS participating sites across the United States, including the FBI Laboratory, the U.S. Army Criminal Investigation Laboratory, and a laboratory in Puerto Rico.

The NDIS contains 6.2 million offender profiles and 233,454 forensic profiles as of August 2008. Its operation requires determining the eligibility of samples for the National Index in accordance with applicable federal law, developing procedures for laboratories participating in the Index, and monitoring the participating laboratories' compliance with federal law. The CODIS Unit also provides administrative management and support for the NDIS Procedures Board and other DNA working groups. As of August 2008, CODIS has produced more than 74,500 hits, assisting in more than 74,700 investigations.[a]

The National Automotive Paint File contains entries dating as far back as the 1930s. The Paints and Polymers Subunit also serves as the U.S. repository for the Paint Data Query database, which is a Canadian database. State and local law enforcement agencies investigating hit-and-run homicides rely on both the National Automotive Paint File and the Paint Data Query database.

The FBI Explosives Reference File contains several thousand standards that help examiners identify the components and manufacturers of explosive and incendiary devices. The Explosives Reference Tools database (EXPeRT) combines the text of FBI Laboratory reports with evidentiary photographs from bombing cases and permits the rapid retrieval of information on any aspect of the forensic examination. The database also contains manufacturer data and open-source literature on the construction and use of explosives and explosive devices. An examiner can search EXPeRT, find similar devices, and identify similarities in the components used in the construction of an improvised explosive device.8

The Reference Firearms Collection contains more than 5,500 handguns and shoulder firearms; and the Standard Ammunition File, a collection of more than 15,000 military and commercial ammunition specimens from both domestic and international manufacturers.

---

[a]See www.fbi.gov/hq/lab/codis/clickmap.htm.
SOURCE: FBI Web site at www.fbi.gov/hq/lab/html/ipgu1.htm.

Copyright © National Academy of Sciences. All rights reserved.

forensic services utilized by the Secret Service include identification, forensic automation, polygraph, questioned documents, and visual information.

Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)

The ATF Laboratories reside within DOJ. Currently, the ATF Laboratories have more than 100 employees working in 4 laboratories in 3 cities. In FY 2005, ATF Laboratories performed more than 2,600 forensic examinations with an authorized staff of 106 positions and a budget of approximately $16 million.

In FY 2006, the ATF Laboratories:

- analyzed 64 samples related to alcohol and tobacco diversion;
- processed 3,086 forensic cases;
- spent 171 days providing expert testimony in the courts;
- spent 242 days at crime scenes; and
- spent 371 days providing training to federal, state, and local investigators and examiners.

A new $135 million National Laboratory Center in suburban Maryland was opened in 2003. The National Laboratory Center contains a unique fire testing facility, designed to support fire investigations. Each ATF Laboratory also has a mobile laboratory designed to support the examination of evidence at the scene of a fire or explosion. In FY 2006, ATF established a DNA analysis capability at the National Laboratory Center.[28] The Laboratories are ASCLD/Laboratory Accreditation Board (LAB) accredited in the disciplines of trace evidence, biology (serology only), questioned documents, firearms/toolmarks, and latent prints.

In a 2006 semiannual report from the DOJ Office of the Inspector General (OIG), the OIG's Audit Division evaluated whether the ATF Laboratories managed workloads effectively to provide timely services to ATF field divisions. The audit report stated the following:

> Our audit found that processing times have not significantly improved in the past 4 years. Two-thirds of completed forensic examinations continued to take more than 30 days to complete and about one-third of examinations took more than 90 days.
>
> Improvements in the timeliness of laboratory examinations have been limited because ATF has not accomplished actions it committed to in 2001, such as increasing the number of examiner positions in the forensic laboratories, implementing a new priority system, implementing a new

[28] See www.atf.treas.gov/labs/index.htm.

Copyright © National Academy of Sciences. All rights reserved.

information management system, and significantly reducing the size of its backlog of examination requests. Laboratory staffing generally was adequate to manage the incoming workload, but backlogged requests continued to interfere with the timely analysis of incoming examination requests. The audit found that the backlog could increase as a result of unusually resource-intensive cases. We concluded that if these conditions are not addressed serious consequences may result, such as delays in making arrests and bringing offenders to trial.[29]

Department of Defense (DOD)

DOD's forensic requirements are growing beyond the traditional realm of criminal investigations, casualty investigations, and medical examiner functions toward more intelligence and counterintelligence functions. DOD's activities are primarily mission oriented, but they also serve specific functional roles in criminal investigations. A DOD Forensic Sciences Committee provides advice on forensic science activities across the department.

Like other crime laboratories, DOD has capabilities in most of the forensic science disciplines. Its major forensic entities include the Criminal Investigation Laboratory, the Armed Forces Institute of Pathology, the Cyber Crime Center ($20 million annually), and the Central Identification Laboratory ($1 million annually), all of which are ASCLD/LAB accredited.[30] The Army also maintains the Armed Forces Repository of Specimen Samples for the Identification of Remains, with more than 5 million DNA samples primarily from military service members. It also maintains a searchable database of DNA profiles from detainees and known or suspected terrorists. The Criminal Investigation Laboratory provides worldwide forensic laboratory services, training, and research and development (R&D) to all DOD investigative agencies.

DOD currently is developing a "Defense Forensic Enterprise System" to more centrally manage, integrate, and coordinate across the Services for both criminal investigation and warfighter operations, as well as to serve homeland security functions.[31] Part of the system is the Joint Expeditionary Forensic Facilities, which are modular by design for deployment purposes

[29] Office of the Inspector General. *Semiannual Report to Congress*, October 1, 2005-March 31, 2006. April 8, 2006. Available at www.usdoj.gov/oig/semiannual/0605/message.htm. Also see U.S. Department of Justice Office of the Inspector General Audit Division, Audit Report 06-15. March 2006. *Follow-Up Audit of the Bureau of Alcohol, Tobacco, Firearms and Explosives Forensic Science Laboratories Workload Management.*

[30] L.C. Chelko, Director, U.S. Army Criminal Investigation Laboratory. Presentation to the committee. September 21, 2007.

[31] R. Tontarski, Chief, Forensic Analysis Division, CID Command, U.S. Army Criminal Investigation Laboratory. Presentation to the committee. September 21, 2007.

Copyright © National Academy of Sciences. All rights reserved.

but which are also designed for expansion to full-spectrum analyses. The Defense Forensic Network connects all DOD forensic operations virtually and synchronizes worldwide DOD forensic operations. A Forensic Training and Research Academy is responsible for all DOD forensic examiner training and serves as DOD's certification authority. In addition to conducting its own research, DOD partners with academia, industry, and other federal agencies. It is collaborating with the National Forensic Science Technology Center to leverage its work in deployable forensic instrumentation and technologies and with NIJ on technology transfer strategies.

National Bioforensic Analysis Center (NBFAC), DHS

NBFAC is a component of the National Biodefense Analysis and Countermeasures Center (NBACC), which is operated by a contractor on behalf of DHS, with a proposed budget of $28.3 million for FY 2009. NBFAC and NBACC are not federal agencies. Their prime customer for their services is the FBI. They do not perform complete forensic analyses on evidence from biocrimes and bioterrorism; they do perform or direct the performance (by one or more of their affiliated laboratories) of analyses targeting biological materials and biotoxins. NBFAC provides the laboratories and training for FBI Laboratory examiners in several disciplines to safely and effectively conduct their standard examinations on contaminated traditional evidence. It is also charged with establishing and maintaining reference collections of biological agents.[32]

National Counterproliferation Center

The National Counterproliferation Center, a policy and program oversight organization within the Office of the Director of National Intelligence, is seeking to bring a unified, strategic perspective to microbial forensics (bioforensics) research and development and its application to intelligence purposes. Microbial forensics is a "developing interdisciplinary field of microbiology devoted to the development, assessment, and validation of methods to fully characterize microbial samples for the ultimate purpose of high confidence comparative analysis."[33]

[32] J. Burans, Bioforensics Program Manager, National Bioforensics Analysis Center. Presentation to the committee. September 21, 2007.

[33] C.L. Cooke, Jr., Office of the Deputy Director for Strategy and Evaluation, National Counterproliferation Center. Presentation to the committee. September 21, 2007.

Copyright © National Academy of Sciences. All rights reserved.

RESEARCH FUNDING

Nearly all forensic science research funds are channeled through DOJ. NIJ and the FBI are the two primary federal sources of funding for forensic science research.

National Institute of Justice (NIJ)

NIJ provides the bulk of funds for research. The BJS 2002 census found that of the 12 percent of laboratories that had resources dedicated to research, the primary source of funding for this research was NIJ.

NIJ has two operating offices: (1) the Office of Research and Evaluation develops, conducts, directs, and supervises research and evaluation activities across a wide variety of issues and (2) the Office of Science and Technology manages technology research and development, the development of technical standards, testing, forensic science capacity building, and technology assistance to state and local law enforcement and corrections agencies.[34] NIJ's forensic science programs relevant to research include the President's DNA Initiative; General Forensics R&D; the Forensic Resource Network; and Electronic Crime. These programs vary in their direct support of research. Research decisions are managed through a peer-review process.[35] Total expenditures for forensic research were $78 million in FY 2002, but they decreased to $33 million by FY 2009. According to John Morgan, Deputy Director, NIJ, the agency is able to fund 5 to 7 percent of the applications submitted.[36] Commentators have noted that NIJ funds often are not awarded to working members of the forensic science community.[37]

In 2003, the President announced a five-year, $1 billion initiative to improve the use of DNA in the criminal justice system. The President's DNA Initiative pushed for increased funding, training, and assistance to ensure that DNA technology "reaches its full potential to solve crimes, protect the innocent, and identify missing persons."[38] Congress has appropriated more than $300 million to date for the initiative, although only a small fraction is directed toward research. Since 2003, DOJ has made grants in excess of $26 million for new research on forensic tools and techniques,[39] with grants tending to go to population geneticists, medical geneticists, molecular biolo-

[34] See www.ojp.gov/nij/about_rsrchpri.htm#1.

[35] J. Morgan, Deputy Director National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. Presentation to the committee. January 25, 2007.

[36] Ibid.

[37] K. Pyrek. 2007. *Forensic Science Under Siege: The Challenges of Forensic Laboratories and the Medico-Legal Investigation System.* Burlington, MA: Academic Press (Elsevier), p. 448.

[38] See www.dna.gov/info/e_summary.

[39] Morgan, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

gists, technology experts, and crime laboratory personnel. The bulk of the funding has gone to state and local law enforcement agencies to support the examination of nearly 104,000 DNA cases from 2004 to 2007 and 2,500,000 convicted offender and arrestee samples, which will be added to the national DNA database. More than 5,000 "hits," or matches to unknown profiles or other cases, have resulted from these efforts. In 2008, NIJ expects to fund the testing of an additional 9,000 backlogged cases and more that 834,000 backlogged convicted offender and arrestee samples.[40]

Under the General Forensics R&D Program, 53 awards have been made through 2007 for the development of "tools and technologies that will allow faster, more reliable, more robust, less costly, or less labor-intensive identification, collection, preservation, and/or analysis of forensic evidence; tools that provide a quantitative measure or statistical evaluation of forensic comparisons; and identification or characterization of new analytes of forensic importance."[41] In FY 2007, solicitations were issued for proposals in Research and Development on Crime Scene Tools, Techniques, and Technologies; Research and Development on Impression Evidence; Research and Development in the Forensic Analysis of Fire and Arson Evidence; and Forensic Toxicology Research and Development.

The size of the NIJ research program warrants comparison with other research programs. In FY 2007, NIJ awarded 21 grants for forensic research and development (not including awards for DNA research) (see Box 2-2). As will be seen in Chapter 5, the number of open research questions about the more common forensic science methods greatly exceeds 21, and none of these open questions appear to be squarely addressed by the projects listed in Box 2-2. The 2007 NIJ awards totaled nearly $6.6 million, with an average award size of $314,000. As a comparison, in the same year, the National Institutes of Health awarded 37,275 research project grants, averaging $359,000, for a total of $15 billion.[42] Also in FY 2007, the National Science Foundation made over 11,500 research project awards for a total of $6.0 billion.[43]

NIJ's Forensic Resource Network is a system of four forensic centers whose mission is to assist state and local forensic service providers in achieving their service delivery goals through research and development, testing and evaluation, training, technology transfer, and technology assistance.

The NIJ Electronic Crime Portfolio addresses "the practical needs of the criminal justice community in its efforts to respond to electronic crime,

[40]Statement of J.S. Morgan, Deputy Director National Institute of Justice, Office of Justice Programs, U.S. Department of Justice, before the U.S. Senate Committee on the Judiciary concerning "Oversight of the Justice For All Act: Has the Justice Department Effectively Administered the Bloodsworth and Coverdell DNA Grant Programs?" January 23, 2008.

[41]Morgan, 2007, op. cit.

[42]See http://report.nih.gov/index.aspx?section=NIHFunding.

[43]See www.nsf.gov/news/news_summ.jsp?cntn_id=105803.

Copyright © National Academy of Sciences. All rights reserved.

aiding/assisting law enforcement in the discovery, analysis, presentation and preservation of digital evidence of probative value."[44]

In September 2007, NIJ announced the addition of four Technology Centers of Excellence to serve as resources within their respective technology focus areas by providing technology assistance to law enforcement personnel as well as by working with technology developers and users to test and evaluate equipment in operational environments. In addition, NIJ set aside $5 million for grants to support the development of forensic science standards at NIST.[45]

Federal Bureau of Investigation (FBI)

The FBI Laboratory also receives roughly $33 million per year for its own research. To set priorities, the laboratory consults with its own staff and with working-level scientists in the SWGs they support.

The FBI's Counterterrorism and Forensic Science Research Unit "provides technical leadership/advancement of counterterrorism and forensic sciences for the FBI as well as for state and local law enforcement agencies through the development and validation of new technologies/techniques by both internal and outsourced research efforts and through advanced scientific training in specialized forensic procedures."[46] It fulfills its research mission through two core programs.

The Research and Development Program creates and coordinates the development of new forensic techniques, instrumentation, and protocols for FBI Laboratory units to use in terrorism and violent crime cases. The program focuses its efforts in the areas of DNA analysis, trace organic chemical analysis, toxicology, explosives, fingerprints, drug and materials analysis (e.g., paints, tapes, inks, glass, and metals), database development, anthropology, microbial forensics, and field instrumentation. The committee was told that the program publishes some of its results in scientific journals. The Research Partnership Program transfers new forensic technologies and procedures to case-working examiners at state and local crime laboratories through collaborative studies and implements SWG-defined protocols and national forensic databases. Workshops include those involving the use of an automotive carpet fiber database, messenger RNA (mRNA) profiling of human semen, the visualization and identification of pepper spray on evidentiary materials, 1-step purification of DNA from different matrices, and the permanence of friction ridge skin detail.

---

[44] Ibid.

[45] J. Morgan, Deputy Director for Science and Technology, NIJ. Presentation to the committee. January 25, 2007.

[46] See www.fbi.gov/hq/lab/html/cterror1.htm.

Copyright © National Academy of Sciences. All rights reserved.

Box 2-2
FY 2007 NIJ Awards for Forensic Science Research and Development

Biometric Technologies

Automatic Fingerprint Matching Using Extended Feature Set, Michigan State University, $260,038
Selective Feature-Based Quality Measure Plug-In for Iris Recognition System, Indiana University, $84,858
Site-Adaptive Face Recognition at a Distance, General Electric Co., $496,341

Forensic DNA Research and Development

A Low-Cost Microfluidic Microarray Instrument for Typing Y-Chromosome Single Nucleotide Polymorphisms (SNPs), Akonni Biosystems, Inc., $448,466
A Rapid, Efficient and Effective Assay to Determine Species Origin in Biological Materials, Bode Technology Group, Inc., $170,212
DNA Profiling of the Semen Donor in Extended Interval Post-Coital Samples, University of Central Florida, $271,504
Microfabricated Capillary Array Electrophoresis Genetic Analysis for Forensic Short Tandem Repeat DNA Profiling, Regents of the University of California, $592,183
National Institute of Justice Forensic DNA Research and Development, Network Biosystems, Inc., $497,346
National Institute of Justice Forensic DNA Research and Development in Vermont for Fiscal Year 2007,Vermont Department of Public Safety, $112,481
Population Genetics of Single Nucleotide Polymorphisms (SNPs) for Forensic Purposes, Yale University, $680,516
Sperm Capture Using Aptamer-Based Technology, Denver, City and County of, $370,813

PROFESSIONAL ASSOCIATIONS

Numerous professional organizations are focused on the forensic science disciplines (see Box 2-3). The Consortium of Forensic Science Organizations, founded in 2000, includes the largest of these organizations—the American Academy of Forensic Sciences (AAFS), ASCLD, ASCLD/LAB, IAI, NAME, and Forensic Quality Services (FQS).

AAFS, with 6,000 members worldwide, was founded in 1948. It created and supports the Forensic Specialties Accreditation Board, which accredits

Copyright © National Academy of Sciences. All rights reserved.

Tools for Improving the Quality of Aged, Degraded, Damaged or Otherwise Compromised DNA Evidence, Louisiana State University, $580,337
Y Chromosome Whole Genome Analysis Strategies: Improved Detection of Male DNA, University of Central Florida, $324,705

Research and Development on Crime Scene Tools, Techniques and Technologies

Detecting Buried Firearms Using Multiple Geophysical Technologies, University of Central Florida, $89,584
Developing Fluorogenic Reagents for Detecting and Enhancing Bloody Fingerprints, Portland State University, $168,904
Electronic Fingerprint Development Device "Fuma-Room," Mountain State University, $61,152
Investigations on the Use of Sample Matrix to Collect and Stabilize Crime Scene Biological Evidence for Optimized Analysis and Room Temperature Storage, California State University, Los Angeles, University Auxiliary Services, $353,449
Rapid Visualization of Biological Fluids at Crime Scenes Using Optical Spectroscopy, University of South Carolina Research Foundation, $382,394

Research and Development on Impression Evidence

Analysis of Footwear Impression Evidence, Research Foundation of the State University of New York, $350,172
The Use of Infrared Imaging, a Robust Matching Engine and Associated Algorithms to Enhance Identification of Both 2-D and 3-D Impressions: Phase 1, SED Technology, LLC, $295,247

SOURCE: www.ojp.usdoj.gov/nij/awards/2007.htm#solvingcoldcaseswithdna.

certification organizations.[47] Membership includes physicians, attorneys, dentists, toxicologists, physical anthropologists, document examiners, psychiatrists, physicists, engineers, criminalists, educators, and others. AAFS sponsors an annual scientific meeting, publishes the *Journal of Forensic Sciences*, and promotes research, education, and training. It also operates the Forensic Science Education Programs Accreditation Commission (see Chapter 8 for further discussion).[48]

[47] See www.thefasb.org.

[48] B.A. Goldberger, AAFS President-Elect. Presentation to the committee. January 25, 2007.

Copyright © National Academy of Sciences. All rights reserved.

Box 2-3
Forensic Associations and Societies

American Academy of Forensic Sciences
American Board of Criminalistics
American Board of Forensic Anthropology
American Board of Forensic Odontology
American Board of Forensic Toxicology
American Society for Quality
American Society for Testing and Materials
American Society of Crime Laboratory Directors
American Society of Questioned Document Examiners
AOAC International
Association of Firearm & Tool Marks Examiners
Association of Forensic Quality Assurance Managers
California Association of Criminalistics
Canadian Society of Forensic Sciences
Council of Federal Forensic Crime Laboratory Directors
Forensic Science Society
International Association for Identification
International Association of Arson Investigators
International Association of Bloodstain Pattern Analysts
International Association of Coroners and Medical Examiners
International Association of Forensic Nurses
International Association of Forensic Toxicologists
Mid-Atlantic Association of Forensic Scientists
Midwestern Association of Forensic Scientists
National Association of Medical Examiners
National Center of Forensic Science
National Forensic Science Technology Center
New Jersey Association of Forensic Scientists
Northeastern Association of Forensic Scientists
Northwest Association of Forensic Scientists
Society of Forensic Toxicologists
Southern Association of Forensic Science
Southwestern Association of Forensic Scientists
Wisconsin Association for Identification

IAI was founded in 1915 and has 6,700 members worldwide. Its members tend to be involved at the "front end" of the process—crime scene investigation, evidence collection, and evidence preservation.[49] It operates certification programs in seven disciplines and publishes the *Journal of*

[49] J. Polski, IAI Chief Operations Officer. Presentation to the committee. January 25, 2007.

Copyright © National Academy of Sciences. All rights reserved.

Forensic Identification. The focus of its activities is pattern evidence—for example, fingerprint, footwear, tire track, questioned documents, forensic photography, and forensic art.

ASCLD/LAB and FQS accredit crime laboratories and are discussed in greater detail in Chapter 7. Chapter 9 describes the activities of NAME.

CONCLUSIONS AND RECOMMENDATION

The fragmented nature of the forensic science community makes it difficult to gather data on the entire universe of forensic service entities and activities, although efforts have been made to collect data on publicly funded crime laboratories and nonlaboratory-based providers. For example, the committee could find no data available on for-profit forensic service providers, other than on DNA laboratories. Thus, attempts to construct effective policies are hampered by the lack of coherent and consistent information on the forensic science infrastructure in the United States. However, the large amount of information provided to the committee by people engaged in the forensic science enterprise and by experts who have studied how well that enterprise functions all points to a system that lacks coordination and that is underresourced in many ways.

By using the term "underresourced," the committee means to imply all of its dimensions. Existing data suggest that forensic laboratories are underresourced and understaffed, which contributes to a backlog in cases and likely makes it difficult for laboratories to do as much as they could to inform investigations, provide strong evidence for prosecutions, and avoid errors that could lead to imperfect justice. But underresourced also means that the tools of forensic science are not as strong as they could be. The knowledge base that underpins analysis and the interpretation of evidence—which enable the forensic science disciplines to excel at informing investigations, providing strong evidence for prosecutions, and avoiding errors that could lead to imperfect judgment—is incomplete in important ways. NIJ is the only federal agency that provides direct support to crime laboratories to alleviate the backlog, and those funds are minimal. The enterprise also is underresourced in the sense that it has only thin ties to an academic research base that could undergird the forensic science disciplines and fill knowledge gaps. This underresourcing limits the ability of the many hard-working and conscientious people in the forensic science community to do their best work.

Among the various facets of underresourcing, the committee is most concerned about the knowledge base, which is further examined in Chapter 5. Adding more dollars and people to the enterprise might reduce case backlogs, but it will not address fundamental limitations in the capability of the forensic science disciplines to discern valid information from crime scene

Copyright © National Academy of Sciences. All rights reserved.

evidence. For the most part, it is impossible to discern the magnitude of those limitations, and reasonable people will differ on their significance.

Forensic science research is not well supported, and there is no unified strategy for developing a forensic science research plan across federal agencies. Relative to other areas of science, the forensic science disciplines have extremely limited opportunities for research funding. Although the FBI and NIJ have supported some research in the forensic science disciplines, the level of support has been well short of what is necessary for the forensic science community to establish strong links with a broad base of research universities and the national research community. Moreover, funding for academic research is limited and requires law enforcement collaboration, which can inhibit the pursuit of more fundamental scientific questions essential to establishing the foundation of forensic science. Finally, the broader research community generally is not engaged in conducting research relevant to advancing the forensic science disciplines.

The forensic science community also is hindered by its extreme disaggregation—marked by multiple types of practitioners with different levels of education and training and different professional cultures and standards for performance. Many forensic scientists are given scant opportunity for professional activities such as attending conferences or publishing their research, which could help strengthen that professional community. Furthermore, the fragmented nature of the forensic science community raises the worrisome prospect that the quality of evidence presented in court, and its interpretation, can vary unpredictably according to jurisdiction.

Numerous professional associations are organized around the forensic science disciplines, and many of them are involved in training and education (see Chapter 8) and developing standards and accreditation and certification programs (see Chapter 7). The efforts of these groups are laudable. However, except for the largest organizations, it is not clear how these associations interact or the extent to which they share requirements, standards, or policies. Thus, there is a need for more consistent and harmonized requirements.

In the course of its deliberations and review of the forensic science community, it became obvious to the committee that truly meaningful advances will not come without significant leadership from the federal government. The forensic science community lacks the necessary governance structure to pull itself up from its current weaknesses. Insufficiencies in the current system cannot be addressed simply by increasing the staff within existing crime laboratories and medical examiners offices. Of the many professional societies that serve the forensic science community, none is dominant, and none has clearly articulated the need for change or presented a vision for accomplishing it. And clearly no municipal or state forensic office has the mandate to lead the entire community. The major federal resources—NIJ

Copyright © National Academy of Sciences. All rights reserved.

and the FBI Laboratory—have provided modest leadership, for which they should be commended. NIJ has contributed a helpful research program and the FBI Laboratory has spearheaded the SWGs. But again, neither entity has recognized, let alone articulated, a need for change or a vision for affecting it. Neither has the full confidence of the larger forensic science community. And because both are part of a prosecutorial department of the government, they could be subject to subtle contextual biases that should not be allowed to undercut the power of forensic science.

The forensic science community needs strong governance to adopt and promote an aggressive, long-term agenda to help strengthen forensic science. Governance must be strong enough—and independent enough—to identify the limitations of forensic science methodologies and must be well connected with the Nation's scientific research base in order to affect meaningful advances in forensic science practices. The governance structure must be able to create appropriate incentives for jurisdictions to adopt and adhere to best practices and promulgate the necessary sanctions to discourage bad practices. It must have influence with educators in order to effect improvements to forensic science education. It must be able to identify standards and enforce them. The governance entity must be geared toward (and be credible within) the law enforcement community, but it must have strengths that extend beyond that area. Oversight of the forensic science community and medical examiner system will sweep broadly into areas of criminal investigation and prosecution, civil litigation, legal reform, investigation of insurance claims, national disaster planning and preparedness, homeland security, certification of federal, state, and local forensic practitioners, public health, accreditation of public and private laboratories, research to improve forensic methodologies, education programs in colleges and universities, and advancing technology.

The committee considered whether such a governing entity could be established within an existing federal agency. The National Science Foundation (NSF) was considered because of its strengths in leading research and its connections to the research and education communities. NSF is surely capable of building and sustaining a research base, but it has very thin ties to the forensic science community. It would be necessary for NSF to take many untested steps if it were to assume responsibility for the governance of applied fields of science. The committee also considered NIST. In the end analysis, however, NIST did not appear to be a viable option. It has a good program of research targeted at forensic science and law enforcement, but the program is modest. NIST also has strong ties to industry and academia, and it has an eminent history in standard setting and method development. But its ties to the forensic science community are still limited, and it would not be seen as a natural leader by the scholars, scientists, and practitioners in the field. In sum, the committee concluded that neither NSF nor NIST has

Copyright © National Academy of Sciences. All rights reserved.

the breadth of experience or institutional capacity to establish an effective governance structure for the forensic science enterprise.

There was also a strong consensus in the committee that no existing or new division or unit within DOJ would be an appropriate location for a new entity governing the forensic science community. DOJ's principal mission is to enforce the law and defend the interests of the United States according to the law. Agencies within DOJ operate pursuant to this mission. The FBI, for example, is the investigative arm of DOJ and its principal missions are to produce and use intelligence to protect the Nation from threats and to bring to justice those who violate the law. The work of these law enforcement units is critically important to the Nation, but the scope of the work done by DOJ units is much narrower than the promise of a strong forensic science community. Forensic science serves more than just law enforcement; and when it does serve law enforcement, it must be equally available to law enforcement officers, prosecutors, and defendants in the criminal justice system. The entity that is established to govern the forensic science community cannot be principally beholden to law enforcement. The potential for conflicts of interest between the needs of law enforcement and the broader needs of forensic science are too great. In addition, the committee determined that the research funding strategies of DOJ have not adequately served the broad needs of the forensic science community. This is understandable, but not acceptable when the issue is whether an agency is best suited to support and oversee the Nation's forensic science community. In sum, the committee concluded that advancing science in the forensic science enterprise is not likely to be achieved within the confines of DOJ. Moreover, DHS is too focused on national security to embed a new entity within it.

The committee thus concluded that no existing agency has the capacity or appropriate mission to take on the roles and responsibilities needed to govern and improve the forensic science community. The tasks assigned to it require that it be unfettered and objective and as free from bias as possible. What is needed is a new, strong, and independent entity with no ties to the past and with the authority and resources to implement a fresh agenda designed to address the many problems found by the committee and discussed in the remainder of this report.

The proposed entity must meet the following minimum criteria:

- It must have a culture that is strongly rooted in science, with strong ties to the national research and teaching communities, including federal laboratories.
- It must have strong ties to state and local forensic entities, as well as to the professional organizations within the forensic science community.

Copyright © National Academy of Sciences. All rights reserved.

- It must not be in any way committed to the existing system, but should be informed by its experiences.
- It must not be part of a law enforcement agency.
- It must have the funding, independence, and sufficient prominence to raise the profile of the forensic science disciplines and push effectively for improvements.
- It must be led by persons who are skilled and experienced in developing and executing national strategies and plans for standard setting; managing accreditation and testing processes; and developing and implementing rulemaking, oversight, and sanctioning processes.

No federal agency currently exists that meets all of these criteria.

Recommendation 1:

To promote the development of forensic science into a mature field of multidisciplinary research and practice, founded on the systematic collection and analysis of relevant data, Congress should establish and appropriate funds for an independent federal entity, the National Institute of Forensic Science (NIFS). NIFS should have a full-time administrator and an advisory board with expertise in research and education, the forensic science disciplines, physical and life sciences, forensic pathology, engineering, information technology, measurements and standards, testing and evaluation, law, national security, and public policy. NIFS should focus on:

(a) establishing and enforcing best practices for forensic science professionals and laboratories;
(b) establishing standards for the mandatory accreditation of forensic science laboratories and the mandatory certification of forensic scientists and medical examiners/forensic pathologists—and identifying the entity/entities that will develop and implement accreditation and certification;
(c) promoting scholarly, competitive peer-reviewed research and technical development in the forensic science disciplines and forensic medicine;
(d) developing a strategy to improve forensic science research and educational programs, including forensic pathology;
(e) establishing a strategy, based on accurate data on the forensic science community, for the efficient allocation of

Copyright © National Academy of Sciences. All rights reserved.

available funds to give strong support to forensic methodologies and practices in addition to DNA analysis;

(f) funding state and local forensic science agencies, independent research projects, and educational programs as recommended in this report, with conditions that aim to advance the credibility and reliability of the forensic science disciplines;

(g) overseeing education standards and the accreditation of forensic science programs in colleges and universities;

(h) developing programs to improve understanding of the forensic science disciplines and their limitations within legal systems; and

(i) assessing the development and introduction of new technologies in forensic investigations, including a comparison of new technologies with former ones.

The benefits that will flow from a strong, independent, strategic, coherent, and well-funded federal program to support and oversee the forensic science disciplines in this country are clear: The Nation will (1) bolster its ability to more accurately identify true perpetrators and exclude those who are falsely accused; (2) improve its ability to effectively respond to, attribute, and prosecute threats to homeland security; and (3) reduce the likelihood of convictions resting on inaccurate data. Moreover, establishing the scientific foundation of the forensic science disciplines, providing better education and training, and requiring certification and accreditation will position the forensic science community to take advantage of current and future scientific advances.

The creation of a new federal entity undoubtedly will pose challenges, not the least of which will be budgetary constraints. The committee is not in a position to estimate how much it will cost to implement the recommendations in this report; this is a matter best left to the expertise of the Congressional Budget Office. What is clear, however, is that Congress must take aggressive action if the worst ills of the forensic science community are to be cured. Political and budgetary concerns should not deter bold, creative, and forward-looking action, because the country cannot afford to suffer the consequences of inaction. It will also take time and patience to implement the recommendations in this report. But this is true with any large, complex, important, and challenging enterprise.

The committee strongly believes that the greatest hope for success in this enterprise will come with the creation of NIFS to oversee and direct the forensic science community. The remaining recommendations in this report are crucially tied to the creation of NIFS. However, each recom-

Copyright © National Academy of Sciences. All rights reserved.

mendation is a separate, essential piece of the plan to improve the forensic science community in the United States. Therefore, even if the creation of NIFS is forestalled, the committee vigorously supports the adoption of the core ideas and principles embedded in the additional recommendations that appear in this report.

Copyright © National Academy of Sciences. All rights reserved.

Copyright © National Academy of Sciences. All rights reserved.

3

The Admission of Forensic Science Evidence in Litigation

This chapter describes the legal system's reliance on forensic science evidence in criminal prosecutions and examines the existing adversarial process for admitting this type of evidence. The report describes and analyzes the current situation and makes recommendations for the future. No judgment is made about past convictions and no view is expressed as to whether courts should reassess cases that already have been tried. The report finds that the existing legal regime—including the rules governing the admissibility of forensic evidence, the applicable standards governing appellate review of trial court decisions, the limitations of the adversary process, and judges and lawyers who often lack the scientific expertise necessary to comprehend and evaluate forensic evidence—is inadequate to the task of curing the documented ills of the forensic science disciplines. This matters a great deal, because "forensic science is but the handmaiden of the legal system."[1] As explained in Chapters 4 and 5, there are serious issues regarding the capacity and quality of the current forensic science system; yet, the courts continue to rely on forensic evidence without fully understanding and addressing the limitations of different forensic science disciplines. This profound conjunction of law and science, especially in the context of law enforcement, underscores the need for improvement in the

[1] 4 D.L. Faigman, M.J. Saks, J. Sanders, and E.K. Cheng. 2007-2008. *Modern Scientific Evidence: The Law and Science of Expert Testimony.* Eagan, MN: Thomson/West, § 29.4, p.6. See also P.C. Giannelli and E.J. Imwinkelried. 2007. *Scientific Evidence,* 4th ed. Albany, NY: Lexis Publishing Co., on the latest forensic techniques and scientific concepts used in collecting and evaluating evidence.

Copyright © National Academy of Sciences. All rights reserved.

forensic science community. The report concludes that every effort must be made to limit the risk of having the reliability of certain forensic science methodologies judicially certified before the techniques have been properly studied and their accuracy verified.

LAW AND SCIENCE

Science and law always have had an uneasy alliance:

> Since as far back as the fourteenth century, scientific evidence has posed profound challenges for the law. At bottom, many of these challenges arise from fundamental differences between the legal and scientific processes. . . . The legal system embraces the adversary process to achieve "truth," for the ultimate purpose of attaining an authoritative, final, just, and socially acceptable resolution of disputes. Thus law is a normative pursuit that seeks to define how public and private relations *should* function. . . . In contrast to law's vision of truth, however, science embraces empirical analysis to discover truth as found in verifiable facts. Science is thus a descriptive pursuit, which does not define how the universe should be but rather describes how it actually *is*.
>
> These differences between law and science have engendered both systemic and pragmatic dilemmas for the law and the actors within it. . . . Moreover, in almost every instance, scientific evidence tests the abilities of judges, lawyers, and jurors, all of whom may lack the scientific expertise to comprehend the evidence and evaluate it in an informed manner.[2]

Nowhere are these dilemmas more evident than in decisions pertaining to the admissibility of forensic science evidence proffered in criminal trials.

Forensic science experts and evidence are routinely used in the service of the criminal justice system. DNA testing may be used to determine whether sperm found on a rape victim came from an accused party; a latent fingerprint found on a gun may be used to determine whether a defendant handled the weapon; drug analysis may be used to determine whether pills found in a person's possession were illicit; and an autopsy may be used to determine the cause of death of a murder victim. In order for qualified forensic science experts to testify competently about forensic evidence, they must first find the evidence in a usable state and properly preserve it. A latent fingerprint that is badly smudged when found cannot be usefully saved, analyzed, or explained. An inadequate drug sample may be insufficient to allow for proper analysis. And, DNA tests performed on a contaminated

[2] Developments in the law—confronting the new challenges of scientific evidence. 108 HARV. L. REV. 1481, 1484 (1995) (hereinafter "Developments in the law") (footnotes omitted); see also M.A. Berger and L.M. Solan. The uneasy relationship between science and law: An essay and introduction. 73 BROOK. L. REV. 847 (2008).

Copyright © National Academy of Sciences. All rights reserved.

or otherwise compromised sample cannot reliably identify or eliminate an individual as the perpetrator of a crime. These are important matters having to do with the proper "processing" of forensic evidence. The law's greatest dilemma in its heavy reliance on forensic evidence, however, concerns the question of whether—and to what extent—there is *science* in any given "forensic science" discipline.[3]

The degree of science in a forensic science method may have an important bearing on the reliability of forensic evidence in criminal cases. There are two very important questions that *should* underlie the law's admission of and reliance upon forensic evidence in criminal trials: (1) the extent to which a particular forensic discipline is founded on a reliable scientific methodology that gives it the capacity to accurately analyze evidence and report findings and (2) the extent to which practitioners in a particular forensic discipline rely on human interpretation that could be tainted by error, the threat of bias, or the absence of sound operational procedures and robust performance standards. These questions are significant:[4] The goal of law enforcement actions is to identify those who have committed crimes and to prevent the criminal justice system from erroneously convicting the innocent. So it matters a great deal whether an expert is qualified to testify about forensic evidence and whether the evidence is sufficiently reliable to merit a fact finder's reliance on the truth that it purports to support.

As discussed in Chapters 4 and 5, no forensic method other than nuclear DNA analysis has been rigorously shown to have the capacity to consistently and with a high degree of certainty support conclusions about "individualization" (more commonly known as "matching" of an unknown item of evidence to a specific known source). In terms of scientific basis, the analytically based disciplines generally hold a notable edge over disciplines based on expert interpretation. But there also are important variations among the disciplines relying on expert interpretation. For example, there are more established protocols and available research for the analysis of fingerprints than for bite marks. In addition, there also are significant variations within each discipline. Thus, not all fingerprint evidence is equally good, because the true value of the evidence is determined by the quality of the latent fingerprint image. In short, the interpretation of forensic evidence is not infallible. Quite the contrary. This reality is not always fully appre-

[3] Principles of science are discussed in Chapter 4.

[4] Descriptions and assessments of different forensic science disciplines are set forth in Chapters 5 and 6.

Copyright © National Academy of Sciences. All rights reserved.

ciated or accepted by many forensic science practitioners, judges, jurors, policymakers, or lawyers and their clients.[5]

THE *FRYE* STANDARD AND RULE 702 OF THE FEDERAL RULES OF EVIDENCE

During the twentieth century, as science advanced, the legal system "attempted to develop coherent tests for the admissibility of scientific evidence."[6] The first notable development occurred in 1923 with the issuance of the landmark decision in *Frye v. United States*.[7] The *Frye* case involved a murder trial in which the defendant sought to demonstrate his innocence through the admission of a lie detector test that measured systolic blood pressure. The court rejected the evidence, stating:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.[8]

The *Frye* decision held that the lie detector test was unreliable because it had not gained "general acceptance" in the relevant scientific community. The meaning of the *Frye* test is elusive. Indeed, "[t]he merits of the *Frye* test have been much debated, and scholarship on its proper scope and application is legion."[9] For many years, the *Frye* test was cited in both civil and criminal cases, but it was applied most frequently in criminal cases.[10] "In the 70 years since its formulation in the *Frye* case, the 'general acceptance'

---

[5] See 4 Faigman et al., op. cit., *supra* note 1, §29.3, p. 6 ("Few forensic scientists harbor serious misgivings about the expectation of good science on the part of their clients, be they the police, the prosecution, or the defense bar. . . . The clients want good science and the truth if it will help their case."); S. Scarborough. 2005. They keep putting fingerprints in print. *The CACNews*. California Association of Criminalists, 2nd Quarter. Available at www.cacnews.org/news/2ndq05.pdf, p. 19 ("As scientists we are confident that any 'critic' that tries to prove the fallibility of fingerprints will actually find the opposite. Just as we testify to everyday.").

[6] Developments in the law, *supra* note 2, p. 1486.

[7] *Frye v. United States*, 54 App. D.C. 46, 293 F. 1013 (1923).

[8] Ibid., p. 1014.

[9] *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 586 & n.4 (1993) (citing authorities).

[10] P.C. Giannelli. 1993. "Junk science": The criminal cases. *Journal of Criminal Law and Criminology* 84:105, 111, and n.35.

Copyright © National Academy of Sciences. All rights reserved.

test [was] the dominant standard for determining the admissibility of novel scientific evidence at trial."[11]

In 1975, more than a half-century after *Frye* was decided, the Federal Rules of Evidence were promulgated to guide criminal and civil litigation in federal courts. The first version of Federal Rule of Evidence 702 provided that:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.[12]

In place of *Frye*'s requirement of general scientific acceptance, mere "assistance" to the trier of fact appeared to be "the touchstone of admissibility under Rule 702."[13]

After the promulgation of Rule 702, litigants, judges, and legal scholars remained at odds over whether the rule embraced the *Frye* standard or established a new standard.[14] There was also much controversy surrounding the application of Rule 702 in civil cases. Most notably, Peter Huber popularized the now well-known phrase "junk science" to criticize the judiciary's acceptance of unreliable expert testimony in support of tort claims.[15] Huber's study was sharply criticized,[16] but it nonetheless spurred a debate over the use of expert testimony in the courts. However, "[d]espite the highly visible efforts to reform the rules governing experts in the civil arena, the 'junk science' debate . . . all but ignored criminal prosecutions."[17] The "neglect of the problems of expert testimony in criminal prosecutions" was seen by some as "deplorable."[18]

---

[11] *Daubert*, 509 U.S. at 585.

[12] FED. R. EVID. 702, P.L. No. 93-595, § 1, 88 Stat. 1926 (effective January 2, 1975).

[13] Giannelli, op. cit., *supra* note 10, p. 107.

[14] T. Lyons. 1997. *Frye, Daubert* and where do we go from here? *Rhode Island Bar Journal* 45(5):21 (stating that "the vast majority of federal circuit and other courts adopted *Frye* as the standard of admissibility in their jurisdictions").

[15] P.W. Huber. 1991. *Galileo's Revenge: Junk Science in the Courtroom*. New York: Basic Books.

[16] See, e.g., K.J. Chesebro. *Galileo's* retort: Peter Huber's junk scholarship. 42 AM. U. L. REV. 1637 (1993); Book Note: Rebel without a cause. 105 HARV. L. REV. 935 (1992).

[17] Giannelli, op. cit., *supra* note 10, p. 110.

[18] Ibid., pp. 110-111. Over time, a number of courts and commentators found the "general acceptance" test seriously wanting. See 1 Faigman et al., op. cit., *supra* note 1, § 1:6, pp. 13-17; P.C. Giannelli. The admissibility of novel scientific evidence: *Frye v. United States*, a half-century later. 80 COLUM. L. REV. 1197, 1207-1208 (1980) ("[T]he problems *Frye* has engendered—the difficulties in applying the test and the anomolous results it creates—so far outweigh [its] advantages that the argument for adopting a different test has become overwhelming."); M. McCormick. Scientific evidence: Defining a new approach to admissibility. 67 IOWA L. REV. 879, 915 (1982) (*Frye*'s "main drawbacks are its inflexibility, confusion of

Copyright © National Academy of Sciences. All rights reserved.

THE *DAUBERT* DECISION AND THE SUPREME COURT'S CONSTRUCTION OF RULE 702

In 1993, in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, the Supreme Court finally clarified that Rule 702, not *Frye*, controlled the admission of expert testimony in the federal courts.[19] *Daubert* was a civil case brought by two minor children and their parents, alleging that the children's serious birth defects had been caused by their mothers' prenatal ingestion of Bendectin, a prescription drug marketed by the defendant pharmaceutical company. In support of a motion for summary judgment, the drug company submitted an affidavit from a qualified expert, who stated that he had reviewed all the literature on Bendectin and human birth defects and had found no study showing Bendectin to be a human teratogen (i.e., an agent that can cause malformations of an embryo or fetus). The plaintiffs countered with experts of their own, each of whom concluded that Bendectin could cause birth defects. Their conclusions were based on animal studies that found a link between Bendectin and malformations; pharmacological studies of the chemical structure of Bendectin that purported to show similarities between the structure of the drug and that of other substances known to cause birth defects; and the "reanalysis" of previously published epidemiological (human statistical) studies. The district court held that the expert testimony proffered by the plaintiffs was inadmissible, because their scientific evidence was not sufficiently established to have general acceptance in the field to which it belonged.[20] The court of appeals, citing *Frye*, affirmed the judgment of the district court, declaring that expert opinion based on a methodology that diverges significantly from the procedures accepted by recognized authorities in the field cannot be shown to be generally accepted as a reliable technique.[21] The Supreme Court reversed, holding that the trial court had applied the wrong standard in assessing the expert testimony proffered by the plaintiffs. The case was then remanded for further proceedings.

In construing and applying Rule 702, the *Daubert* Court ruled that a "trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable."[22] The Court rejected the *Frye* test, noting that the drafting history of Rule 702 made no mention of *Frye*,

---

issues, and superfluity."); J.W. Strong. Questions affecting the admissibility of scientific evidence. U. ILL. L.F. 1, 14 (1970) ("The *Frye* standard, however, tends to obscure these proper considerations by asserting an undefinable general acceptance as the principal if not sole determinative factor.").

[19] 509 U.S. 579 (1993).

[20] *Daubert v. Merrell Dow Pharm, Inc.*, 727 F. Supp. 570, 575 (S.D. Cal. 1989).

[21] *Daubert v. Merrell Dow Pharm., Inc.*, 951 F.2d 1128, 1129-30 (9th Cir. 1991).

[22] *Daubert*, 509 U.S. at 589.

Copyright © National Academy of Sciences. All rights reserved.

"and a rigid 'general acceptance' requirement would be at odds with the 'liberal thrust' of the Federal Rules and their 'general approach of relaxing the traditional barriers to 'opinion' testimony.'"[23] The Court indicated that the subject of expert testimony should be "scientific knowledge," so "evidentiary reliability will be based upon scientific validity."[24] The Court also emphasized that, in considering the admissibility of evidence, trial judges should focus "solely" on experts' "principles and methodology," and "not on the conclusions that they generate."[25] In sum, *Daubert*'s requirement that expert testimony pertain to "scientific knowledge" established a standard of "evidentiary reliability."

In explaining this evidentiary standard, the *Daubert* Court pointed to several factors that might be considered by a trial judge: (1) whether a theory or technique can be (and has been) tested; (2) whether the theory or technique has been subjected to peer review and publication; (3) the known or potential rate of error of a particular scientific technique; (4) the existence and maintenance of standards controlling the technique's operation; and (5) a scientific technique's degree of acceptance within a relevant scientific community.[26] In the end, however, the Court emphasized that the inquiry under Rule 702 is "a flexible one."[27] The Court also rejected the suggestion that its liberal construction of Rule 702 would "result in a 'free-for-all' in which befuddled juries are confounded by absurd and irrational pseudoscientific assertions."[28] Rather, the Court expressed confidence in the adversary system, noting that "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence."[29]

---

[23] Ibid., p. 588 (internal citations omitted).

[24] Ibid, p. 590 and n.9 (emphasis omitted).

[25] Ibid., p. 595. In *General Electric Co. v. Joiner*, 522 U.S. 136, 146 (1997), the Court added: "[C]onclusions and methodology are not entirely distinct from one another. Trained experts commonly extrapolate from existing data. But nothing in *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert."

[26] Ibid., pp. 592-94.

[27] Ibid., p. 594. In *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137 (1999), the Court confirmed that the *Daubert* factors do not constitute a definitive checklist or test. *Kumho Tire* importantly held that Rule 702 applies to both scientific and nonscientific expert testimony; the Court also indicated that the *Daubert* factors might be applicable in a trial judge's assessment of the reliability of nonscientific expert testimony, depending upon "the particular circumstances of the particular case at issue." 526 U.S. at 150.

[28] *Daubert*, 509 U.S. at 595.

[29] Ibid., p. 596.

Copyright © National Academy of Sciences. All rights reserved.

Daubert-type questions may be raised by the parties pretrial,[30] or during the course of trial,[31] or *sua sponte* by the trial judge.[32] Sometimes a trial judge will conduct a formal "*Daubert* hearing" before ruling on a party's objection to expert testimony; sometimes, however, the judge will simply entertain a party's objection, hear arguments, and then rule.[33] Judges sometimes rule on the briefs alone, without the benefit of formal arguments. There are any number of questions that might arise concerning the testimony of a forensic science expert or about the forensic evidence itself. These questions might include, *inter alia*, issues relating to one of the five *Daubert* factors or other factors appropriate to the forensic evidence, the relevance of the evidence, the qualifications of the expert, the adequacy of the evidentiary sample about which the expert will be testifying, and the procedures followed in the handling and processing of the evidence. After considering the matter at issue, a trial judge may exclude the evidence in whole or in part, prevent or limit the testimony of the expert witness, or deny the challenge. The Supreme Court has made it clear that trial judges have great discretion in deciding on the admissibility of evidence under Rule 702, and that appeals from *Daubert* rulings are subject to a very narrow abuse-of-discretion standard of review.[34] Most importantly, in *Kumho Tire Co., Ltd. v. Carmichael*, the Court made it clear that "whether *Daubert*'s specific factors are, or are not, reasonable measures of reliability in a particular case is a matter that the law grants the trial judge broad latitude to determine."[35]

THE 2000 AMENDMENT OF RULE 702

In 2000, Rule 702 was amended "in response to *Daubert*."[36] The revised rule provides:

---

[30] See, e.g., *Alfred v. Caterpillar, Inc.*, 262 F.3d 1083, 1087 (10th Cir. 2001). ("[B]ecause *Daubert* generally contemplates a 'gatekeeping' function, not a 'gotcha' junction, [the case law] permits a district court to reject as untimely *Daubert* motions raised late in the trial process.")

[31] See, e.g., *United States v. Alatorre*, 222 F.3d 1098, 1100 (9th Cir. 2000) (holding trial courts are not compelled to conduct pretrial hearings in order to discharge the gatekeeping function under *Daubert* as to expert testimony).

[32] See, e.g., *Hoult v. Hoult*, 57 F.3d 1, 4 (1st Cir. 1995) ("We think *Daubert* does instruct district courts to conduct a preliminary assessment of the reliability of expert testimony, even in the absence of an objection.").

[33] 1 Faigman et al., op. cit., *supra* note 1, § 1.8, p. 23 (stating "[i]n general, most courts considering the matter hold that a separate hearing to determine the validity of the basis for scientific evidence is not required" and discussing cases).

[34] See *Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 142-43 (1997).

[35] *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 153 (1999).

[36] FED. R. EVID. 702 advisory committee's note (2000 Amendments).

Copyright © National Academy of Sciences. All rights reserved.

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.[37]

The commentary accompanying the revised rule[38] recites the "*Daubert* factors" and then goes on to explain that:

> Courts both before and after *Daubert* have found other factors relevant in determining whether expert testimony is sufficiently reliable to be considered by the trier of fact. These factors include:
>
> (1) Whether experts are proposing to testify about matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying.
> (2) Whether the expert has unjustifiably extrapolated from an accepted premise to an unfounded conclusion.[39]
> (3) Whether the expert has adequately accounted for obvious alternative explanations.
> (4) Whether the expert is being as careful as he would be in his regular professional work outside his paid litigation consulting.
> (5) Whether the field of expertise claimed by the expert is known to reach reliable results for the type of opinion the expert would give.[40]

All of these factors remain relevant to the determination of the reliability of expert testimony under the rule as amended.

The commentary accompanying the revised rule also notes that:

---

[37] FED. R. EVID. 702.

[38] FED. R. EVID. 702 advisory committee's note (2000 Amendments) (citations and quotation marks omitted).

[39] The commentary cites *General Electric*, 522 U.S. at 146 (noting that in some cases a trial court "may conclude that there is simply too great an analytical gap between the data and the opinion proffered").

[40] The commentary cites *Kumho Tire*, 526 U.S. at 150 (*Daubert*'s general acceptance factor does not "help show that an expert's testimony is reliable where the discipline itself lacks reliability, as for example, do theories grounded in any so-called generally accepted principles of astrology or necromancy."); *Moore v. Ashland Chem., Inc.*, 151 F.3d 269 (5th Cir. 1998) (en banc) (clinical doctor was properly precluded from testifying to the toxicological cause of the plaintiff's respiratory problem, where the opinion was not sufficiently grounded in scientific methodology); *Sterling v. Velsicol Chem. Corp.*, 855 F.2d 1188 (6th Cir. 1988) (rejecting testimony based on "clinical ecology" as unfounded and unreliable).

Copyright © National Academy of Sciences. All rights reserved.

> [T]he amendment [to Rule 702] does not distinguish between scientific and other forms of expert testimony. The trial court's gatekeeping function applies to testimony by any expert. While the relevant factors for determining reliability will vary from expertise to expertise, the amendment rejects the premise that an expert's testimony should be treated more permissively simply because it is outside the realm of science. An opinion from an expert who is not a scientist should receive the same degree of scrutiny for reliability as an opinion from an expert who purports to be a scientist. Some types of expert testimony will be more objectively verifiable, and subject to the expectations of falsifiability, peer review, and publication, than others. Some types of expert testimony will not rely on anything like a scientific method, and so will have to be evaluated by reference to other standard principles attendant to the particular area of expertise. The trial judge in all cases of proffered expert testimony must find that it is properly grounded, well-reasoned, and not speculative before it can be admitted. The expert's testimony must be grounded in an accepted body of learning or experience in the expert's field, and the expert must explain how the conclusion is so grounded.
>
> The amendment requires that the testimony must be the product of reliable principles and methods that are reliably applied to the facts of the case. While the terms "principles" and "methods" may convey a certain impression when applied to scientific knowledge, they remain relevant when applied to testimony based on technical or other specialized knowledge. For example, when a law enforcement agent testifies regarding the use of code words in a drug transaction, the principle used by the agent is that participants in such transactions regularly use code words to conceal the nature of their activities. The method used by the agent is the application of extensive experience to analyze the meaning of the conversations. So long as the principles and methods are reliable and applied reliably to the facts of the case, this type of testimony should be admitted.
>
> Nothing in this amendment is intended to suggest that experience alone—or experience in conjunction with other knowledge, skill, training or education—may not provide a sufficient foundation for expert testimony. To the contrary, the text of Rule 702 expressly contemplates that an expert may be qualified on the basis of experience. In certain fields, experience is the predominant, if not sole, basis for a great deal of reliable expert testimony. *See, e.g., United States v. Jones*, 107 F.3d 1147 (6th Cir. 1997) (no abuse of discretion in admitting the testimony of a handwriting examiner who had years of practical experience and extensive training, and who explained his methodology in detail). . . . *See also Kumho Tire Co. v. Carmichael*, 119 S. Ct.1167, 1178 (1999) (stating that "no one denies that an expert might draw a conclusion from a set of observations based on extensive and specialized experience.").[41]

[41] FED. R. EVID. 702 advisory committee's note (2000 Amendments).

Copyright © National Academy of Sciences. All rights reserved.

Given this view of Rule 702—which makes clear that "technical or other specialized knowledge" may be credited as expert testimony "so long as the principles and methods are reliable and applied reliably to the facts of the case"—it is not surprising that the courts might be hard pressed, under existing standards of admissibility, to hold some forensic science practitioners to the more demanding standards of the traditional sciences.[42]

AN OVERVIEW OF JUDICIAL DISPOSITIONS OF *DAUBERT*-TYPE QUESTIONS

Assessing the admission of forensic evidence in litigation is no small undertaking, given the huge number of cases in which such evidence is proffered. Moreover, although *Daubert* remains the standard by which admissibility in federal cases is measured under Federal Rule of Evidence 702, states remain free to apply other evidentiary standards. Some states still apply some version of the *Frye* standard, while others have adopted *Daubert* or some version of the *Daubert* test.[43] Considering the patchwork of state standards and the fact that "[s]tate courts receive 200 times more criminal prosecutions than federal courts," because "[f]orensic science is used most commonly in crimes of violence, and most crimes of violence are tried in state court,"[44] a comprehensive overview would be difficult to create.

The focus of this section and succeeding sections of this chapter will be on judicial dispositions of *Daubert*-type questions in criminal cases in the federal courts. The reason for this is that, although not every state has adopted the *Daubert* standard, there is little doubt that *Daubert* has effectively set a norm that applies in every federal court and in a great many state jurisdictions. It cannot be ignored, and the reported federal cases give the best evidence of how *Daubert* is applied by the judiciary.

Judicial dispositions of *Daubert*-type questions in criminal cases have been criticized by some lawyers and scholars who thought that the Supreme Court's decision would be applied more rigorously to protect the rights of accused parties:

> [*Daubert*] obligated trial court judges to assume the role of "gatekeepers" and to exclude proffered scientific evidence unless it rested on scientifically valid reasoning and methodology. Many thought *Daubert* would be the

[42] See generally Giannelli and Imwinkelried, op. cit., for thoughtful discussions of the admissibility of some forms of forensic science testimony as technical or other specialized knowledge under Rule 702.

[43] See generally D.E. Bernstein and J.D. Jackson. The *Daubert* trilogy in the states. 44 JURIMETRICS J. 351 (2004).

[44] P.J. Neufeld. 2005. The (near) irrelevance of *Daubert* to criminal justice: And some suggestions for reform. *American Journal of Public Health* 95(Supp. 1):S107, S110.

Copyright © National Academy of Sciences. All rights reserved.

> meaningful standard that was lacking in criminal cases and that it would serve to protect innocent defendants.
>
> . . .
>
> [However, a]n analysis of post-*Daubert* decisions demonstrates that whereas civil defendants prevail in their *Daubert* challenges, most of the time criminal defendants almost always lose their challenges to government proffers. But when the prosecutor challenges a criminal defendant's expert evidence, the evidence is almost always kept out of the trial. . . . In the first 7 years after *Daubert*, there were 67 reported federal appellate decisions reviewing defense challenges to prosecution experts. The government prevailed in all but 6, and even among the 6, only 1 resulted in the reversal of a conviction. In contrast, in the 54 cases in which the defense appealed a trial court ruling to exclude the defendant's expert, the defendant lost in 44 cases. In 7 of the remaining 10, the case was remanded for a *Daubert* hearing.[45]

This critique of reported federal appellate decisions cannot be the end of the analysis, however. First, there are two sides to any discussion concerning the admissibility and reliability of forensic evidence: (1) enhancing the ability of law enforcement to identify persons who commit crimes and (2) protecting innocent persons from being convicted of crimes that they did not commit. It is easier to assess the latter than the former, because there are no good studies indicating how many convictions are lost because of faulty forensic science evidence. Second, if one focuses solely on federal appellate decisions, the picture is not appealing to those who have preferred a more rigorous application of *Daubert*. Federal appellate courts have not with any consistency or clarity imposed standards ensuring the application of scientifically valid reasoning and reliable methodology in criminal cases involving *Daubert* questions.[46] This is not really surprising. The Supreme Court itself described the *Daubert* standard as "flexible." This means that, beyond questions of relevance, *Daubert* offers appellate courts no clear substantive standard pursuant to which to review decisions by trial courts.[47] As a result, trial judges exercise great discretion in deciding whether to

[45] Ibid., p. S109. See also P.C. Giannelli. Wrongful convictions and forensic science: The need to regulate crime labs. 86 N.C. L. Rev. 163 (2007).

[46] See, e.g., *United States v. Brown*, 415 F.3d 1257 (11th Cir. 2005); *United States v. Havvard*, 260 F.3d 597 (7th Cir. 2001). The *Havvard* decision has been described as "[a]n excellent, albeit deeply troubling, example of a court straining scientific credulity for the sake of a venerable forensic science." See 1 Faigman et al., op. cit., *supra* note 1, § 1:30, pp. 85-86.

[47] As noted above, "whether *Daubert*'s specific factors are, or are not, reasonable measures of reliability in a particular case is a matter that the law grants the trial judge broad latitude to determine." *Kumho Tire*, 526 U.S. at 153.

Copyright © National Academy of Sciences. All rights reserved.

admit or exclude expert testimony, and their judgments are subject only to a highly deferential "abuse of discretion" standard of review.[48]

To get a clearer picture of judicial dispositions of *Daubert*-type questions, we need to know how these matters are handled by trial courts. Unfortunately, the picture is unclear. There are countless *Daubert*-type, evidentiary challenges in criminal cases, some resulting in formal *Daubert* hearings, and many others not. There is no way to know with any degree of certainty how many of these challenges are entirely or partially sustained, because many trial court judgments on evidentiary matters are issued without published opinions[49] and with no appeal. If a defendant's challenge is sustained and is followed by an acquittal, no appeal ensues and the matter is over. If a defendant's challenge is sustained and is followed by a conviction, the defendant obviously will not appeal the favorable evidentiary ruling. If a defendant's challenge is rejected and is followed by an acquittal, no appeal ensues and the matter is over. *Reported* opinions in criminal cases indicate that trial judges sometimes exclude or restrict expert testimony offered by prosecutors;[50] *reported* opinions also indicate that appellate courts routinely deny appeals contesting trial court decisions admitting forensic evidence against criminal defendants.[51] But the reported opinions do not offer in any way a complete sample of federal trial court dispositions of *Daubert*-type questions in criminal cases.[52]

---

[48] *Gen. Elec. Co. v. Joiner*, 522 U.S. 136, 142-43 (1997); see also H.T. Edwards and L.A. Elliott. 2007. *Federal Standards of Review.* St. Paul, MN: Thomson/West, pp. 72-74 (explaining that when a trial judge acts pursuant to broad discretion, appellate court scrutiny is necessarily very limited).

[49] See, e.g., *Hoult*, 57 F.3d at 5 (district courts are not required "to make explicit on-the-record rulings regarding the admissibility of expert testimony"); *United States v. Locascio*, 6 F.3d 924, 938-939 (2d Cir. 1993) ("We decline . . . to shackle the district court with a mandatory and explicit trustworthiness analysis. . . . In fact, we assume that the district court consistently and continually performed a trustworthiness analysis *sub silentio* of all evidence introduced at trial. We will not, however, circumscribe this discretion by burdening the court with the necessity of making an explicit determination for all expert testimony.").

[50] See, e.g., *United States v. Green*, 405 F. Supp. 2d 104 (D. Mass. 2005) (toolmark analysis); *United States v. Mikos*, No. 02-137, 2003 WL 22922197 (N.D. Ill. Dec. 9, 2003) (expert testimony relating to comparative bullet lead analysis); *United States v. Horn*, 185 F. Supp. 2d 530 (D. Md. 2002) (evidence of defendant's performance on field sobriety tests); *United States v. Rutherford*, 104 F. Supp. 2d 1190 (D. Neb. 2000) (handwriting analysis).

[51] See, e.g., *United States v. Ford*, 481 F.3d 215 (3d Cir. 2007); *United States v. Moreland*, 437 F.3d 424 (4th Cir. 2006); *United States v. Brown*, 415 F.3d 1257 (11th Cir. 2005); *United States v. Davis*, 397 F.3d 173 (3d Cir. 2005); *United States v. Conn*, 297 F.3d 548 (7th Cir. 2002); *United States v. Havvard*, 260 F.3d 597 (7th Cir. 2001); *United States v. Malveaux*, 208 F.3d 223 (9th Cir. 2000); *United States v. Harris*, 192 F.3d 580 (6th Cir. 1999).

[52] In 2000, Michael Risinger published a study in which he found that, "as to proffers of asserted expert testimony, civil defendants win their *Daubert* reliability challenges to plaintiffs' proffers most of the time, and that criminal defendants virtually always lose their reliability challenges to government proffers. And, when civil defendants' proffers are challenged by

Copyright © National Academy of Sciences. All rights reserved.

The situation is very different in civil cases. The party who loses before the trial court in a nonfrivolous civil case always has the right and incentive to appeal to contest the admission or exclusion of expert testimony. In addition, plaintiffs and defendants, equally, are more likely to have access to expert witnesses in civil cases, whereas prosecutors usually have an advantage over most defendants in offering expert testimony in criminal cases. And, ironically, the appellate courts appear to be more willing to second-guess trial court judgments on the admissibility of purported scientific evidence in civil cases than in criminal cases.[53]

---

plaintiffs, those defendants usually win, but when criminal defendants' proffers are challenged by the prosecution, the criminal defendants usually lose." D. M. Risinger Navigating expert reliability: Are criminal standards of certainty being left on the dock? 64 ALB. L. REV. 99, 99 (2000). However, the sample of federal district court decisions included "only sixty-five . . . criminal cases, and only fifty-four dealt with dependability issues in a guilt-or-innocence context . . . . These fifty-four cases represented *twelve opinions on defense challenges to prosecution proffers*, and forty-two opinions on government challenges to defense proffers. Of the twelve defense challenges, the government's challenged evidence was fully admitted eleven times, and admitted with restrictions once." Ibid., p. 109 (emphasis added) (footnotes omitted). The study did not include any sample of trial court dispositions of *Daubert*-type claims in which no opinion was issued, which might explain why the study included only 12 dispositions of defense challenges to prosecution proffers. The author speculated that "one can be relatively confident that virtually any decision totally excluding government proffered expertise on dependability grounds would have been the subject of some sort of opinion, at least the first time the decision was made in regard to a particular kind of proffer." Ibid. But there is no reason to believe that this assumption is correct. Trial judges routinely issue evidentiary rulings without reported opinions, and many such rulings might implicate *Daubert*-type questions. Merely because a defense attorney fails to state "I object on *Daubert* grounds" says very little about whether the objection raises an issue that is cognizable under *Daubert*.

[53] See, e.g., *McClain v. Metabolife Int'l, Inc.*, 401 F.3d 1233 (11th Cir. 2005); *Chapman v. Maytag Corp.*, 297 F.3d 682 (7th Cir. 2002); *Goebel v. Denver & Rio Grande W. R.R. Co.*, 215 F.3d 1083 (10th Cir. 2000); *Smith v. Ford Motor Co.*, 215 F.3d 713 (7th Cir. 2000); *Walker v. Soo Line R.R. Co.*, 208 F.3d 581 (7th Cir. 2000); see also 1 Faigman et al., op. cit., *supra* note 1, § 1:35, p. 105 (discussing studies suggesting that courts "employ *Daubert* more lackadaisically in criminal trials—especially in regard to prosecution evidence—than in civil cases—especially in regard to plaintiff evidence"); Risinger, op. cit., *supra* note 52, p. 100 ("The system shipwreck I fear is that in ten years we will find that civil cases are subject to strict standards of expertise quality control, while criminal cases are not. The result would be that the pocketbooks of civil defendants would be protected from plaintiffs' claims by exclusion of undependable expert testimony, but that criminal defendants would not be protected from conviction based on similarly undependable expert testimony. Such a result would seem particularly unacceptable given the law's claim that inaccurate criminal convictions are substantially worse than inaccurate civil judgments, reflected in the different applicable standards of proof.").

Copyright © National Academy of Sciences. All rights reserved.

SOME EXAMPLES OF JUDICIAL DISPOSITIONS OF QUESTIONS RELATING TO FORENSIC SCIENCE EVIDENCE

Judicial Dispositions of Questions Relating to DNA Evidence

> DNA typing has been subjected to the most rigorous scrutiny by the courts, presumably because its discriminating power is so great and so much is at stake when a suspect is associated to a crime scene only through DNA typing. Or perhaps because (at least some) modern courts or lawyers are more literate about science than they were in the past.[54]

Unlike many forensic techniques that were developed empirically within the forensic community, with little foundation in scientific theory or analysis, DNA analysis is a fortuitous byproduct of cutting-edge science. From the beginning, eminent scientists contributed their expertise to ensuring that DNA evidence offered in a courtroom would be valid and reliable,[55] and by 1996 the National Academy of Sciences had convened two committees that issued influential recommendations on the use of DNA technology in forensic science.[56] As a result, principles of statistics and population genetics that pertain to DNA evidence were clarified, the methods for conducting DNA analyses and declaring a match became less subjective, and quality assurance and quality control protocols were designed to improve laboratory performance.

Although some courts initially refused to admit the results of DNA testing because of perceived flaws,[57] DNA evidence is now universally admit-

---

[54] 4 Faigman et al., op. cit., *supra* note 1, § 29:35, p. 41.

[55] See, e.g., *United States v. Yee*, 134 F.R.D. 161 (N.D. Ohio 1991) (hearings held over 6 weeks featuring a total of 12 expert witnesses on the admissibility of DNA evidence); *People v. Castro*, 545 N.Y.S.2d 985 (N.Y. Sup. Ct. 1989) (hearings held over 12 weeks featuring a total of 10 expert witnesses on the admissibility of DNA evidence).

[56] National Research Council, Committee on DNA Forensic Science. 1996. *The Evaluation of Forensic DNA Evidence*. Washington, DC: National Academy Press; National Research Council, Committee on DNA Technology in Forensic Science. 1992. *DNA Technology in Forensic Science*. Washington, DC: National Academy Press.

[57] See *Castro*, 545 N.Y.S.2d at 999 (finding after a pretrial hearing that the "DNA identification evidence of inclusion" was inadmissible because "[t]he testing laboratory failed in several major respects to use the generally accepted scientific techniques and experiments for obtaining reliable results, within a reasonable degree of scientific certainty"). Decided a few years before the *Daubert* decision was handed down, *Castro* applied a modified *Frye* standard to determine the admissibility of DNA evidence. Later federal cases, both pre- and post-*Daubert*, held that alleged errors in handling and interpreting specific DNA samples would not render the evidence inadmissible as a matter of law, but should instead be raised at trial as factors for the jury to weigh in determining the credibility of the DNA evidence. See, e.g., *United States v. Jakobetz*, 955 F.2d 786, 800 (2d Cir. 1992); *United States v. Trala*, 162 F. Supp. 2d 336, 349 (D. Del. 2001), *aff'd*, 386 F.3d 536 (3rd Cir. 2004), *vacated on other grounds*, 546

Copyright © National Academy of Sciences. All rights reserved.

ted by courts in the United States. When 2 profiles are found to "match" in a search of the Federal Bureau of Investigation's (FBI's) Combined DNA Index System (CODIS) database using 13 short tandem repeat (STR) loci, the likelihood that the profiles came from different people is extremely small. In other words, assuming the samples were properly collected and analyzed, an observer may state with a high degree of confidence that the two profiles likely came from the same person.

Among existing forensic methods, only nuclear DNA analysis has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between an evidentiary sample and a specific individual or source. Indeed, DNA testing has been used to exonerate persons who were convicted as a result of the misapplication of other forensic science evidence.[58] However, this does not mean that DNA evidence is always unassailable in the courtroom. There may be problems in a particular case with how the DNA was collected,[59] examined in the laboratory,[60] or interpreted, such as when there are mixed samples, limited amounts of DNA, or biases due to the statistical interpretation of data from partial profiles.[61]

Courts were able to subject DNA evidence to rigorous evaluation

---

U.S. 1086 (2006); *United States v. Shea*, 957 F. Supp. 331, 340-41 (D.N.H. 1997), *aff'd*, 159 F.3d 37 (1st Cir. 1998).

[58] According to The Innocence Project, there have been 220 postconviction DNA exonerations in the United States since 1989. See The Innocence Project, Fact Sheet: Facts on Post-Conviction DNA Exonerations. Available at www.innocenceproject.org/Content/351.php; see also B.L. Garrett. Judging innocence. 108 COLUM. L. REV. 55 (2008) (discussing the results of an empirical study of the types of faulty evidence that was admitted in more than 200 cases for which DNA testing subsequently enabled postconviction exonerations); but see J. Collins and J. Jarvis. 2008. *The Wrongful Conviction of Forensic Science*. CRIME LAB REPORT. Available at www.crimelabreport.com/library/pdf/wrongful_conviction.pdf (contesting the percentage of exonerated defendants whose convictions allegedly were based on faulty forensic science).

[59] See, e.g., W.C. Thompson. DNA evidence in the O.J. Simpson trial. 67 U. COLO. L. REV. 827 (1996) (detailing the defense counsel's theory that proper procedures were not followed in the collection or handling of the DNA samples at various points in the murder investigation).

[60] See, e.g., L. Hart. 2003. "DNA Lab's Woes Cast Doubt on 68 Prison Terms." *Los Angeles Times*. March 31, at 19; A. Liptak. 2003. "Houston DNA Review Clears Convicted Rapist, and Ripples in Texas Could Be Vast." *New York Times*. March 11, at A14; R. Tanner. 2003. "Crime Labs Stained by a Shadow of a Doubt." *Los Angeles Times*. July 13, at 18.

[61] See, e.g., *Coy v. Renico*, 414 F. Supp. 2d 744, 761-63 (E.D. Mich. 2006) (rejecting habeas petitioner's claim that he was denied a fair trial because the statistical techniques used to evaluate mixed DNA samples were insufficiently reliable); see also B.S. Weir. 2007. The rarity of DNA profiles. *Annals of Applied Statistics* 1(2):358-370 (suggesting that wholesale searches of large DNA databases for solving cold cases might yield false positives with some regularity).

Copyright © National Academy of Sciences. All rights reserved.

standards from the beginning,[62] because scientific groundwork for DNA analysis had been laid outside the context of law enforcement. The National Institutes of Health (NIH) and other respected institutions funded and conducted extensive basic research, followed by applied research. Serious studies on DNA analysis preceded the establishment and implementation of "individualization" criteria and parameters for assessing the probative value of claims of individualization. This history stands in sharp contrast to the history of research involving most other forensic science disciplines, which have not benefitted from extensive basic research, clinical applications, federal oversight, vast financial support from the private sector for applied research, and national standards for quality assurance and quality control. The goal is not to hold other disciplines to DNA's high standards in all respects; after all, it is unlikely that most other current forensic methods will ever produce evidence as discriminating as DNA. However, using *Daubert* as a guide, the least that the courts should insist upon from any forensic discipline is certainty that practitioners in the field adhere to enforceable standards, ensuring that any and all scientific testimony or evidence admitted is not only relevant, but reliable.

Judicial Dispositions of Questions Relating to Drug Identification

Over the years, there have been countless instances in which trial judges have assessed the admissibility of expert testimony relating to drug analyses, either *sua sponte* or pursuant to objections raised by defense counsel. Because trial court decisions in these matters often are resolved without published written opinions and with no challenges on appeal, there is no sure way to know how often trial judges deny the admissibility of the evidence. Trial judges may sometimes sustain challenges to the admissibility of expert testimony, especially in instances where the defense can show defects in the foundational laboratory reports.[63] But there are very few such reported cases.

In addition to alleged defects in laboratory reports and sampling procedures, trial courts routinely consider whether experts possess the necessary qualifications to testify and, more generally, whether expert testimony is sufficiently reliable to be admitted under *Daubert* and Federal Rule of Evidence 702. However, in published opinions addressing expert testimony based on drug identification, federal appellate courts rarely reverse trial

[62] See *supra* text accompanying note 54; see also *Gov't of V.I. v. Byers*, 941 F. Supp. 513 (D.V.I. 1996); *United States v. Jakobetz*, 747 F. Supp. 250 (D. Vt. 1990), *aff'd*, 955 F.2d 786 (2d Cir. 1992).

[63] See, e.g., *United States v. Diaz*, 2006 WL 3512032 (N.D. Cal. 2006).

Copyright © National Academy of Sciences. All rights reserved.

court decisions rejecting *Daubert* challenges.[64] Why? First, as noted above, in cases where the evidence is excluded at trial, no appeal will be taken. Second, the scientific methodology supporting many drug tests is sound. This means that, regardless of the standard of review, most decisions by trial courts will withstand scrutiny. Finally, courts of appeals owe great deference to trial court judgments on questions relating to the admission of evidence.[65]

The importance of the limited standard of review was clearly explained in *United States v. Brown*:[66]

> Immersed in the case as it unfolds, a district court is more familiar with the procedural and factual details and is in a better position to decide *Daubert* issues. The rules relating to *Daubert* issues are not precisely calibrated and must be applied in case-specific evidentiary circumstances that often defy generalization. And we don't want to denigrate the importance of the trial and encourage appeals of rulings relating to the testimony of expert witnesses. All of this explains why the task of evaluating the reliability of expert testimony is uniquely entrusted to the district court under *Daubert*, and why we give the district court considerable leeway in the execution of its duty. That is true whether the district court admits or excludes expert testimony. *Joiner*, 522 U.S. at 141-42 ("A court of appeals applying 'abuse-of-discretion' review to [*Daubert*] rulings may not categorically distinguish between rulings allowing expert testimony and rulings disallowing it."). And it is true where the *Daubert* issue is outcome determinative.[67]

Judicial Dispositions of Questions Relating to Fingerprint Analyses

Over the years, the courts have admitted fingerprint evidence, even though this evidence has "made its way into the courtroom without empirical validation of the underlying theory and/or its particular application."[68] The courts sometimes appear to assume that fingerprint evidence is irrefutable. For example, in *United States v. Crisp*, the court noted that "[w]hile the principles underlying fingerprint identification have not attained the

---

[64] See, e.g., *United States v. Moreland*, 437 F.3d 424, 430-31 (4th Cir. 2006), *cert. denied*, 547 U.S. 1142 (2006); *United States v. Scalia*, 993 F.2d 984, 988-90 (1st Cir. 1993).

[65] See, e.g., *United States v. Gaskin*, 364 F.3d 438, 460 n.8 (2d Cir. 2004) (holding that "when a party questions whether sound scientific methodology provides a basis for an expert opinion, it may move to preclude the admission of the opinion" under *Daubert*; however, when a defendant makes no such motion and instead stipulates to the admissibility of the expert opinion, "he cannot complain on appeal that the opinion lacks foundation").

[66] 415 F.3d 1266 (11th Cir. 2005).

[67] Ibid., pp. 1265-66 (alteration in original) (internal quotation marks, other internal citations omitted).

[68] M.A. Berger. Procedural paradigms for applying the *Daubert* test. 78 MINN. L. REV. 1345, 1354 (1994).

Copyright © National Academy of Sciences. All rights reserved.

status of scientific law, they nonetheless bear the imprimatur of a strong general acceptance, not only in the expert community, but in the courts as well."[69] The court went on to say:

> [E]ven if we had a more concrete cause for concern as to the reliability of fingerprint identification, the Supreme Court emphasized in *Daubert* that "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence." *Daubert*, 509 U.S. at 596. Ultimately, we conclude that while further research into fingerprint analysis would be welcome, "to postpone present in-court utilization of this bedrock forensic identifier pending such research would be to make the best the enemy of the good."[70]

Opinions of this sort have drawn sharp criticism:

> [M]any fingerprint decisions of recent years . . . display a remarkable lack of understanding of certain basic principles of the scientific method. Court after court, for example, [has] repeated the statement that fingerprinting met the *Daubert* testing criterion by virtue of having been tested by the adversarial process over the last one-hundred years. This silly statement is a product of courts' perception of the incomprehensibility of actually limiting or excluding fingerprint evidence. Such a prospect stilled their critical faculties. It also transformed their admissibility standard into a *Daubert*-permissive one, at least for that subcategory of expertise.[71]

This is a telling critique, especially when one compares the judicial decisions that have pursued rigorous scrutiny of DNA typing with the decisions that have applied less stringent standards of review in cases involving fingerprint evidence.

In holding that fingerprint evidence satisfied *Daubert*'s reliability and relevancy standards for admissibility, the Fourth Circuit's decision in *Crisp* noted approvingly that "the Seventh Circuit [in *United States v. Havvard*, 260 F.3d 597 (7th Cir. 2001)] determined that *Daubert*'s 'known error rate' factor was satisfied because the expert in *Havvard* had testified that the error rate for fingerprint comparison was 'essentially zero.'"[72] This statement appears to overstate the expert's testimony in *Havvard*, and gives fuel to the misconception that the forensic discipline

---

[69] 324 F.3d 261, 268 (4th Cir. 2003).

[70] Ibid., pp. 269-70 (second alteration in original) (other internal citation omitted).

[71] 1 Faigman et al., op. cit., *supra* note 1, § 1:1, p. 4; see also J.J. Koehler. Fingerprint error rates and proficiency tests: What they are and why they matter. 59 HASTINGS L.J. 1077 (2008).

[72] 324 F.3d at 269 (quoting *Havvard*, 260 F.3d at 599).

Copyright © National Academy of Sciences. All rights reserved.

of fingerprinting is infallible. The *Havvard* opinion actually described the expert's testimony as follows:

> [The expert] testified that the error rate for fingerprint comparison is essentially zero. Though conceding that a small margin of error exists because of differences in individual examiners, he opined that this risk is minimized because print identifications are typically confirmed through peer review. [The expert] did acknowledge that fingerprint examiners have not adopted a single standard for determining when a fragmentary latent fingerprint is sufficient to permit a comparison, but he suggested that the unique nature of fingerprints is counterintuitive to the establishment of such a standard and that through experience each examiner develops a comfort level for deciding how much of a fragmentary print is necessary to permit a comparison.[73]

This description of the expert's equivocal testimony calls into question any claim that fingerprint evidence is infallible.

The decision in *Crisp* also pointed out that "[f]ingerprint identification has been admissible as reliable evidence in criminal trials in this country since at least 1911."[74] The court, however, pointed to no studies supporting the reliability of fingerprint evidence. When forensic DNA first appeared, it was sometimes called "DNA fingerprinting" to suggest that it was as reliable as fingerprinting, which was then viewed as the premier identification science and one that consistently produced irrefutable results. During the effort to validate DNA evidence for courtroom use, however, it became apparent that assumptions about fingerprint evidence had been reached without the scientific scrutiny being accorded DNA. When the Supreme Court decided *Daubert* in 1993, with its emphasis on validation, legal commentators turned their attention to fingerprinting and began questioning whether experts could match and attribute fingerprints with a zero error rate as the FBI expert claimed in *Havvard*, and whether experts should be allowed to testify and make these claims in the absence of confirmatory studies. As noted above, most of these challenges have thus far failed, but the questions persist.

The 2004 Brandon Mayfield case refueled the debate over fingerprint evidence. The chronology of events in the Mayfield case is as follows:

---

[73] *Havvard*, 260 F.3d at 599. The *Havvard* decision is sharply criticized by 1 Faigman et al., op. cit., *supra* note 1, § 1:30, pp. 86-89.

[74] *Crisp*, 324 F.3d at 266. The decision cites a number of other legal references, including, *inter alia*: *People v. Jennings*, 96 N.E. 1077 (1911); J.L. Mnookin. Fingerprint evidence in an age of DNA profiling. 67 BROOK. L. REV. 13 (2001) (discussing history of fingerprint identification evidence).

Copyright © National Academy of Sciences. All rights reserved.

> March 11, 2004: Terrorists detonate bombs on a number of trains in Madrid, Spain, killing approximately 191 people, and injuring thousands more, including a number of United States citizens.
>
> May 6, 2004: Brandon Bieri Mayfield, a 37-year-old civil and immigration lawyer, practicing in Portland, Oregon, is arrested as a material witness with respect to a federal grand jury's investigation into that bombing. An affidavit signed by FBI Special Agent Richard K. Werder, submitted in support of the government's application for the material witness arrest warrant, [avers] that Mayfield's fingerprint has been found on a bag in Spain containing detonation devices similar to those used in the bombings, and that he has to be detained so that he cannot flee before the grand jury has a chance to obtain his testimony.
>
> May 24, 2004: The government announces that the FBI has erred in its identification of Mayfield and moves to dismiss the material witness proceeding.[75]

In March 2006, the Office of the Inspector General of the U.S. Department of Justice issued a comprehensive analysis of how the misidentification occurred.[76] And in November 2006, the federal government agreed to pay Mayfield $2 million for his wrongful jailing in connection with the 2004 terrorist bombings in Madrid.[77] The Mayfield case and the resulting report from the Inspector General surely signal caution against simple, and unverified, assumptions about the reliability of fingerprint evidence.

In *Maryland v. Rose*, a Maryland State trial court judge found that the Analysis, Comparison, Evaluation, and Verification (ACE-V) process (see Chapter 5) of latent print identification does not rest on a reliable factual foundation.[78] The opinion went into considerable detail about the lack of error rates, lack of research, and potential for bias. The judge ruled that the State could not offer testimony that any latent fingerprint matched the prints of the defendant. The judge also noted that, because the case involved

---

[75] S.T. Wax and C.J. Schatz. 2004. A multitude of errors: The Brandon Mayfield case. *The Champion*. September-October, p. 6. The facts of the case and Mayfield's legal claims against the government are fully reported in *Mayfield v. United States*, 504 F. Supp. 2d 1023 (D. Or. 2007).

[76] Office of the Inspector General, Oversight and Review Division, U.S. Department of Justice. 2006. *A Review of the FBI's Handling of the Brandon Mayfield Case*. Available at www.usdoj.gov/oig/special/s0601/exec.pdf.

[77] E. Lichtblau. 2006. "U.S. Will Pay $2 Million To Lawyer Wrongly Jailed." *New York Times*. November 30, at A18.

[78] *Maryland v. Rose*, Case No. K06-0545, mem. op. at 31 (Balt. County Cir. Ct. Oct. 19, 2007) (holding that the ACE-V methodology of latent fingerprint identification was "a subjective, untested, unverifiable identification procedure that purports to be infallible" and therefore ruling that fingerprint evidence was inadmissible). The ACE-V process is described in Chapter 5.

Copyright © National Academy of Sciences. All rights reserved.

the possibility of the death penalty, the reliability of the evidence offered against the defendant was critically important.[79]

The same concerns cited by the judge in *Maryland v. Rose* can be raised with respect to other forensic techniques that lack scientific validation and careful reliability testing.

Judicial Dispositions of Questions Relating to Other Forensic Disciplines

Review of reported judicial opinions reveals that, at least in criminal cases, forensic science evidence is not routinely scrutinized pursuant to the standard of reliability enunciated in *Daubert*. The Supreme Court in *Daubert* indicated that the subject of an expert's testimony should be "scientific knowledge"—which implies that such knowledge is based on scientific methods—to ensure that "evidentiary reliability will be based upon scientific validity." The standard is admittedly "flexible," but that does not render it meaningless. Any reasonable reading of *Daubert* strongly suggests that, when faced with forensic evidence, "trial judge[s] must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable." As the reported cases suggest, however, *Daubert* has done little to improve the use of forensic science evidence in criminal cases.

> For years in the forensic science community, the dominant argument against regulating experts was that every time a forensic scientist steps into a courtroom, his work is vigorously peer reviewed and scrutinized by opposing counsel. A forensic scientist might occasionally make an error in the crime laboratory, but the crucible of courtroom cross-examination

---

[79] Professor Jennifer Mnookin has also highlighted an important concern over "the rhetorical dimensions of the testimony . . . provide[d] in court" by members of the fingerprint community:

> At present, fingerprint examiners typically testify in the language of absolute certainty. Both the conceptual foundations and the professional norms of latent fingerprinting prohibit experts from testifying to identification unless they believe themselves certain that they have made a correct match. Experts therefore make only what they term "positive" or "absolute" identifications—essentially making the claim that they have matched the latent print to the one and only person in the entire world whose fingertip could have produced it. In fact, if a fingerprint examiner testifies on her own initiative that a match is merely "likely" or "possible" or "credible," rather than certain, she could possibly be subject to disciplinary sanction! Given the general lack of validity testing for fingerprinting; the relative dearth of difficult proficiency tests; the lack of a statistically valid model of fingerprinting; and the lack of validated standards for declaring a match, such claims of absolute, certain confidence in identification are unjustified, the product of hubris more than established knowledge. Therefore, in order to pass scrutiny under *Daubert*, fingerprint identification experts should exhibit a greater degree of epistemological humility. Claims of "absolute" and "positive" identification should be replaced by more modest claims about the meaning and significance of a "match."

J.L. Mnookin. 2008. The validity of latent fingerprint identification: Confessions of a fingerprinting moderate. *Law, Probability and Risk* 7(2):127; see also Koehler, *supra* note 71.

Copyright © National Academy of Sciences. All rights reserved.

would expose it at trial. This "crucible," however, turned out to be utterly ineffective.

. . .

Unlike the extremely well-litigated civil challenges, the criminal defendant's challenge is usually perfunctory. Even when the most vulnerable forensic sciences—hair microscopy, bite marks, and handwriting—are attacked, the courts routinely affirm admissibility citing earlier decisions rather than facts established at a hearing. Defense lawyers generally fail to build a challenge with appropriate witnesses and new data. Thus, even if inclined to mount a *Daubert* challenge, they lack the requisite knowledge and skills, as well as the funds, to succeed.[80]

The reported decisions dealing with judicial dispositions of *Daubert*-type questions appear to confirm this assessment. As noted above, the courts often "affirm admissibility citing earlier decisions rather than facts established at a hearing." Much forensic evidence—including, for example, bite marks[81] and firearm and toolmark identifications[82]—is introduced in

[80] Neufeld, *supra* note 44, at S109, S110.

[81] There is nothing to indicate that courts review bite mark evidence pursuant to *Daubert*'s standard of reliability. See, e.g., *Milone v. Camp*, 22 F.3d 693, 702 (7th Cir. 1994) (denying habeas petition after finding, in part, that the inclusion of bite mark testimony against the defendant had not denied him a fair trial, and stating that "while the science of forensic odontology might have been in its infancy at the time of trial . . . certainly there is some probative value to comparing an accused's dentition to bite marks found on the victim."). Two recent cases might, at first glance, seem to indicate that courts were beginning to seriously evaluate the general credibility of bite mark testimony, but this is not in fact the case. In *Burke v. Town of Walpole*, 405 F.3d 66 (1st Cir. 2005), the court denied summary judgment to police officers in a 42 U.S.C. § 1983 action where exculpatory DNA evidence that directly contradicted inculpatory bite mark evidence was "intentionally or recklessly withheld from the officer who was actually preparing the warrant application," ibid., p. 84, resulting in petitioner being wrongfully imprisoned for 41 days. However, the *Burke* court rejected the petitioner's claim that the inclusion of bite mark evidence in the arrest warrant had demonstrated "reckless disregard for the truth," because the method was generally unreliable. Ibid., pp. 82-83. In *Ege v. Yukins*, 380 F. Supp. 2d 852 (E.D. Mich. 2005), *aff'd in part and rev'd in part*, 485 F.3d 364 (6th Cir. 2007), the court granted the habeas petition of a defendant whose conviction was based in significant part on bite mark testimony from a later-discredited expert witness. But the disposition in *Ege* rested primarily on the flaws of one "particular witness and his particular testimony," not on a judicial evaluation of "*the* [bite mark] *field*'s more general shortcomings." 4 Faigman et al., op. cit., *supra* note 1, § 36:6, p. 662.

[82] There is little to indicate that courts review firearms evidence pursuant to *Daubert*'s standard of reliability. See e.g., *United States v. Hicks*, 389 F.3d 514 (5th Cir. 2004) (upholding defendant's conviction after finding, in part, that it was not an abuse of discretion for the court to admit testimony on shell casing comparisons by the Government's firearms expert); *United States v. Foster*, 300 F. Supp. 2d 375 (D. Md. 2004) (denying defendant's motion to exclude expert firearms testimony). Several federal trial judges, however, have subjected expert firearm testimony to rigorous analysis under *Daubert*. In *United States v. Monteiro*, 407 F. Supp. 2d 351 (D. Mass. 2006), Judge Saris concluded that toolmark identification testimony was

Copyright © National Academy of Sciences. All rights reserved.

criminal trials without any meaningful scientific validation, determination of error rates, or reliability testing to explain the limits of the discipline. One recent judicial decision highlights the problem. In *United States v. Green*, Judge Gertner acknowledged that toolmark identification testimony *ought not be considered admissible* under *Daubert*.[83] But the judge pointed out that "the problem for the defense is *that every single court* post-*Daubert* has admitted this testimony, sometimes without any searching review, much less a hearing."[84] Judge Gertner allowed the prosecution's expert to describe the similarities between the shell casings at issue, but prohibited him from testifying that there was a definitive match. Obviously feeling bound by circuit precedent, the judge stated:

> I reluctantly [admit the evidence] because of my confidence that any other decision will be rejected by appellate courts, in light of precedents across the country, regardless of the findings I have made. While I recognize that the *Daubert-Kumho* standard does not require the illusory perfection of a television show (CSI, this wasn't), when liberty hangs in the balance—and, in the case of the defendants facing the death penalty, life itself—the standards should be higher than were met in this case, and than have been imposed across the country. The more courts admit this type of toolmark evidence without requiring documentation, proficiency testing, or evidence of reliability, the more sloppy practices will endure; we should require more.[85]

"[T]he undeniable reality is that the community of forensic science

---

generally admissible under *Daubert*, but excluded the specific testimony at issue, because the experts failed to properly document their basis for identification, and because an independent examiner had not verified the experts' conclusions. Likewise, in *United States v. Diaz*, No. 05-CR-167, 2007 WL 485967, at *14 (N.D. Cal. Feb. 12, 2007), Judge Alsup allowed firearm identification testimony under *Daubert*, but prevented experts from testifying to their conclusions "to the exclusion of all other firearms in the world" and only allowed testimony "to a reasonable degree of certainty." *Cf. United States v. Glynn*, 578 F. Supp. 2d 569 (S.D.N.Y. 2008), where Judge Rakoff precluded testimony that a bullet and shell casings came from a firearm linked to the defendant "to a reasonable degree of ballistics certainty," because "whatever else ballistics identification analysis could be called, it could not fairly be called 'science.'" However, the judge ruled that although inadmissible under *Daubert*, testimony that the evidence was "more likely than not" from the firearm was admissible under Federal Rule of Evidence 401. See also *Green*, 405 F. Supp. 2d 104, discussed in the text.

[83] 405 F. Supp. 2d at 107-08.

[84] Ibid., p. 108.

[85] Ibid., p. 109 (footnotes omitted). "The case law on the admissibility of toolmark identification and firearms identification expert evidence is typified by decisions admitting such testimony with little, and usually no, reference to legal authority beyond broad 'discretion' and an adroit sidestepping of any judicial duty to assure that experts' claims are valid. Appellate courts defer to trial courts, and trial courts defer to juries. Later appellate courts simply defer to earlier appellate courts." 4 Faigman et al., op. cit., *supra* note 1, § 34:5, p. 589.

Copyright © National Academy of Sciences. All rights reserved.

professionals has not done nearly as much as it reasonably could have done to establish either the validity of its approach or the accuracy of its practitioners' conclusions,"[86] and the courts have been "utterly ineffective" in addressing this problem.[87]

CONCLUSION

Prophetically, the *Daubert* decision observed that "there are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory. Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly."[88] But because accused parties in criminal cases are convicted on the basis of testimony from forensic science experts, much depends upon whether the evidence offered is reliable. Furthermore, in addition to protecting innocent persons from being convicted of crimes that they did not commit, we are also seeking to protect society from persons who have committed criminal acts. Law enforcement officials and the members of society they serve need to be assured that forensic techniques are *reliable*. Therefore, we must limit the risk of having the reliability of certain forensic science methodologies condoned by the courts before the techniques have been properly studied and their accuracy verified. "[T]here is no evident reason why ['rigorous, systematic'] research would be infeasible."[89] However, some courts appear to be loath to insist on such research as a condition of admitting forensic science evidence in criminal cases, perhaps because to do so would likely "demand more by way of validation than the disciplines can presently offer."[90]

Some legal scholars think that, "[o]ver time, if *Daubert* does not come

---

[86] Mnookin, op. cit., *supra* note 79.

[87] Neufeld, op. cit., *supra* note 44, p. S109. In *Green*, 405 F. Supp. 2d at 109 n.6, Judge Gertner also noted that:

> [R]ecent reexaminations of relatively established forensic testimony have produced striking results. Saks and Koehler, for example, report that forensic testing errors were responsible for wrongful convictions in 63% of the 86 DNA Exoneration cases reported by the Innocence Project at Cardozo Law School. Michael Saks and Jonathan Koehler, The Coming Paradigm Shift in Forensic Identification Science, 309 Science 892 (2005). This only reinforces the importance of careful analysis of expert testimony in this case.

See also S.R. Gross, *Convicting the Innocent* (U. Mich. Law Sch. Pub. Law & Legal Theory Working Paper Series, Working Paper No. 103, 2008). Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1100011 (forthcoming in *Annual Review of Law & Social Science* 2008).

[88] *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 596-97 (1993).

[89] J. Griffin and D.J. LaMagna. 2002. *Daubert* challenges to forensic evidence: Ballistics next on the firing line. *The Champion*. September-October:21.

[90] Ibid. See, e.g., *Crisp*, 324 F.3d at 270.

Copyright © National Academy of Sciences. All rights reserved.

to be diluted or distorted, . . . courts will increasingly appreciate its power and flexibility to evaluate proffered expert testimony."[91] However, at least with respect to criminal cases, this may reflect an unrealistic assessment of the problem. "The principal difficulty, it appears, is that many [forensic science] techniques have been relied on for so long that courts might be reluctant to rethink their role in the trial process. . . . In many forensic areas, effectively no research exists to support the practice."[92]

As the discussion in this chapter indicates, the adversarial process relating to the admission and exclusion of scientific evidence is not suited to the task of finding "scientific truth." The judicial system is encumbered by, among other things, judges and lawyers who generally lack the scientific expertise necessary to comprehend and evaluate forensic evidence in an informed manner, trial judges (sitting alone) who must decide evidentiary issues without the benefit of judicial colleagues and often with little time for extensive research and reflection, and the highly deferential nature of the appellate review afforded trial courts' *Daubert* rulings. Furthermore, the judicial system embodies a case-by-case adjudicatory approach that is not well suited to address the systematic problems in many of the various forensic science disciplines. Given these realities, there is a tremendous need for the forensic science community to improve. Judicial review, by itself, will not cure the infirmities of the forensic science community.[93] The development of scientific research, training, technology, and databases associated with DNA analysis have resulted from substantial and steady federal support for both academic research and programs employing techniques for DNA analysis. Similar support must be given to all credible forensic science disciplines if they are to achieve the degrees of reliability needed to serve the goals of justice. With more and better educational programs, accredited laboratories, certified forensic practitioners, sound operational principles and procedures, and serious research to establish the limits and measures of performance in each discipline, forensic science experts will be better able to analyze evidence and coherently report their findings in the courts. The present situation, however, is seriously wanting, both because of the limitations of the judicial system and because of the many problems faced by the forensic science community.

---

[91] 1 Faigman et al., op. cit., *supra* note 1, § 1:1, p. 5 n. 9.

[92] Ibid. § 1:30, p. 85 (footnotes omitted).

[93] See J.L. Mnookin. Expert evidence, partisanship, and epistemic competence. 73 BROOK. L. REV. 1009, 1033 (2008) ("[S]o long as we have our adversarial system in much its present form, we are inevitably going to be stuck with approaches to expert evidence that are imperfect, conceptually unsatisfying, and awkward. It may well be that the real lesson is this: those who believe that we might ever fully resolve—rather than imperfectly manage—the deep structural tensions surrounding both partisanship and epistemic competence that permeate the use of scientific evidence within our legal system are almost certainly destined for disappointment.").

Copyright © National Academy of Sciences. All rights reserved.

4

The Principles of Science and Interpreting Scientific Data

> Scientific method refers to the body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. It is based on gathering observable, empirical and measurable evidence subject to specific principles of reasoning.
>
> Isaac Newton (1687, 1713, 1726)
> "Rules for the study of natural philosophy,"
> *Philosophiae Naturalis Principia Mathematica*

Forensic science actually is a broad array of disciplines, as will be seen in the next chapter. Each has its own methods and practices, as well as its strengths and weaknesses. In particular, each varies in its level of scientific development and in the degree to which it follows the principles of scientific investigation. Adherence to scientific principles is important for concrete reasons: they enable the reliable inference of knowledge from uncertain information—exactly the challenge faced by forensic scientists. Thus, the reliability of forensic science methods is greatly enhanced when those principles are followed. As Chapter 3 observes, the law's admission of and reliance on forensic evidence in criminal trials depends critically on (1) the extent to which a forensic science discipline is founded on a reliable scientific methodology, leading to accurate analyses of evidence and proper reports of findings and (2) the extent to which practitioners in those forensic science disciplines that rely on human interpretation adopt procedures and performance standards that guard against bias and error. This chapter discusses the ways in which science more generally addresses those goals.

Copyright © National Academy of Sciences. All rights reserved.

FUNDAMENTAL PRINCIPLES OF THE SCIENTIFIC METHOD

The scientific method presumes that events occur in consistent patterns that can be understood through careful comparison and systematic study. Knowledge is produced through a series of steps during which data are accumulated methodically, strengths and weaknesses of information are assessed, and knowledge about causal relationships is inferred. In the process, scientists also develop an understanding of the limits of that knowledge (such as the precision of the observations), the inferred nature of relationships, and key assumptions behind the inferences. Hypotheses are developed, are measured against the data, and are either supported or refuted.

Scientists continually observe, test, and modify the body of knowledge. Rather than claiming absolute truth, science approaches truth either through breakthrough discoveries or incrementally, by testing theories repeatedly. Evidence is obtained through observations and measurements conducted in the natural setting or in the laboratory. In the laboratory, scientists can control and vary the conditions in order to isolate exclusive effects and thus better understand the factors that influence certain outcomes. Typically, experiments or observations must be conducted over a broad range of conditions before the roles of specific factors, patterns, or variables can be understood. Methods to reduce errors are part of the study design, so that, for example, the size of the study is chosen to provide sufficient statistical power to draw conclusions with a high level of confidence or to understand factors that might confound results. Throughout scientific investigations, the investigator must be as free from bias as possible, and practices are put in place to detect biases (such as those from measurements, human interpretation) and to minimize their effects on conclusions.

Ultimately, the goal is to construct explanations ("theories") of phenomena that are consistent with broad scientific principles, such as the laws of thermodynamics or of natural selection. These theories, and investigations of them through experiments and observed data, are shared through conferences, publications, and collegial interactions, which push the scientist to explain his or her work clearly and which raise questions that might not have been considered. The process of sharing data and results requires careful recordkeeping, reviewed by others. In addition, the need for credibility among peers drives investigators to avoid conflicts of interest. Acceptance of the work comes as results and theories continue to hold, even under the scrutiny of peers, in an environment that encourages healthy skepticism. That scrutiny might extend to independent reproduction of the results or experiments designed to test the theory under different conditions. As credibility accrues to data and theories, they become accepted as established fact and become the "scaffolding" upon which other investigations are constructed.

Copyright © National Academy of Sciences. All rights reserved.

This description of how science creates new theories illustrates key elements of good scientific practice: precision when defining terms, processes, context, results, and limitations; openness to new ideas, including criticism and refutation; and protections against bias and overstatement (going beyond the facts). Although these elements have been discussed here in the context of creating new methods and knowledge, the same principles hold when applying known processes or knowledge. In day-to-day forensic science work, the process of formulating and testing hypotheses is replaced with the careful preparation and analysis of samples and the interpretation of results. But that applied work, if done well, still exhibits the same hallmarks of basic science: the use of validated methods and care in following their protocols; the development of careful and adequate documentation; the avoidance of biases; and interpretation conducted within the constraints of what the science will allow.

Validation of New Methods

One particular task of science is the validation of new methods to determine their reliability under different conditions and their limitations. Such studies begin with a clear hypothesis (e.g., "new method X can reliably associate biological evidence with its source"). An unbiased experiment is designed to provide useful data about the hypothesis. Those data—measurements collected through methodical prescribed observations under well-specified and controlled conditions—are then analyzed to support or refute the hypothesis. The thresholds for supporting or refuting the hypothesis are clearly articulated before the experiment is run. The most important outcomes from such a validation study are (1) information about whether or not the method can discriminate the hypothesis from an alternative, and (2) assessments of the sources of errors and their consequences on the decisions returned by the method. These two outcomes combine to provide precision and clarity about what is meant by "reliably associate."

For a method that has not been subjected to previous extensive study, a researcher might design a broad experiment to assist in gaining knowledge about its performance under a range of conditions. Those data are then analyzed for any underlying patterns that may be useful in planning or interpreting tests that use the new method. In other situations, a process already has been formulated from existing experimental data, knowledge, and theory (e.g., "biological markers A, B, and C can be used in DNA forensic investigations to pair evidence with suspect").

To confirm the validity of a method or process for a particular purpose (e.g., for a forensic investigation), validation studies must be performed.

The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) developed a joint document,

Copyright © National Academy of Sciences. All rights reserved.

"General requirements for the competence of testing and calibration laboratories" (commonly referred to as "ISO 17025"), which includes a well-established list of techniques that can be used, alone or in combination, to validate a method:

- calibration using reference standards or reference materials;
- comparison of results achieved with other methods;
- interlaboratory comparisons;
- systematic assessment of the factors influencing the result; and
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience.[1]

A critical step in such validation studies is their publication in peer-reviewed journals, so that experts in the field can review, question, and check the repeatability of the results. These publications must include clear statements of the hypotheses under study, as well as sufficient details about the experiments, the resulting data, and the data analysis so that the studies can be replicated. Replication will expose not only additional sources of variability but also further aspects of the process, leading to greater understanding and scientific knowledge that can be used to improve the method. Methods that are specified in more detail (such as DNA analysis, where particular genetic loci are to be compared) will have greater credibility and also are more amenable to systematic improvement than those that rely more heavily on the judgments of the investigator.

The validation of results over time increases confidence. Moreover, the scientific culture encourages continued questioning and improvement. Thus, the relevant scientific community continues to check that established results still hold under new conditions and that they continue to hold in the face of new knowledge. The involvement of graduate student researchers in scientific research contributes greatly to this diligence, because part of their education is to read carefully and to question so-called established methods. This culture leads to continued reexamination of past research and hence increased knowledge.

In the case of DNA analysis, studies have evaluated the precision, reliability, and uncertainties of the methods. This knowledge has been used to define standard procedures that, when followed, lead to reliable evidence. For example, below is a brief sample of the specifications required by the Federal Bureau of Investigation's (FBI's) Quality Assurance Standards for

[1] Quoted from Section 5.4.5 2 (Note 2) of ISO/IEC 17025, "General requirements for the competence of testing and calibration laboratories" (2nd ed., May 15, 2005).

Copyright © National Academy of Sciences. All rights reserved.

Forensic DNA Testing Laboratories[2] in order to ensure reliable DNA forensic analysis:

- Testing laboratories must have a standard operating protocol for each analytical technique used, specifying reagents, sample preparation, extraction, equipment, and controls that are standard for DNA analysis and data interpretation.
- The laboratory shall monitor the analytical procedures using appropriate controls and standards, including quantitation standards that estimate the amount of human nuclear DNA recovered by extraction, positive and negative amplification controls, and reagent blanks.
- The laboratory shall check its DNA procedures annually or whenever substantial changes are made to the protocol(s) against an appropriate and available NIST standard reference material or standard traceable to a NIST standard.
- The laboratory shall have and follow written general guidelines for the interpretation of data.
- The laboratory shall verify that all control results are within established tolerance limits.
- Where appropriate, visual matches shall be supported by a numerical match criterion.
- For a given population(s) and/or hypothesis of relatedness, the statistical interpretation shall be made following the recommendations 4.1, 4.2, or 4.3 as deemed applicable of the National Research Council report entitled *The Evaluation of Forensic DNA Evidence* (1996) and/or a court-directed method. These calculations shall be derived from a documented population database appropriate for the calculation.[3]

This level of specificity is consistent with the spirit of the guidelines presented in ISO 17025. The second edition (May 15, 2005) of those guidelines includes the following minimum set of information for properly specifying the process of any new analytical method:

(a) appropriate identification;
(b) scope;
(c) description of the type of item to be tested or calibrated;

---

[2] DNA Advisory Board. 2000. *Forensic Science Communications* 2(3). Available at www.bioforensics.com/conference04/TWGDAM/Quality_Assurance_Standards_2.pdf.

[3] Paraphrased from Section 9 of the FBI's Quality Assurance Standards for Forensic DNA Testing Laboratories.

Copyright © National Academy of Sciences. All rights reserved.

(d) parameters or quantities and ranges to be determined;
(e) apparatus and equipment, including technical performance requirements;
(f) reference standards and reference materials required;
(g) environmental conditions required and any stabilization period needed;
(h) description of the procedure, including
- affixing of identification marks, handling, transporting, storing and preparation of items;
- checks to be made before the work is started;
- checks that the equipment is working properly and, where required, calibration and adjustment of the equipment before each use;
- the method of recording the observations and results;
- any safety measures to be observed;

(i) criteria and/or requirements for approval/rejection;
(j) data to be recorded and method of analysis and presentation;
(k) the uncertainty or the procedure for estimating uncertainty.[4]

Uncertainty and Error

Scientific data and processes are subject to a variety of sources of error. For example, laboratory results and data from questionnaires are subject to measurement error, and interpretations of evidence by human observers are subject to potential biases. A key task for the scientific investigator designing and conducting a scientific study, as well as for the analyst applying a scientific method to conduct a particular analysis, is to identify as many sources of error as possible, to control or to eliminate as many as possible, and to estimate the magnitude of remaining errors so that the conclusions drawn from the study are valid. Numerical data reported in a scientific paper include not just a single value (point estimate) but also a range of plausible values (e.g., a confidence interval, or interval of uncertainty).

Measurement Error

As with all other scientific investigations, laboratory analyses conducted by forensic scientists are subject to measurement error. Such error reflects the intrinsic strengths and limitations of the particular scientific technique. For example, methods for measuring the level of blood alcohol in an individual or methods for measuring the heroin content of a sample

[4] Quoted from Section 5.4.4 of ISO/IEC 17025, "General requirements for the competence of testing and calibration laboratories" (2nd ed., May 15, 2005).

Copyright © National Academy of Sciences. All rights reserved.

can do so only within a confidence interval of possible values. In addition to the inherent limitations of the measurement technique, a range of other factors may also be present and can affect the accuracy of laboratory analyses. Such factors may include deficiencies in the reference materials used in the analysis, equipment errors, environmental conditions that lie outside the range within which the method was validated, sample mix-ups and contamination, transcriptional errors, and more.

Consider, for example, a case in which an instrument (e.g., a breathalyzer such as Intoxilyzer) is used to measure the blood-alcohol level of an individual three times, and the three measurements are 0.08 percent, 0.09 percent, and 0.10 percent. The variability in the three measurements may arise from the internal components of the instrument, the different times and ways in which the measurements were taken, or a variety of other factors. These measured results need to be reported, along with a confidence interval that has a high probability of containing the true blood-alcohol level (e.g., the mean plus or minus two standard deviations). For this illustration, the average is 0.09 percent and the standard deviation is 0.01 percent; therefore, a two-standard-deviation confidence interval (0.07 percent, 0.11 percent) has a high probability of containing the person's true blood-alcohol level. (Statistical models dictate the methods for generating such intervals in other circumstances so that they have a high probability of containing the true result.) The situation for assessing heroin content from a sample of white powder is similar, although the quantification and limits are not as broadly standardized. The combination of gas chromatography and mass spectrometry (GC/MS) is used extensively in identifying controlled substances. Those analyses tend to be more qualitative (e.g., identifying peaks on a spectrum that appear at frequencies consistent with the controlled substance and which stand out above the background "noise"), although quantification is possible.

Error Rates

Analyses in the forensic science disciplines are conducted to provide information for a variety of purposes in the criminal justice process. However, most of these analyses aim to address two broad types of questions: (1) can a particular piece of evidence be associated with a particular class of sources? and (2) Can a particular piece of evidence be associated with one particular source? The first type of question leads to "classification" conclusions. An example of such a question would be whether a particular hair specimen shares physical characteristics common to a particular ethnic group. An affirmative answer to a classification question indicates only that the item belongs to a particular *class* of similar items. Another example might be whether a paint mark left at a crime scene is consistent (according

Copyright © National Academy of Sciences. All rights reserved.

to some collection of relevant measurements) with a particular paint sample in a database, from which one can infer the class of vehicle (e.g., model(s) and production year(s)) that could have left the mark. The second type of question leads to "individualization" conclusions—for example, does a particular DNA sample belong to individual X?

Although the questions addressed by forensic analyses are not always binary (yes/no) or as crisply stated as in the previous paragraph, the paradigm of yes/no conclusions is useful for describing and quantifying the accuracy with which forensic science disciplines can provide answers.[5] In such situations, results from analyses for which the truth is known can be classified in a two-way table as follows:

	Analysis Results	
Truth	yes	no
yes	a (true positives)	b (false negatives)
no	c (false positives)	d (true negatives)

The conceptual framework and terminology for evaluating the accuracy of forensic analyses is illustrated using a *hypothetical* example from microscopic analysis of head hair. In this situation, multiple features, both qualitative and quantitative, on each sample of hair are assessed. Qualitative features include color (e.g., blonde, brown, red), coloring (natural or treated), form (straight, wavy, curved, kinked), texture (smooth, medium, coarse). Quantitative features include length and diameter. Undoubtedly, these features will vary from hair to hair, even from the same individual, but features that vary *less* for the *same* individual (i.e., within-individual variability) and *more* for *different* individuals (i.e., between-individual variability) are needed for purposes of class identification and discrimination. These features may also be combined in some fashion to result in some overall score, or set of scores, for each sample, and these scores are then compared with those from the target sample. In the final analysis, however, a binary conclusion is often required. For example, "Did this hair come from the head of a Caucasian person?"

As in the case of all analyses leading to classification conclusions (e.g., diagnostic tests in medicine), the microscopic hair analysis process must be subjected to performance and validation studies in which appropriate error rates can be defined and estimated. Consider a hypothetical study in

[5] More complete discussion of the questions addressed by forensic science may be found in references such as K. Inman and N. Rudin. 2002. The origin of evidence. *Forensic Science International* 126:11-16; and R. Cook, I.W. Evett, G. Jackson, P.J. Jones, and J.A. Lambert. 1998. A hierarchy of propositions: Deciding which level to address in casework. *Science and Justice* 38:231-239.

Copyright © National Academy of Sciences. All rights reserved.

which 100 samples (each with multiple hairs) are taken from the heads of 100 individuals from class C, and another 100 samples are taken from the heads of individuals not in class C. The analyst is asked to determine, for each of the 200 samples, whether it does or does not come from a person in class C, and the true answer is known. The validation study returns the following results:

Hypothetical Hair Analysis Validation Study

	Analysis of Hair Samples Indicates:		
	Class C	Not Class C	Row Total
Sample is from Class C Persons	95 True Positive (correct determination)	5 False Negative	100
Sample is not from Class C Persons	2 False Positive	98 True Negative (correct determination)	100
Column Total	97	103	Overall total 200

The accuracy of a test (here, microscopic hair analysis) can be assessed in different ways. Borrowing terminology from the evaluation of medical diagnostic tests, four characterizations and their associated measures are given below. Each one is useful in its own way: the first two emphasize the ability to *detect* an association; the last two emphasize the ability to *predict* an association:[6]

- Among samples from persons in Class C, the fraction that is correctly identified by the test is called the "sensitivity" or the "true positive rate" (TPR) of the test. In this table, the sensitivity would be estimated as [95/(95+5)] × 100=95 percent.
- Among samples from persons not in Class C, the fraction that is correctly identified by the test is called the "specificity" or the "true

[6] See, e.g., X-H. Zhou, N. Obuchowski, and D. McClish. 2002. *Statistical Methods in Diagnostic Medicine*. Hoboken, NJ. Wiley & Sons, for a general account of methods for diagnostic tests. A series of NAS/NRC reports have applied such methods to the examination of forensic disciplines. See, e.g., NRC. Committee to Review the Scientific Evidence on the Polygraph. 2003. *The Polygraph and Lie Detection*. Washington, DC: The National Academies Press; NRC. 2004. *Forensic Analysis: Weighing Bullet Lead Evidence*. Washington, DC: The National Academies Press; NAS. 2005. *The Sackler Colloquium on Forensic Science: The Nexus of Science and the Law*, November 16-18, 2005.

Copyright © National Academy of Sciences. All rights reserved.

negative rate" (TNR) of the test. In this table, the specificity would be estimated as [98/(2+98)] × 100=98 percent.

- Among samples classified by the test as coming from persons in Class C, the fraction that actually turns out to be from Class C is called the "positive predictive value (PPV)" of the test. In this table, the PPV would be estimated as [95/(95+ 2)] × 100=98 percent.
- Among samples classified by the test as coming from persons not in Class C, the fraction that actually turns out to not be persons from Class C is called the "negative predictive value (NPV)" of the test. In this table, the NPV would be estimated as [98/(5+98)] × 100=95 percent.

The above four measures emphasize the ability of the analysis to make correct determinations.[7] "Error rates" are defined as proportions of cases in which the analysis led to a false conclusion. For example, the complement of sensitivity (100 percent minus the sensitivity) is the percent of false negative cases in which the sample was from class C but the analysis reached the opposite conclusion. In the above table, this would be estimated as 5 percent. Similarly, the complement of specificity (100 percent minus the specificity) is the percent of false positive cases in which the sample was not from class C but the analysis concluded that it was. In the above table this would be estimated as 2 percent. A global error rate could be defined as the percent of incorrectly identified cases among all those analyzed. In the above table this would be estimated as [(5+2)/200] × 100=3.5 percent.

Importantly, whether the test answer is correct or not depends on which question is being addressed by the test. In this hair comparison example, the purpose is to determine whether the hair came from the head of an individual from class C. Thus, the analysis should be evaluated on the accuracy of the classification. In this example, if the analysis indicated "Class C" but the hair actually came from a "non-Class C" individual, then the analysis returned an incorrect classification. This accuracy evaluation does not apply to other tasks that are beyond the goal of the particular analysis, such as pinpointing the individual from whom the specimen was obtained. In the paint example about paint marks left by a vehicle, if the question is whether a vehicle under investigation was a model A made by manufacturer B in 2000, then a correct answer is limited to only the model, manufacturer, and year.

[7] Each estimate (of sensitivity, specificity, PPV, NPV) is associated with an interval that has a high probability of containing the true sensitivity, specificity, PPV, NPV. The larger the study, the more precise the estimate (i.e., the narrower the interval of uncertainty about the estimate).

Copyright © National Academy of Sciences. All rights reserved.

Although only illustrations, these examples serve to demonstrate the importance of:

- the careful and precise characterization of the scientific procedure, so that others can replicate and validate it;
- the identification of as many sources of error as possible that can affect both the accuracy and precision of a measurement;
- the quantification of measurements (e.g., in the example of GC/MS analysis of possible heroin, reporting peak area, as well as appropriate calibration data, including the response area for a known amount of analyte standard, rather than merely "peak is present/absent");
- the reporting of a measurement with an interval that has a high probability of containing the true value;
- the precise definition of the question addressed by the method (e.g., classification versus individualization), and the recognition of its limitations; and
- the conducting of validation studies of the performance of a forensic procedure to assess the percentages of false positives and false negatives.

Clearly, better understanding of the measuring equipment and the measurement process leads to more improvements to every process and ultimately to fewer false positive and false negative results. Most importantly, as stated above, whether the test answer is correct or not depends on the question the test is being used to address. In the case of microscopic hair analysis, the validation study may confirm its value in identifying *class characteristics* of an individual, but not in identifying the specific person.

It is also important to note that errors and corresponding error rates can have more complex sources than can be accommodated within the simple framework presented above. For example, in the case of DNA analysis, a declaration that two samples match can be erroneous in at least two ways: The two samples might actually come from different individuals whose DNA appears to be the same within the discriminatory capability of the tests, or two different DNA profiles could be mistakenly determined to be matching. The probability of the former error is typically very low, while the probability of a false positive (different profiles wrongly determined to be matching) may be considerably higher. Both sources of error need to be explored and quantified in order to arrive at reliable error rate estimates for DNA analysis.[8]

[8] C. Aitken and F. Taroni. 2004. *Statistics and the Evaluation of Evidence for Forensic Scientists*. Chichester, UK: John Wiley & Sons.

Copyright © National Academy of Sciences. All rights reserved.

The existence of several types of potential error rates makes it absolutely critical for all involved in the analysis to be explicit and precise in the particular rate or rates referenced in a specific setting. The estimation of such error rates requires rigorously developed and conducted scientific studies. Additional factors may play a role in analyses involving human interpretation, such as the experience, training, and inherent ability of the interpreter, the protocol for conducting the interpretation, and biases from a variety of sources, as discussed in the next section. The assessment of the accuracy of the conclusions from forensic analyses and the estimation of relevant error rates are key components of the mission of forensic science.

Sources of Bias

Human judgment is subject to many different types of bias, because we unconsciously pick up cues from our environment and factor them in an unstated way into our mental analyses. Those mental analyses might also be affected by unwarranted assumptions and a degree of overconfidence that we do not even recognize in ourselves. Such cognitive biases are not the result of character flaws; instead, they are common features of decisionmaking, and they cannot be willed away.[9] A familiar example is how the common desire to please others (or avoid conflict) can skew one's judgment if co-workers or supervisors suggest that they are hoping for, or have reached, a particular outcome. Science takes great pains to avoid biases by using strict protocols to minimize their effects. The 1996 National Academies DNA report, for example, notes, "[l]aboratory procedures should be designed with safeguards to detect bias and to identify cases of true ambiguity. Potential ambiguities should be documented."[10]

A somewhat obvious cognitive bias that may arise in forensic science is a willingness to ignore base rate information in assessing the probative value of information. For example, suppose carpet fibers from a crime scene are found to match carpet fibers found in a suspect's home. The probative value of this information depends on the rate at which such fibers are found in homes in addition to that of the suspect. If the carpet fibers are extremely common, the presence of matching fibers in the suspect's home will be of little probative value.[11]

A common cognitive bias is the tendency for conclusions to be affected by how a question is framed or how data are presented. In a police line-up,

[9] See, e.g., M.J. Saks, D.M. Risinger, R. Rosenthal, and W.C. Thompson. 2003. Context effects in forensic science: A review and application of the science of science to crime laboratory practice in the United States. *Science and Justice* 43(2):77-90.

[10] NRC. 1996. *The Evaluation of Forensic DNA Evidence.* Washington, DC: National Academy Press.

[11] C. Guthrie, J.J. Rachlinski, and A.J. Wistrich. 2001. Inside the judicial mind. *Cornell Law Review* 86:777-830.

Copyright © National Academy of Sciences. All rights reserved.

for instance, an eyewitness who is presented with a pool of faces in one batch might assume that the suspect is among them, which may not be correct. If the mug shots are presented together at one time and the witness is asked to identify the suspect, the witness may choose the photograph that is most similar to the perpetrator, even if the perpetrator's picture is not among those presented. Similarly, if the photographs are presented sequentially and the witness knows that only a limited number will be presented, the eyewitness might tend to "identify" one of the last photographs under the assumption that the suspect must be in that batch. (This is also driven by the common bias toward reaching closure.) A series of studies has shown that judges can be subject to errors in judgment resulting from similar cognitive biases.[12] Forensic scientists also can be affected by this cognitive bias if, for example, they are asked to compare two particular hairs, shoeprints, fingerprints—one from the crime scene and one from a suspect—rather than comparing the crime scene exemplar with a pool of counterparts.

Another potential bias is illustrated by the erroneous fingerprint identification of Brandon Mayfield as someone involved with the Madrid train bombing in 2004. The FBI investigation determined that once the fingerprint examiner had declared a match, both he and other examiners who were aware of this finding were influenced by the urgency of the investigation to affirm repeatedly this erroneous decision.[13]

Recent research provided additional evidence of this sort of bias through an experiment in which experienced fingerprint examiners were asked to analyze fingerprints that, unknown to them, they had analyzed previously in their careers. For half the examinations, contextual biasing was introduced. For example, the instructions accompanying the latent prints included information such as the "suspect confessed to the crime" or the "suspect was in police custody at the time of the crime." In 6 of the 24 examinations that included contextual manipulation, the examiners reached conclusions that were consistent with the biasing information and different from the results they had reached when examining the same prints in their daily work.[14]

Other cognitive biases may be traced to common imperfections in our reasoning ability. One commonly recognized bias is the tendency to avoid cognitive dissonance, such as persuading oneself through rational argument that a purchase was a good value once the transaction is complete. A scientist encounters this unconscious bias if he/she becomes too wedded to a preliminary conclusion, so that it becomes difficult to accept new infor-

[12] Ibid.

[13] R.B. Stacey. 2004. A report on the erroneous fingerprint individualization in the Madrid train bombing case. *Journal of Forensic Identification* 54:707.

[14] I.E. Dror and D. Charlton. 2006. Why experts make errors. *Journal of Forensic Identification* 56(4):600-616.

Copyright © National Academy of Sciences. All rights reserved.

mation fairly and unduly difficult to conclude that the initial hypotheses were wrong. This is often manifested by what is known as "anchoring," the well-known tendency to rely too heavily on one piece of information when making decisions. Often, the piece of information that is weighted disproportionately is one of the very first ones encountered. One tends to seek closure and to view the initial part of an investigation as a "sunk cost" that would be wasted if overturned.

Another common cognitive bias is the tendency to see patterns that do not actually exist. This bias is related to our tendency to underestimate the amount of complexity that can really exist in nature. Both tendencies can lead one to formulate overly simple models of reality and thus to read too much significance into coincidences and surprises. More generally, human intuition is not a good substitute for careful reasoning when probabilities are concerned. As an example, consider a problem commonly posed in beginning statistics classes: How many people must be in a room before there is a 50 percent probability that at least two will share a common birthday? Intuition might suggest a large number, perhaps over 100, but the actual answer is 23. This is not difficult to prove through careful logic, but intuition is likely to be misleading.

All of these sources of bias are well known in science, and a large amount of effort has been devoted to understanding and mitigating them. The goal is to make scientific investigations as objective as possible so the results do not depend on the investigator. Certain fields of science (most notably, biopharmaceutical clinical trials of treatment protocols and drugs) have developed practices such as double-blind tests and independent (blind) verification to minimize the impact of biases. Additionally, science seeks to publish its discoveries, findings, and conclusions so that they are subjected to independent peer review; this enables others to study biases that may exist in the investigative method or attempt to replicate unexpected results. Avoiding, or compensating for, a bias is an important task. Even fields with well-established protocols to minimize the effects of bias can still bear improvement. For example, a recent working paper[15] has raised questions about the way cognitive dissonance has been studied since 1956. Although these results must be considered preliminary because the paper has yet to be published, they do demonstrate that continual vigilance is needed. Research has been sparse on the important topic of cognitive bias in forensic science—both regarding their effects and methods for minimizing them.[16]

[15] M.K. Chen. 2008. *Rationalization and Cognitive Dissonance: Do Choices Affect or Reflect Preferences?* Available at www.som.yale.edu/Faculty/keith.chen/papers/CogDisPaper.pdf.

[16] See, e.g., I.E. Dror, D. Charlton, and A.E. Peron. 2006. Contextual information renders experts vulnerable to making erroneous identifications. *Forensic Science International* 156:74-78; I.E. Dror, A. Peron, S. Hind, and D. Charlton. 2005. When emotions get the better of us:

Copyright © National Academy of Sciences. All rights reserved.

The Self-Correcting Nature of Science

The methods and culture of scientific research enable it to be a self-correcting enterprise. Because researchers are, by definition, creating new understanding, they must be as cautious as possible before asserting a new "truth." Also, because researchers are working at a frontier, few others may have the knowledge to catch and correct any errors they make. Thus, science has had to develop means of revisiting provisional results and revealing errors before they are widely used. The processes of peer review, publication, collegial interactions (e.g., sharing at conferences), and the involvement of graduate students (who are expected to question as they learn) all support this need. Science is characterized also by a culture that encourages and rewards critical questioning of past results and of colleagues. Most technologies benefit from a solid research foundation in academia and ample opportunity for peer-to-peer stimulation and critical assessment, review and critique through conferences, seminars, publishing, and more. These elements provide a rich set of paths through which new ideas and skepticism can travel and opportunities for scientists to step away from their day-to-day work and take a longer-term view. The scientific culture encourages cautious, precise statements and discourages statements that go beyond established facts; it is acceptable for colleagues to challenge one another, even if the challenger is more junior. The forensic science disciplines will profit enormously by full adoption of this scientific culture.

CONCLUSION

The way in which science is conducted is distinct from, and complementary to, other modes by which humans investigate and create. The methods of science have a long history of successfully building useful and trustworthy knowledge and filling gaps while also correcting past errors. The premium that science places on precision, objectivity, critical thinking, careful observation and practice, repeatability, uncertainty management, and peer review enables the reliable collection, measurement, and interpretation of clues in order to produce knowledge.

The effects of contextual top-down processing on matching fingerprints. *Journal of Applied Cognitive Psychology* 19:799-809; and B. Schiffer and C. Champod. 2007. The potential (negative) influence of observational biases at the analysis stage of fingerprint individualization. *Forensic Science International* 167:116-120.

Copyright © National Academy of Sciences. All rights reserved.

Copyright © National Academy of Sciences. All rights reserved.

5

Descriptions of Some Forensic Science Disciplines

This chapter describes the methods of some of the major forensic science disciplines. It focuses on those that are used most commonly for investigations and trials as well as on those that have been cause for concern in court or elsewhere because their reliability has not been sufficiently established in a systematic (scientific) manner in accordance with the principles discussed in Chapter 4. The chapter focuses primarily on the forensic science disciplines' capability for providing evidence that can be presented in court. As such, there is considerable discussion about the reliability and precision of results—attributes that factor into probative value and admissibility decisions. It should be recalled, however, that forensic science also provides great value to law enforcement investigations, and even those forensic science disciplines whose scientific foundation is currently limited might have the capacity (or the potential) to provide probative information to advance a criminal investigation.[1] This chapter also provides the committee's summary assessment of each of these disciplines.[2]

[1] For example, forensic odontology might not be sufficiently grounded in science to be admissible under *Daubert*, but this discipline might be able to reliably exclude a suspect, thereby enabling law enforcement to focus its efforts on other suspects. And forensic science methods that do not meet the standards of admissible evidence might still offer leads to advance an investigation.

[2] The chapter does not discuss eyewitness identification or line-ups, because these techniques do not normally rely on forensic scientists for analysis or implementation. They clearly are of major importance for investigations and trials, and their effective use and interpretation relies on scientific knowledge and continuing research. For similar reasons, this chapter does not delve into the polygraph. The validity of polygraph testing for security screening was addressed

Copyright © National Academy of Sciences. All rights reserved.

Because forensic science aims to glean information from a wide variety of clues and evidence associated with a crime, it deals with a broad range of tools and with evidence of highly variable quality. In general, the forensic science disciplines are pragmatic, with practitioners adopting, adapting, or developing whatever tools and technological aids they can to distill useful information from crime scene evidence. Many forensic science methods have been developed in response to such evidence—combining experience-based knowledge with whatever relevant science base exists in order to create a procedure that returns useful information. Although some of the techniques used by the forensic science disciplines—such as DNA analysis, serology, forensic pathology, toxicology, chemical analysis, and digital and multimedia forensics—are built on solid bases of theory and research, many other techniques have been developed heuristically. That is, they are based on observation, experience, and reasoning without an underlying scientific theory, experiments designed to test the uncertainties and reliability of the method, or sufficient data that are collected and analyzed scientifically.

In the course of its deliberations, the committee received testimony from experts in many forensic science disciplines concerning current practices, validity, reliability and errors, standards, and research.[3] From this testimony and from many written submissions, as well as from the personal experiences of the committee members, the committee developed the consensus views presented in this chapter.

BIOLOGICAL EVIDENCE

Biological evidence is provided by specimens of a biological origin that are available in a forensic investigation. Such specimens may be found at the scene of a crime or on a person, clothing, or weapon. Some—for example, pet hairs, insects, seeds, or other botanical remnants—come from the crime scene or from an environment through which a victim or suspect has recently traversed. Other biological evidence comes from specimens obtained directly from the victim or suspect, such as blood, semen, saliva, vaginal secretions, sweat, epithelial cells, vomitus, feces, urine, hair, tissue, bones, and microbiological and viral agents. The most common types of biological evidence collected for examination are blood, semen, and saliva. Human biological evidence that contains nuclear DNA can be particularly valuable because the possibility exists to associate that evidence with one individual with a degree of reliability that is acceptable for criminal justice.

---

in National Research Council, Committee to Review the Scientific Evidence on the Polygraph. 2003. *The Polygraph and Lie Detection*. Washington, DC: The National Academies Press. It does not cover forensic pathology, because that field is addressed in Chapter 9.

[3] A complete list of those who provided testimony to the committee is included in Appendix B.

Copyright © National Academy of Sciences. All rights reserved.

Sample Data and Collection

At the crime scene, biological evidence is located, documented, collected, and preserved for subsequent analysis in the crime laboratory. Locating and recognizing biological evidence can be more difficult than a layperson would presume. For example, blood is not always red, some red substances are not blood, and most biological evidence, such as saliva or semen, is not readily visible. Crime scene investigators locate biological evidence through tests that screen for the presence of a particular biological fluid (e.g., blood, semen, saliva), and investigators have a choice of techniques.[4] For blood they might use an alternate light source (ALS) at 415nm, the wavelength under which bloodstains absorb light and are thus more visible to the naked eye. Most commonly, though, the screening test for blood is a catalytic chemical test that turns color or luminesces in the presence of blood. Scene investigators may also use Luminol, fluorescein, or crystal violet to identify areas at the scene where attempts were made to clean a bloody crime scene.

These tests for blood may also locate other evidence that should be collected and taken to the laboratory for analysis. Recently, immunological tests that can identify human hemoglobin or glycophorin A have become available. These are blood-specific proteins that can be demonstrated to be of human origin. At some point in the future, these immunological tests may replace standard chemical tests, and, although more expensive, they are more specific because they identify blood conclusively instead of just presumptively. Investigators also have several techniques for locating semen at the crime scene. Commonly they rely on an ALS, under which semen, other biological fluids, and some other evidence will luminesce. More recently, immunological tests can be used to identify seminal plasma proteins, for example, prostate specific antigen (p30 or PSA) or semenogelin.[5]

Finding saliva at the scene is mostly happenstance. Although it luminesces with the ALS at specific wavelengths, the glow is not as strong, and a weaker ALS light source may not highlight it well and possibly not at all. Thus, it can be easily missed. Screening tests for saliva are chemical tests that identify amylase, an enzyme occurring in high concentrations in saliva. But the screening is not definitive, because other types of tissue also

[4] Interpreting the results of any screening test requires expertise and experience. Many crime scene investigators have the requisite experience, but they may lack a scientific background, and it is not always straightforward to correctly interpret the results of screening tests. Crime scene investigations that require science-based screening tools are most reliable if someone is involved who understands the physics and chemistry of those tools.

[5] I. Sato, M. Sagi, A. Ishiwari, H. Nishijima, E. Ito, and T. Mukai. 2002. Use of the "SMITEST" PSA card to identify the presence of prostate-specific antigen in semen and male urine. *Forensic Science International* 127(1-2):71-74.

Copyright © National Academy of Sciences. All rights reserved.

contain amylase, including the particular type (AMY 1) that is associated with saliva.

Analyses

Although the forensic use of nuclear DNA is barely 20 years old, DNA typing is now universally recognized as the standard against which many other forensic individualization techniques are judged. DNA enjoys this preeminent position because of its reliability and the fact that, absent fraud or an error in labeling or handling, the probabilities of a false positive are quantifiable and often miniscule. However, even a very small (but nonzero) probability of false positive can affect the odds that a suspect is the source of a sample with a matching DNA profile.[6] The scientific bases and reliability of other types of biological analysis are also well established, but absent nuclear DNA, they can only narrow the field of suspects, not suggest any particular individual.

Testing biological evidence in the laboratory involves the use of a logical sequence of analyses designed to identify what a substance is and then from whom it came. The sequence begins with a forensic biologist locating the substance on the evidence. This is followed by a presumptive test that would give more information about the substance, typically using the same tests employed by scene investigators: the ALS, enzymatic, chemical, or immunological tests. Once the material (e.g., blood, semen, or saliva) is known, an immunological test or a human DNA test is run to determine whether the sample comes from a human or an animal.

The final step in the analytical sequence procedure is to identify the source of the biological material. If a sufficient sample is present and is probative, the forensic biologist prepares the material for DNA testing. The analyst who conducts the DNA test may or may not be the same person who examines the original physical evidence, depending on laboratory policies.

A decision might be required regarding the type of DNA testing to employ. Two primary types of DNA tests are conducted in U.S. forensic laboratories: nuclear testing and mitochondrial DNA (mtDNA) testing, with several variations of the former. For most biological evidence having evidentiary significance, forensic DNA laboratories employ nuclear testing routinely,[7] and testing for the 13 core Short Tandem Repeat (STR)

[6] W.C. Thompson, F. Taroni, and C.G.G. Aitken. 2003. How the probability of a false positive affects the value of DNA evidence. *Journal of Forensic Sciences* 48(1):47-54.

[7] T.R. Moretti, A.L. Baumstark, D.A. Defenbaugh, K.M. Keys, J.B. Smerick, and B. Budowle B. 2001. Validation of short tandem repeats (STRs) for forensic usage: Performance testing of fluorescent multiplex STR systems and analysis of authentic and simulated forensic samples. *Journal of Forensic Sciences* 46(3):647-660.

Copyright © National Academy of Sciences. All rights reserved.

polymorphisms is the first line of attack.[8] The results are entered into the Federal Bureau of Investigation's (FBI's) Combined DNA Indexing System (CODIS) and are searched against DNA profiles already in one of three databases: a convicted felon database, a forensic database containing DNA profiles from crime scenes, and a database of DNA from unidentified persons.

Sometimes the evidence dictates testing just for Y STRs, which assesses only the Y (male) chromosome. In sexual assaults for which only small amounts of male nuclear DNA are available (e.g., a large excess of vaginal DNA), it is possible to obtain a Y STR profile of the male who left the semen. Unlike the 13 core loci used in CODIS searches, where a match of all 13 is a strong indicator that both samples come from the same individual, Y STR testing is not as definitive with respect to identifying a single person. A third nuclear test involves the analysis of single nucleotide polymorphisms (SNPs). Although no public forensic DNA laboratory in the United States is routinely analyzing forensic evidence for SNPs, the utility of this genomic information for cases in which the DNA is too damaged to allow standard testing has garnered attention since its use in the World Trade Center identification effort.[9]

If insufficient nuclear DNA is present for STR testing, or if the existing nuclear DNA is degraded, two options potentially are available. One technique amplifies the amount of DNA available, although this technique is not widely available in U.S. forensic laboratories. A second alternative is to sequence mitochondrial DNA (mtDNA). Since 1996, it has been possible to compare single-source crime scene samples and samples from the victim or defendant on the basis of mtDNA. Four FBI-supported mtDNA laboratories and a few private mtDNA laboratories conduct DNA casework. This technique has been particularly helpful with regard to hairs—which do not contain enough nuclear DNA to enable analysis with current methods unless the root is present—and bones and teeth. Because it measures only a single locus of the genome, mtDNA analysis is much less discriminating than nuclear DNA analysis; all people with a common female ancestor (within the past few generations) share a common profile. But mtDNA testing has forensic value in its ability to include or exclude an individual as its source.

Laboratories entering the results of forensic DNA testing into CODIS must meet specific quality guidelines, which include the requirement that

[8] Some laboratories are now using 16 loci, 13 of which are the original core loci.

[9] B. Leclair, R. Shaler, G.R. Carmody, K. Eliason, B.C.Hendrickson, T. Judkins, M.J. Norton, C. Sears, and T. Scholl. 2007. Bioinformatics and human identification in mass fatality incidents: The World Trade Center disaster. *Journal of Forensic Sciences* 52(4):806-819. Epub May 25, 2007.

Copyright © National Academy of Sciences. All rights reserved.

the laboratory be accredited and that specific procedures be in place and followed. In accredited laboratories, forensic DNA personnel must take proficiency tests and must meet specific educational and training requirements. (See Chapter 8 for further discussion.) Laboratory analyses are conducted by scientists with degrees ranging from a bachelor's degree in science to a doctoral degree. Each forensic DNA laboratory has a technical leader, who normally must meet additional experience and educational requirements.

Although DNA laboratories are expected to conduct their examinations under stringent quality controlled environments, errors do occasionally occur. They usually involve situations in which interpretational ambiguities occur or in which samples were inappropriately processed and/or contaminated in the laboratory. Errors also can occur when there are limited amounts of DNA, which limits the amount of test information and increases the chance of misinterpretation. Casework reviews of mtDNA analysis suggest a wide range in the quality of testing results that include contamination, inexperience in interpreting mixtures, and differences in how a test is conducted.[10]

Reporting of Results

FBI quality guidelines require that reports from forensic DNA analysis must contain, at a minimum, a description of the evidence examined, a listing of the loci analyzed, a description of the methodology, results and/or conclusions, and an interpretative statement (either quantitative or qualitative) concerning the inference to be drawn from the analysis.[11]

---

[10] Personal communication, Terry Melton, Mitotyping Laboratory. December 2007. See also L. Prieto; A. Alonso; C. Alves; M. Crespillo; M. Montesino; A. Picornell; A. Brehm; J.L. Ramirez; M.R. Whittle; M.J. Anjos; I. Boschi; J. Buj; M. Cerezo; S. Cardoso; R. Cicarelli; D. Comas; D. Corach; C. Doutremepuich; R.M. Espinheira; I. Fernandez-Fernandez; S. Filippini; Julia Garcia-Hirschfeld; A. Gonzalez; B. Heinrichs; A. Hernandez; F.P.N. Leite; R.P. Lizarazo; A.M. Lopez-Parra; M. Lopez-Soto; J.A. Lorente; B. Mechoso; I. Navarro; S. Pagano; J.J. Pestano; J. Puente; E. Raimondi; A. Rodriguez-Quesada; M.F. Terra-Pinheiro; L. Vidal-Rioja; C. Vullo; A. Salas. 2008. GEP-ISFG collaborative exercise on mtDNA: Reflections about interpretation, artefacts and DNA mixtures. *Forensic Science International: Genetics* 2(2):126-133; and A. Salas, L. Prieto, M. Montesino, C. Albarrán, E. Arroyo, M. Paredes-Herrera, A. Di Lonardo, C. Doutremepuich, I. Fernández-Fernández, A. de la Vega. 2005. Mitochondrial DNA error prophylaxis: Assessing the causes of errors in the GEP'02-03 proficiency testing trial. *Forensic Science International* 148(2-3):191-198.

[11] DNA Advisory Board. 2000. Quality assurance standards for forensic DNA testing laboratories. *Forensic Science Communications* 2(3). Available at www.bioforensics.com/conference04/TWGDAM/Quality_Assurance_Standards_2.pdf.

Copyright © National Academy of Sciences. All rights reserved.

Summary Assessment

Unlike many forensic techniques that were developed empirically within the forensic science community, with limited foundation in scientific theory or analysis, DNA analysis is a fortuitous by-product of cutting-edge science. Eminent scientists contributed their expertise to ensuring that DNA evidence offered in a courtroom would be valid and reliable (e.g., in the 1989 New York case, *People v. Castro*), and by 1996 the National Academy of Sciences had convened two committees that issued influential recommendations on handling DNA forensic science.[12] As a result, principles of statistics and population genetics that pertain to DNA evidence were clarified, the methods for conducting DNA analyses and declaring a match became less subjective, and quality assurance and quality control protocols were designed to improve laboratory performance.

DNA analysis is scientifically sound for several reasons: (1) there are biological explanations for individual-specific findings; (2) the 13 STR loci used to compare DNA samples were selected so that the chance of two different people matching on all of them would be extremely small; (3) the probabilities of false positives have been explored and quantified in some settings (even if only approximately); (4) the laboratory procedures are well specified and subject to validation and proficiency testing; and (5) there are clear and repeatable standards for analysis, interpretation, and reporting. DNA analysis also has been subjected to more scrutiny than any other forensic science discipline, with rigorous experimentation and validation performed prior to its use in forensic investigations. As a result of these characteristics, the probative power of DNA is high. Of course, DNA evidence is not available in every criminal investigation, and it is still subject to errors in handling that can invalidate the analysis. In such cases, other forensic techniques must be applied. The probative power of these other methods can be high, alone or in combination with other evidence. This power likely can be improved by strengthening the methods' scientific foundations and practice, as has occurred with forensic DNA analysis.

ANALYSIS OF CONTROLLED SUBSTANCES

The term "illicit drugs" is widely used to describe abused substances. Other terms that are used include "abused drugs," "illegal drugs," "street drugs," and, in the United States, "controlled substances." The latter term refers specifically to drugs that are controlled by federal and state laws.[13]

[12] National Research Council. 1992. *DNA Technology in Forensic Science*. Washington, DC: National Academy Press; National Research Council. 1996. *The Evaluation of Forensic DNA Evidence: An Update*. Washington, DC: National Academy Press.

[13] See, e.g., 21 U.S.C.A. § 802(6).

Copyright © National Academy of Sciences. All rights reserved.

The analysis of controlled substances is a mature forensic science discipline and one of the areas with a strong scientific underpinning. The analytical methods used have been adopted from classical analytical chemistry, and there is broad agreement nationwide about best practices.[14] In 1997, the U.S. Drug Enforcement Administration and the Office of National Drug Control Policy co-sponsored the formation of the Technical Working Group for the Analysis of Seized Drugs, now known as the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG). This organization brings together more than 20 forensic practitioners from all over the world to develop standards for the analysis and reporting of illicit drug cases. Their standards are being widely adopted by drug analysis laboratories in the United States and worldwide.

Sample Data and Collection

Controlled substances typically are seized by police officers, narcotics agents, and detectives through undercover buys, raids on drug houses and clandestine drug laboratories, and seizures on the streets. In some cases, forensic chemists are sent to clandestine laboratory operations to help render the laboratory safe and help with evidence collection. The seized drugs may be in the form of powders or adulterated powders, chunks of smokeable or injectable material, legitimate and clandestine tablets and capsules, or plant materials or plant extracts.

Analyses

Controlled substances are analyzed by well-accepted standard schemes or protocols. Few drug chemists have the requisite botanical background to identify any common illicit plants other than marijuana; thus, in cases that require botanical identification, the assistance of outside experts is enlisted.

Sampling can be a major issue in the analysis of controlled substances. Although sometimes only trace amounts of a drug are present (e.g., in a syringe used to inject heroin), at other times there are hundreds or thousands of packages of drugs or very large bags or bales. SWGDRUG and others have proposed statistical and nonstatistical methods for sampling,[15] and a wide variety of methods are used.

Most controlled substances are subjected first to a field test for pre-

[14] See F. Smith and J.A. Siegel (eds.). 2004. *Handbook of Forensic Drug Analysis*. Burlington, MA: Academic Press.

[15] Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG) Recommendations. Available at www.swgdrug.org/approved.htm.

Copyright © National Academy of Sciences. All rights reserved.

sumptive identification. This is followed by gas chromatography-mass spectrometry (GC-MS), in which chromatography separates the drug from any diluents or excipients, and then mass spectrometry is used to identify the drug. This is the near universal test for identifying unknown substances. Marijuana is an exception, because it is identified normally through a sequence of tests—a presumptive color test, followed by low-powered microscopic identification, and finally by thin-layer chromatography.

Reporting of Results

Most drug chemists produce terse reports for attorneys and courts. The reports contain administrative data and a short description of the evidence. The weight or number of exhibits is stated and then the results of the analysis. A typical report for a marijuana case might read as follows:

Received:	Item 1—a sealed plastic bag containing 25.6 g of green-brown plant material.
Results:	The green-brown plant material in item 1 was identified as marijuana.

Some laboratories might mention the tests that were conducted, but in most cases the spectra, chromatograms, and other evidence of the analysis and the chemist's notes are not submitted. Likewise, possible sources of error and statistical data are not commonly included. From a scientific perspective, this style of reporting is often inadequate, because it may not provide enough detail to enable a peer or other courtroom participant to understand and, if needed, question the sampling scheme, process(es) of analysis, or interpretation.

Summary Assessment

The chemical foundations for the analysis of controlled substances are sound, and there exists an adequate understanding of the uncertainties and potential errors. SWGDRUG has established a fairly complete set of recommended practices.[16] It also provides pointers to a number of guidelines for statistical sampling, both for illegal drugs per se (created by the European Network of Forensic Science Institutes) and for materials more generally (created by the American Society for Testing and Materials).

The SWGDRUG recommendations include a menu of analytical chemistry techniques that are considered acceptable in certain circumstances. Because this menu was constructed to be applicable worldwide, it includes

[16] See www.swgdrug.org/approved.htm.

Copyright © National Academy of Sciences. All rights reserved.

options that allow laboratories to substitute a concatenation of simple methods if they do not have access to the preferred analytical equipment (e.g., GC-MS). It is questionable, however, whether all of the possible combinations recommended by SWGDRUG would be acceptable in a scientific sense, if one's goal were to identify and classify a completely unknown substance. The committee has been told that experienced forensic chemists and good forensic laboratories understand which tests (or combinations of tests) provide adequate reliability, but the SWGDRUG recommendations do not ensure that these tests will be used. This ambiguity would be a less significant issue if the reports presented in court contained sufficient detail about the methods of analysis.

FRICTION RIDGE ANALYSIS

Fingerprints, palm prints, and sole prints have been used to identify people for more than a century in the United States. Collectively, the analysis of these prints is known as "friction ridge analysis," which consists of experience-based comparisons of the impressions left by the ridge structures of volar (hands and feet) surfaces. Friction ridge analysis is an example of what the forensic science community uses as a method for assessing "individualization"—the conclusion that a piece of evidence (here, a pattern left by friction ridges) comes from a single unambiguous source. Friction ridge analysis shares similarities with other experience-based methods of pattern recognition, such as those for footwear and tire impressions, toolmarks, and handwriting analysis, all of which are discussed separately below.

Friction ridge analysis is performed in various settings, including accredited crime laboratories and nonaccredited facilities. Nonaccredited facilities may be crime laboratories, police "identification units," or private practice (consultants). In some instances, the latent print examiner is employed solely to perform latent print casework. Some examiners may also perform other types of forensic casework (e.g., footwear and tire impressions, firearms analysis). In some agencies, fingerprint examiners also are required to respond to crime scenes and can be sworn officers who also perform police officer/detective duties.

The training of personnel to perform latent print identifications varies from agency to agency. Agencies may have a formalized training program, may use an informal mentoring process, or may send new examiners to a one- to two-week course. The International Association for Identification (IAI) offers a training publication, "Friction Ridge Skin Identification Training Manual,"[17] and the Scientific Working Group on Friction Ridge

[17] International Association for Identification. *Friction Ridge Skin Identification Training Manual*. Available at www.theiai.org.

Copyright © National Academy of Sciences. All rights reserved.

Analysis, Study and Technology (SWGFAST) offers a guideline, "Training to Competency for Latent Print Examiners."[18] Although these are excellent resources, they are not required, and there is no auditing of the content of training programs developed by nonaccredited agencies. The IAI also offers a certification test that measures both the knowledge and skill of latent print examiners; however, not all agencies require latent print examiners to achieve and maintain certification.

Method of Data Collection and Analysis

The technique used to examine prints made by friction ridge skin is described by the acronym ACE-V: "Analysis, Comparison, Evaluation, and Verification."[19] It has been described in forensic literature as a means of comparative analysis of evidence since 1959.[20] The process begins with the analysis of the unknown friction ridge print (now often a digital image of a latent print). Many factors affect the quality and quantity of detail in the latent print and also introduce variability in the resulting impression. The examiner must consider the following:

(1) Condition of the skin—natural ridge structure (robustness of the ridge structure), consequences of aging, superficial damage to the skin, permanent scars, skin diseases, and masking attempts.
(2) Type of residue—natural residue (sweat residue, oily residue, combinations of sweat and oil); other types of residue (blood, paint, etc.); amount of residue (heavy, medium, or light); and where the residue accumulates (top of the ridge, both edges of the ridge, one edge of the ridge, or in the furrows).
(3) Mechanics of touch—underlying structures of the hands and feet (bone creates areas of high pressure on the surface of the skin); flexibility of the ridges, furrows, and creases; the distance adjacent ridges can be pushed together or pulled apart during lateral movement; the distance the length of a ridge might be compressed or stretched; the rotation of ridge systems during torsion; and the effect of ridge flow on these factors.
(4) Nature of the surface touched—texture (rough or smooth), flexibility (rigid or pliable), shape (flat or curved), condition (clean or dirty), and background colors and patterns.

[18] SWGFAST. 2002. *Training to Competency for Latent Print Examiners*. Available at www.SWGFAST.org.

[19] Ashbaugh, op. cit.; Triplette and Cooney, op. cit.; J. Vanderkolk. 2004. ACE-V: A model. *Journal of Forensic Identification* 54(1):45-52; SWGFAST. 2002. *Friction Ridge Examination Methodology for Latent Print Examiners*. Available at www.SWGFAST.org.

[20] R.A. Huber. 1959-1960. Expert witness. *Criminal Law Quarterly* 2:276-296.

Copyright © National Academy of Sciences. All rights reserved.

(5) Development technique—chemical signature of the technique and consistency of the chemical signature across the impression.
(6) Capture technique—photograph (digital or film) or lifting material (e.g., tape or gelatin lifter).
(7) Size of the latent print or the percentage of the surface that is available for comparison.

The examiner also must perform an analysis of the known prints (taken from a suspect or retrieved from a database of fingerprints), because many of the same factors that affect the quality of the latent print can also affect the known prints.

If the latent print does not have sufficient detail for either identification or exclusion, it does not undergo the remainder of the process (comparison and evaluation). These insufficient prints are often called "of no value" or "not suitable" for comparison. Poor-quality known prints also will end the examination. If the examiner deems that there is sufficient detail in the latent print (and the known prints), the comparison of the latent print to the known prints begins.

Visual comparison consists of discerning, visually "measuring," and comparing—within the comparable areas of the latent print and the known prints—the details that correspond. The amount of friction ridge detail available for this step depends on the clarity of the two impressions. The details observed might include the overall shape of the latent print, anatomical aspects, ridge flows, ridge counts, shape of the core, delta location and shape, lengths of the ridges, minutia location and type, thickness of the ridges and furrows, shapes of the ridges, pore position, crease patterns and shapes, scar shapes, and temporary feature shapes (e.g., a wart).

At the completion of the comparison, the examiner performs an evaluation of the agreement of the friction ridge formations in the two prints and evaluates the sufficiency of the detail present to establish an identification (source determination).[21] Source determination is made when the examiner concludes, based on his or her experience, that sufficient quantity and quality of friction ridge detail is in agreement between the latent print and the known print. Source exclusion is made when the process indicates sufficient disagreement between the latent print and known print. If neither an identification nor an exclusion can be reached, the result of the comparison is inconclusive. Verification occurs when another qualified examiner repeats the observations and comes to the same conclusion, although the second examiner may be aware of the conclusion of the first. A more complete de-

[21] Ashbaugh, op. cit.; SWGFAST. 2002. *Friction Ridge Examination Methodology for Latent Print Examiners.*

Copyright © National Academy of Sciences. All rights reserved.

scription of the steps of ACE-V and an analysis of its limitations is provided in a paper by Haber and Haber.[22]

Although some Automated Fingerprint Identification Systems (AFIS) permit fully automated identification of fingerprint records related to criminal history (e.g., for screening job applicants), the assessment of latent prints from crime scenes is based largely on human interpretation. Note that the ACE-V method does not specify particular measurements or a standard test protocol, and examiners must make subjective assessments throughout. In the United States, the threshold for making a source identification is deliberately kept subjective, so that the examiner can take into account both the quantity and quality of comparable details. As a result, the outcome of a friction ridge analysis is not necessarily repeatable from examiner to examiner. In fact, recent research by Dror[23] has shown that experienced examiners do not necessarily agree with even their own past conclusions when the examination is presented in a different context some time later.

This subjectivity is intrinsic to friction ridge analysis, as can be seen when comparing it with DNA analysis. For the latter, 13 specific segments of DNA (generally) are compared for each of two DNA samples. Each of these segments consists of ordered sequences of the base pairs, called A, G, C, and T. Studies have been conducted to determine the range of variation in the sequence of base pairs at each of the 13 loci and also to determine how much variation exists in different populations. From these data, scientists can calculate the probability that two DNA samples from different people will have the same permutations at each of the 13 loci.

By contrast, before examining two fingerprints, one cannot say a priori which features should be compared. Features are selected during the comparison phase of ACE-V, when a fingerprint examiner identifies which features are common to the two impressions and are clear enough to be evaluated. Because a feature that was helpful during a previous comparison might not exist on these prints or might not have been captured in the latent impression, the process does not allow one to stipulate specific measurements in advance, as is done for a DNA analysis. Moreover, a small stretching of distance between two fingerprint features, or a twisting of angles, can result from either a difference between the fingers that left the prints or from distortions from the impression process. For these reasons, population statistics for fingerprints have not been developed, and friction ridge analysis relies on subjective judgments by the examiner. Little research

[22] L. Haber and R.N. Haber. 2008. Scientific validation of fingerprint evidence under *Daubert*. *Law, Probability, and Risk* 7(2):87-109.

[23] I.E. Dror and D. Charlton. 2006. Why experts make errors. *Journal of Forensic Identification* 56(4):600-616.

Copyright © National Academy of Sciences. All rights reserved.

has been directed toward developing population statistics, although more would be feasible.[24]

Methods of Interpretation

The determination of an exclusion can be straightforward if the examiner finds detail in the latent print that does not match the corresponding part of the known print, although distortions or poor image quality can complicate this determination. But the criteria for identification are much harder to define, because they depend on an examiner's ability to discern patterns (possibly complex) among myriad features and on the examiner's experience judging the discriminatory value in those patterns. The clarity of the prints being compared is a major underlying factor. For 10-print fingerprint cards, which tend to have good clarity, even automated pattern-recognition software (which is not as capable as human examiners) is successful enough in retrieving matching sets from databases to enjoy widespread use. When dealing with a single latent print, however, the interpretation task becomes more challenging and relies more on the judgment of the examiner. The committee heard presentations from friction ridge experts who assured it that friction ridge identification works well when a careful examiner works with good-quality latent prints. Clearly, the reliability of the ACE-V process could be improved if specific measurement criteria were defined. Those criteria become increasingly important when working with latent prints that are smudged and incomplete, or when comparing impressions from two individuals whose prints are unusually similar.

The fingerprint community continues to assert that the ability to see latent print detail is an acquired skill attained only through repeated exposure to friction ridge impressions. In their view, a lengthy apprenticeship (typically two years, at the FBI Laboratory) with an experienced latent print examiner enables a new examiner to develop a sense of the rarity of features and groups of features; the rarity of particular kinds of ridge flows; the frequency of features in different areas of the hands and feet; the degree to which differences can be accounted for by mechanical distortion of the skin; a sense of how to extract detail from background noise; and a sense of how much friction ridge detail could be common to two prints from different

[24] See, e.g., E. Gutiérrez, V. Galera, J.M. Martínez, and C. Alonso. 2007. Biological variability of the minutiae in the fingerprints of a sample of the Spanish population. *Forensic Science International* 172(2-3):98-105. For information about the basic availability of data, see C. Champod, C.J. Lennard, P.A. Margot, and M. Stoilovic. 2004. *Fingerprints and other ridge skin impressions*. Boca Raton, FL: CRC Press; D.A. Stoney. 2001. "Measurement of Fingerprint Individuality." In: H.C. Lee and R.E. Gaensslen (eds.). *Advances in Fingerprint Technology*. 2nd ed. Boca Raton, FL: CRC Press; pp. 327-387.

Copyright © National Academy of Sciences. All rights reserved.

sources.[25] From this base of experience, the fingerprint community asserts that the latent print examiner learns to judge whether there is sufficient detail (which varies with image quality) to make a source determination during the evaluation phase of ACE-V.

The latent print community in the United States has eschewed numerical scores and corresponding thresholds, because those developed to date[26] have been based only on minutia, not on the unique features of the friction ridge skin (e.g., lengths of ridges, shapes of ridges, crease lengths and shapes, scar lengths and shapes). Additionally, thresholds based on counting the number of features that correspond, lauded by some as being more "objective," are still based on primarily subjective criteria—an examiner must have the visual expertise to discern the features (most important in low-clarity prints) and must determine that they are indeed in agreement. A simple point count is insufficient for characterizing the detail present in a latent print; more nuanced criteria are needed, and, in fact, likely can be determined.

Reporting of Results

SWGFAST has promulgated three acceptable conclusions resulting from latent print comparison: individualization (or identification), exclusion, or inconclusive.[27] Although adherence to this standard is common, some latent print examiners report either "identification" or "negative" results. "Negative" (or sometimes "not identified") is an ambiguous conclusion, and it could mean excluded, inconclusive, or unable to locate after exhaustive search. It is problematic that the meaning of "negative" may be specific to a particular agency, examiner, or case.

Latent print examiners report an individualization when they are confident that two different sources could not have produced impressions with the same degree of agreement among details. This is a subjective assessment. There has been discussion regarding the use of statistics to assign match probabilities based on population distributions of certain friction ridge features. Current published statistical models, however, have not matured past counts of corresponding minutia and have not taken clarity into consideration. (This area is ripe for additional research.) As a result, the friction ridge community actively discourages its members from testifying in terms of the probability of a match; when a latent print examiner testifies that two

[25] T. Busey and J. Vanderkolk. 2005. Behavioral and electrophysiological evidence for configural processing in fingerprint experts. *Vision Research* 45:431-448.

[26] See, e.g., I.W. Evett and R.A. Williams. 1996. A review of the sixteen points fingerprint standard in England and Wales. *Journal of Forensic Identification* 46(1):49-73.

[27] SWGFAST. 2002. *Friction Ridge Examination Methodology for Latent Print Examiners.* Available at www.swgfast.org/Training_to_Competency_for_Latent_Print_Examiners_2.1.pdf.

Copyright © National Academy of Sciences. All rights reserved.

impressions "match," they are communicating the notion that the prints could not possibly have come from two different individuals.

As noted in Chapter 3, Jennifer Mnookin of the University of California, Los Angeles School of Law summarized the reporting of fingerprint analyses as follows:

> At present, fingerprint examiners typically testify in the language of absolute certainty. Both the conceptual foundations and the professional norms of latent fingerprinting prohibit experts from testifying to identification unless they believe themselves certain that they have made a correct match. Experts therefore make only what they term 'positive' or 'absolute' identifications—essentially making the claim that they have matched the latent print to the one and only person in the entire world whose fingertip could have produced it . . . Given the general lack of validity testing for fingerprinting; the relative dearth of difficult proficiency tests; the lack of a statistically valid model of fingerprinting; and the lack of validated standards for declaring a match, such claims of absolute, certain confidence in identification are unjustified . . . Therefore, in order to pass scrutiny under Daubert, fingerprint identification experts should exhibit a greater degree of epistemological humility. Claims of 'absolute' and 'positive' identification should be replaced by more modest claims about the meaning and significance of a 'match.'[28]

Summary Assessment

Historically, friction ridge analysis has served as a valuable tool, both to identify the guilty and to exclude the innocent. Because of the amount of detail available in friction ridges, it seems plausible that a careful comparison of two impressions can accurately discern whether or not they had a common source. Although there is limited information about the accuracy and reliability of friction ridge analyses, claims that these analyses have zero error rates are not scientifically plausible.

ACE-V provides a broadly stated framework for conducting friction ridge analyses. However, this framework is not specific enough to qualify as a validated method for this type of analysis. ACE-V does not guard against bias; is too broad to ensure repeatability and transparency; and does not guarantee that two analysts following it will obtain the same results. For these reasons, merely following the steps of ACE-V does not imply that one is proceeding in a scientific manner or producing reliable results. A recent

[28] J.L. Mnookin. 2008. The validity of latent fingerprint identification: Confessions of a fingerprinting moderate. *Law, Probability and Risk* 7:127. See also the discussion in C. Champod. 2008. Fingerprint examination: Towards more transparency. *Law Probability and Risk* 7:111-118.

Copyright © National Academy of Sciences. All rights reserved.

paper by Haber and Haber[29] presents a thorough analysis of the ACE-V method and its scientific validity. Their conclusion is unambiguous: "We have reviewed available scientific evidence of the validity of the ACE-V method and found none."[30] Further, they state:

> [W]e report a range of existing evidence that suggests that examiners differ at each stage of the method in the conclusions they reach. To the extent that they differ, some conclusions are invalid. We have analysed the ACE-V method itself, as it is described in the literature. We found that these descriptions differ, no single protocol has been officially accepted by the profession and the standards upon which the method's conclusions rest have not been specified quantitatively. As a consequence, at this time the validity of the ACE-V method cannot be tested.[31]

Recent legal challenges, *New Hampshire vs. Richard Langill*[32] and *Maryland vs. Bryan Rose*,[33] have also highlighted two important issues for the latent print community: documentation and error rate. Better documentation is needed of each step in the ACE-V process or its equivalent. At the very least, sufficient documentation is needed to reconstruct the analysis, if necessary. By documenting the relevant information gathered during the analysis, evaluation, and comparison of latent prints and the basis for the conclusion (identification, exclusion, or inconclusive), the examiner will create a transparent record of the method and thereby provide the courts with additional information on which to assess the reliability of the method for a specific case. Currently, there is no requirement for examiners to document which features within a latent print support their reasoning and conclusions.

Error rate is a much more difficult challenge. Errors can occur with any judgment-based method, especially when the factors that lead to the ultimate judgment are not documented. Some in the latent print community argue that the method itself, if followed correctly (i.e., by well-trained examiners properly using the method), has a zero error rate. Clearly, this assertion is unrealistic, and, moreover, it does not lead to a process of method improvement. The method, and the performance of those who use it, are inextricably linked, and both involve multiple sources of error (e.g., errors in executing the process steps, as well as errors in human judgment).

Some scientific evidence supports the presumption that friction ridge patterns are unique to each person and persist unchanged throughout a

[29] Mnookin, op. cit.
[30] Ibid., p. 19.
[31] Ibid.
[32] 157 N.H. 77, 945 A.2d 1 (N.H., April 04, 2008).
[33] No. K06-0545 (MD Cir. Ct. Oct. 19, 2007).

Copyright © National Academy of Sciences. All rights reserved.

lifetime.[34] Uniqueness and persistence are necessary conditions for friction ridge identification to be feasible, but those conditions do not imply that anyone can reliably discern whether or not two friction ridge impressions were made by the same person. Uniqueness does not guarantee that prints from two different people are always sufficiently different that they cannot be confused, or that two impressions made by the same finger will also be sufficiently similar to be discerned as coming from the same source. The impression left by a given finger will differ every time, because of inevitable variations in pressure, which change the degree of contact between each part of the ridge structure and the impression medium. None of these variabilities—of features across a population of fingers or of repeated impressions left by the same finger—has been characterized, quantified, or compared.[35]

To properly underpin the process of friction ridge identification, additional research is also needed into ridge flow and crease pattern distributions on the hands and feet. This information could be used to limit the possible donor population of a particular print in a statistical approach and could provide examiners with a more robust understanding of the prevalence of different ridge flows and crease patterns. Additionally, more research is needed regarding the discriminating value of the various ridge formations and clusters of ridge formations.[36] This would provide examiners with a solid basis for the intuitive knowledge they have gained through experience and provide an excellent training tool. It also would lead to a good framework for future statistical models and provide the courts with additional information to consider when evaluating the reliability of the science. Recently, research has begun to build some of this basis.[37]

---

[34] F. Galton. 1892. *Fingerprints*. New York: MacMillan; H. Cummins and C. Midlo. 1943. *Finger Prints, Palms and Soles: An Introduction of Dermatoglyphics*. Philadelphia: The Blakiston Company; A. Hale. 1952. Morphogenesis of volar skin in the human fetus. *The American Journal of Anatomy* 91:147-173; S. Holt and L.S. Penrose. 1968. *The Genetics of Dermal Ridges*. Springfield, IL: Charles C Thomas Publishing; W. Montagna and P. Parakkal. 1974. *The Structure and Function of Skin*. New York: Academic Press; J. Raser and E. O'Shea. 2005. Noise in gene expression: Origins, consequences, and control. *Science* 39:2010-2013.

[35] Some in the friction ridge community point to an unpublished 1999 study by the Lockheed-Martin Corporation, the "50K vs. 50K Fingerprint Comparison Test," as evidence of the scientific validity of fingerprint "matchup." But that study has several major design and analysis flaws, as pointed out in D.H. Kaye. 2003. Questioning a courtroom proof of the uniqueness of fingerprints. *International Statistical Review* 71(3):524. Moreover, even if it were valid, the study provides only a highly optimistic estimate of the reliability of friction ridge analyses, biased toward highly favorable conditions.

[36] Haber and Haber also provide a sensible research agenda for enhancing the validity of fingerprint comparisons.

[37] E.g., C. Neumann, C. Champod, R. Puch-Solis, N. Egli, A. Anthonioz, and A. Bromage-Griffiths. 2007. Computation of likelihood ratios in fingerprint identification for configurations of any number of minutiae. *Journal of Forensic Sciences* 52(1):54-64; N.M. Egli,

Copyright © National Academy of Sciences. All rights reserved.

There is also considerable room for research on the various factors that affect the quality of latent prints (e.g., condition of the skin, residue, mechanics of touch). Formal research could provide examiners with additional tools to support or refute distortion explanations. Currently, distortion and quality issues are typically based on "common sense" explanations or on information that is passed down through oral tradition from examiner to examiner. A criticism of the latent print community is that the examiners can too easily explain a "difference" as an "acceptable distortion" in order to make an identification.[38]

OTHER PATTERN/IMPRESSION EVIDENCE: SHOEPRINTS AND TIRE TRACKS

Other pattern evidence, also referred to as impression evidence, occurs when an object such as a shoe or a tire leaves an impression at the crime scene or on another object or a person. Impressions can be either two dimensional, such as shoeprints in dust, or three dimensional, such as tire track impressions in mud. Shoeprints and tire tracks are common types of impression evidence examined by forensic examiners, but the list of potential types of impression evidence is long. Examples include bite marks, markings on bullets and cartridge cases, ear prints, lip prints, toolmarks, some bloodstain patterns, and glove prints.[39] Although there are general approaches concerning the analytical sequence of various types of impression evidence, each has its own set of characteristics. For example, some types of impression evidence, such as those arising from footwear and tires, require knowledge of manufacturing and wear, while other types, such as ear prints and bloodstain patterns, do not. Because footwear and tire track impressions comprise the bulk of the examinations conducted, the remarks in this section are specifically focused on these analyses. Bite marks, markings on bullets and cartridge cases, and bloodstain patterns are covered in later sections in this chapter.

C. Champod, and P. Margot. 2007. Evidence evaluation in fingerprint comparison and automated fingerprint identification systems—Modelling within finger variability. *Forensic Science International* 167(2-3):189-195.

[38] U.S. Department of Justice, Office of the Inspector General. 2006. *A Review of the FBI's Handling of the Brandon Mayfield Case*. Office of the Inspector General Oversight and Review Division, January.

[39] M. Liukkonen, H. Majamaa, and J. Virtanen. 1996. The role and duties of the shoeprint/toolmark examiner in forensic laboratories. *Forensic Science International* 82:99-108.

Copyright © National Academy of Sciences. All rights reserved.

Sample Data and Collection

Impression evidence at the scene is generally of two types: latent (invisible to the naked eye) or patent (visible). The quality of impression evidence left at the scene cannot be controlled, but failures in the initial scene work used to collect, preserve, and possibly enhance the evidence will degrade the quality of the evidence eventually used for comparative analysis. After documentation at the scene, the evidence is preserved and possibly enhanced using techniques such as those based on chemistry (e.g., metal detection), physical characteristics (e.g., super glue fuming, powder dusting, casting), or transfer onto a contrasting surface (e.g., electrostatic transfer or gel lifting). The quality of the enhanced impression that is used for comparison will depend largely on the experience, training, and scientific knowledge of the scene investigator as well as the agency's resources.

Although some analysis of impression evidence might begin at the scene, the comparison of scene evidence to known exemplars occurs in the laboratory. The educational background of forensic scientists who examine shoeprints and tire track impressions runs the gamut from a high school diploma to scientists with Ph.D.s. Identifications are largely subjective and are based on the examiner's experience and on the number of individual, identifying characteristics in common with a known standard.

Analyses

The goal of impression evidence analysis is to identify a specific source of the impression, and the analytical process that this follows generally is an accepted sequence: identifying the class (group) characteristics of the evidence, followed by locating and comparing individual, identifying (also termed accidental or random) characteristics.[40]

Class characteristics of footwear and tires result from repetitive, controlled processes that are typically mechanical, such as those used to manufacture items in quantity. Although defined similarly by various authors, Bodziak describes footwear class characteristics as "an intentional or unavoidable characteristic that repeats during the manufacturing process and is shared by one or more other shoes."[41] For tires, Nause defines class characteristics as, "[p]hysical characteristics acquired during the manufacturing process (made from the same mold) that tires have in common."[42] He continues, "Class characteristics can often be combined to limit a tire impression to a very select group within the overall group bearing similar class

[40] Ibid.

[41] W.J. Bodziak. 1999. *Footwear Impression Evidence–Detection, Recovery, and Examination.* Boca Raton, FL: CRC Press, 2nd ed., p. 329.

[42] Nause, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

characteristics. (In the field of forensic tire evidence, class characteristics often refer to such things as design, pattern, size, shape, mold variations, etc.)."[43] Regardless of the type of impression evidence, class characteristics are not sufficient to conclude that any one particular shoe or tire made the impression. That latter step—which is not always possible—requires comparison of the individual identifying characteristics on the impression evidence with those on a shoe or tire that is suspected of leaving the impression. These individual characteristics occur during the normal use of an item, sometimes called wear and tear,[44] and are created by "random, uncontrolled processes."[45] For footwear, Bodziak writes that "individual identifying characteristics are characteristics that result when something is randomly added to or taken away from a shoe outsole that either causes or contributes to making that shoe outsole unique."[46] Such characteristics might include cuts, scratches, gouges, holes, or random inclusions that result from manufacturing, such as bubbles, and those that result from adherent substances, such as rocks, chewing gum, papers, or twigs.

Following analysis of the impression, an identification is determined or ruled out according to the number of individual characteristics the evidence has in common with the suspected source. But there is no defined threshold that must be surpassed, nor are there any studies that associate the number of matching characteristics with the probability that the impressions were made by a common source. It is generally accepted that the specific number of characteristics needed to assign a definite positive identification depends on the quality and quantity of these accidental characteristics and the criteria established by individual laboratories.[47] According to Cassidy, many factors and accidental characteristics are required before a positive identification can be established; however, the most important are the examiner's experience, the clarity of the impression, and the uniqueness of the characteristic.[48] Proficiency testing for examiners of impression evidence is available through Collaborative Testing Service, Inc., but the proficiency tests for footwear impressions include samples that are either a match or not a match[49]—that is, none of the samples included in the tests have the sort of ambiguities that would lead an experienced examiner to an "inconclusive"

---

[43] Ibid.

[44] M.J. Cassidy. 1980. *Footwear Identification*. Quebec, Canada: Government Printing Office Centre.

[45] K. Inman and N. Rudin. 2001. *Principles and Practice of Criminalistics*. Boca Raton, FL: CRC Press, p. 129.

[46] Ibid., p. 335.

[47] Liukkonen, Majamaa, and Virtanen, op. cit.

[48] Cassidy, op. cit.

[49] H. Majamaa and Y. Anja. 1996. Survey of the conclusions drawn of similar footwear cases in various crime laboratories. *Forensic Science International* 82:109-120.

Copyright © National Academy of Sciences. All rights reserved.

conclusion. IAI has a certification program for footwear and tire track examiners.[50] The group's recommended course of study has 13 segments, and each segment includes a suggested reading list and practical and/or written exercises. The student must pass an examination. This course of study does not require an understanding of the scientific basis of the examinations, and it does not recommend the use of a scientific method. Also, there is no provision or recommendation for proficiency testing or continuing education. SWGTREAD, a group of footwear and tire track examiners formed by the FBI, recommends that a trainee candidate have (1) a bachelor's degree (preferably in a physical or natural science) from an accredited college or university; or (2) an associate degree or 60 college semester hours, plus two years of job-related forensic experience; or (3) a high school diploma or equivalent, plus four years of job-related forensic experience.[51]

Scientific Interpretation and Reporting of Results

For footwear evidence, Fawcett[52] and Bodziak[53] have attempted to assign probabilistic or statistical significance to impression comparisons. Generally, shoeprint and tire track examiners prefer nonstatistical language to report or to testify to the result of their findings. Terms such as "positive identification" and "nonidentification" can be used to indicate an identification or nonidentification, respectively, and "nonconclusive" would indicate situations in which the analysis falls short of either of the other two.[54]

In a European survey, examiners were given identical mock cases. Accidental, identifying characteristics were purposely put onto the sole of new shoes, and examiners were asked to make a statement concerning the strength of matches. The results of the survey concluded that there were considerable differences in the conclusions reached by different laboratories examining identical cases."[55] SWGTREAD recommends terminology such as:

- "identification" (definite conclusion of identity)
- "probably made" (very high degree of association)

---

[50] Recommended Course of Study for Footwear & Tire Track Examiners. 1995. Mendota Heights, MN: International Association for Identification.

[51] SWGTread. 2006. *Guide for Minimum Qualifications and Training for a Forensic Footwear and/or Tire Tread Examiner.* Available at www.theiai.org/guidelines/swgtread/qualifications_final.pdf.

[52] A.S. Fawcett. 1970. The role of the footmark examiner. *Journal of the Forensic Science Society* 10:227-244.

[53] Bodziak, op. cit., pp. 342-346.

[54] Ibid.

[55] H. Majamaa and Y. Anja., op. cit.

Copyright © National Academy of Sciences. All rights reserved.

- "could have made" (significant association of multiple class characteristics)
- "inconclusive" (limited association of some characteristics)
- "probably did not make" (very high degree of nonassociation)
- "elimination" (definite exclusion)
- "unsuitable" (lacks sufficient detail for a meaningful comparison).

Additionally, SWGTREAD discourages the use of once common terminology, such as "consistent with" (acceptable when used to describe a similarity of characteristics), "match/no match," "responsible for/not responsible for," and "caused with/not caused with."[56] Neither the IAI nor SWGTREAD address the statistical evaluation of impression evidence.

Summary Assessment

The scientific basis for the evaluation of impression evidence is that mass-produced items (e.g., shoes, tires) pick up features of wear that, over time, individualize them. However, because these features continue to change as they are worn, elapsed time after a crime can undercut the forensic scientist's certainty. At the least, class characteristics can be identified, and with sufficiently distinctive patterns of wear, one might hope for specific individualization. However, there is no consensus regarding the number of individual characteristics needed to make a positive identification, and the committee is not aware of any data about the variability of class or individual characteristics or about the validity or reliability of the method. Without such population studies, it is impossible to assess the number of characteristics that must match in order to have any particular degree of confidence about the source of the impression.

Experts in impression evidence will argue that they accumulate a sense of those probabilities through experience, which may be true. However, it is difficult to avoid biases in experience-based judgments, especially in the absence of a feedback mechanism to correct an erroneous judgment. These problems are exacerbated with the less common types of impression evidence. For example, a European survey found that 42 laboratories conducted 28,093 shoeprint examinations and 41 laboratories conducted 591 tire track examinations, but only 14 laboratories conducted a total of 21 lip print examinations and 17 laboratories conducted a total of 100 ear print examinations.[57] Although one might argue that those who perform the

[56] SWGTREAD. 2006. *Standard Terminology for Expressing Conclusions of Forensic Footwear and Tire Impression Examinations*. Available at www.theiai.org/guidelines/swgtread/terminology_final.pdf.

[57] Liukkonen, Majamaa, and Virtanen, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

work in laboratories that conduct hundreds or thousands of evaluations of impression evidence develop useful experience and judgment, it is difficult to assert that the field has enough collective judgment about the variabilities in lip prints and ear prints based on tens of examinations. The community simply does not have enough data about the natural variability of those less frequent impressions, absent the presence of a clear deformity or scar, to infer whether the observed degree of similarity is significant.

Most of the research in the field is conducted in forensic laboratories, with the results published in trade journals, such as the *Journal of Forensic Identification*. With regard to reporting, SWGTREAD is moving toward the use of standard language to convey the conclusions reached.[58] But neither IAI nor SWGTREAD addresses the issue of what critical research should be done or by whom, critical questions that should be addressed include the persistence of individual characteristics, the rarity of certain characteristic types, and the appropriate statistical standards to apply to the significance of individual characteristics. Also, little if any research has been done to address rare impression evidence. Much more research on these matters is needed.

TOOLMARK AND FIREARMS IDENTIFICATION

Toolmarks are generated when a hard object (tool) comes into contact with a relatively softer object. Such toolmarks may occur in the commission of a crime when an instrument such as a screwdriver, crowbar, or wire cutter is used or when the internal parts of a firearm make contact with the brass and lead that comprise ammunition. The marks left by an implement such as a screwdriver or a firearm's firing pin depend largely on the manufacturing processes—and manufacturing tools—used to create or shape it, although other surface features (e.g., chips, gouges) might be introduced through post-manufacturing wear. Manufacturing tools experience wear and abrasion as they cut, scrape, and otherwise shape metal, giving rise to the theory that any two manufactured products—even those produced consecutively with the same manufacturing tools—will bear microscopically different marks. Firearms and toolmark examiners believe that toolmarks may be traced to the physical heterogeneities of an individual tool—that is, that "individual characteristics" of toolmarks may be uniquely associated with a specific tool or firearm and are reproduced by the use of that tool and only that tool.

The manufacture and use of firearms produces an extensive set of

[58] SWGTREAD. 2006. *Standard Terminology for Expressing Conclusions of Forensic Footwear and Tire Impression Examinations*. Available at www.theiai.org/guidelines/swgtread/terminology_final.pdf.

Copyright © National Academy of Sciences. All rights reserved.

specialized toolmarks. Gun barrels typically are rifled to improve accuracy, meaning that spiral grooves are cut into the barrel's interior. The process of cutting these grooves into the barrel leaves marks and scrapes on the relatively softer metal of the barrel.[59] In turn, these markings are transferred to the softer metal of a bullet as it exits the barrel. Over time, with repeated use (and metal-to-metal scraping), the marks on a barrel (and the corresponding "stria" imparted to bullets) may change as individual imperfections are formed or as cleanliness of the barrel changes. The brass exterior of cartridge cases receive analogous toolmarks during the process of gun firing: the firing pin dents the soft primer surface at the base of the cartridge to commence firing, the primer area is forced backward by the buildup of gas pressure (so that the texture of the gun's breech face is impressed on the cartridge), and extractors and ejectors leave marks as they expel used cartridges and cycle in new ammunition.

Firearms examination is one of the more common functions of crime laboratories. Even small laboratories with limited services often perform firearms analysis. In addition to the analysis of marks on bullets and cartridges, firearms examination also includes the determination of the firing distance, the operability of a weapon, and sometimes the analysis of primer residue to determine whether someone recently handled a weapon. These broader aspects are not covered here.

Sample and Data Collection

When a tool is used in a crime, the object that contains the tool marks is recovered when possible. If a toolmark cannot be recovered, it can be photographed and cast. Test marks made by recovered tools can be made in a laboratory and compared with crime scene toolmarks.

In the early 1990s, the FBI and the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) developed separate databases of images of bullet and cartridge case markings, which could be queried to suggest possible matches. In 1996, the National Institute of Standards and Technology (NIST) developed data exchange standards that permitted the integration of the FBI's DRUGFIRE database (cartridge case images) and the ATF's CEASEFIRE database (then limited to bullet images). The current National Integrated Ballistic Information Network (NIBIN) includes images from both cartridge cases and bullets that are associated with crime scenes and is maintained by the ATF.

Periodically—and particularly in the wake of the Washington, DC,

[59] Although the metal and initial rifling are very similar, the cutting of the individual barrels, the finishing machining, and the cleaning and polishing begin the process of differentiation of the two sequentially manufactured barrels.

Copyright © National Academy of Sciences. All rights reserved.

sniper attacks in 2002—the question has been raised of expanding the scope of databases like NIBIN to include images from test firings of newly manufactured firearms. In concept, this would permit downstream investigators who recover a cartridge case or bullet at a crime scene to identify the likely source firearm. Though two states (Maryland and New York) instituted such reference ballistic image databases for newly manufactured firearms, proposals to create such a database at the national level did not make substantial progress in Congress. A recent report of the National Academies, *Ballistic Imaging*, examined this option in great detail and concluded that "[a] national reference ballistic image database of all new and imported guns is not advisable at this time."[60]

Analyses

In both firearm and toolmark identification, it is useful to distinguish several types of characteristics that are considered by examiners. "Class characteristics" are distinctive features that are shared by many items of the same type. For example, the width of the head of a screwdriver or the pattern of serrations in the blade of a knife may be class characteristics that are common to all screwdrivers or knives of a particular manufacturer and/or model. Similarly, the number of grooves cut into the barrel of a firearm and the direction of "twist" in those grooves are class characteristics that can filter and restrict the range of firearms that match evidence found at a crime scene. "Individual characteristics" are the fine microscopic markings and textures that are said to be unique to an individual tool or firearm. Between these two extremes are "subclass characteristics" that may be common to a small group of firearms and that are produced by the manufacturing process, such as when a worn or dull tool is used to cut barrel rifling.

Bullets and cartridge cases are first examined to determine which class characteristics are present. If these differ from a comparison bullet or cartridge, further examination may be unnecessary. The microscopic markings on bullets and cartridge cases and on toolmarks are then examined under a comparison microscope (made from two compound microscopes joined by a comparison bridge that allows viewing of two objects at the same time). The unknown and known bullet or cartridge case or toolmark surfaces are compared visually by a firearms examiner, who can evaluate whether a match exists.

[60] National Research Council. 2008. *Ballistic Imaging*. Washington, DC: The National Academies Press, p. 5.

Copyright © National Academy of Sciences. All rights reserved.

Scientific Interpretation

The task of the firearms and toolmark examiner is to identify the individual characteristics of microscopic toolmarks apart from class and subclass characteristics and then to assess the extent of agreement in individual characteristics in the two sets of toolmarks to permit the identification of an individual tool or firearm.

Guidance from the Association of Firearm and Tool Mark Examiners (AFTE)[61] indicates that an examiner may offer an opinion that a specific tool or firearm was the source of a specific set of toolmarks or a particular bullet striation pattern when "sufficient agreement" exists in the pattern of two sets of marks. The standards then define agreement as significant "when it exceeds the best agreement demonstrated between tool marks known to have been produced by different tools and is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool."[62]

Knowing the extent of agreement in marks made by different tools, and the extent of variation in marks made by the same tool, is a challenging task. AFTE standards acknowledge that these decisions involve subjective qualitative judgments by examiners and that the accuracy of examiners' assessments is highly dependent on their skill and training. In earlier years, toolmark examiners relied on their past casework to provide a foundation for distinguishing between individual, class, and subclass characteristics. More recently, extensive training programs using known samples have expanded the knowledge base of examiners.

The emergence of ballistic imaging technology and databases such as NIBIN assist examiners in finding possible candidate matches between pieces of evidence, including crime scene exhibits held in other geographic locations. However, it is important to note that the final determination of a match is always done through direct physical comparison of the evidence by a firearms examiner, not the computer analysis of images. The growth of these databases also permits examiners to become more familiar with similarities in striation patterns made by different firearms. Newer imaging techniques assess toolmarks using three-dimensional surface measurement data, taking into account the depth of the marks. But even with more training and experience using newer techniques, the decision of the toolmark examiner remains a subjective decision based on unarticulated

[61] Theory of identification, range of striae comparison reports and modified glossary definitions—An AFTE Criteria for Identification Committee report. 1992. *Journal of the Association of Firearm and Tool Mark Examiners* 24:336-340.

[62] Ibid., p. 336.

Copyright © National Academy of Sciences. All rights reserved.

standards and no statistical foundation for estimation of error rates.[63] The National Academies report, *Ballistic Imaging*, while not claiming to be a definitive study on firearms identification, observed that, "The validity of the fundamental assumptions of uniqueness and reproducibility of firearms-related toolmarks has not yet been fully demonstrated." That study recognized the logic involved in trying to compare firearms-related toolmarks by noting that, "Although they are subject to numerous sources of variability, firearms-related toolmarks are not completely random and volatile; one can find similar marks on bullets and cartridge cases from the same gun," but it cautioned that, "A significant amount of research would be needed to scientifically determine the degree to which firearms-related toolmarks are unique or even to quantitatively characterize the probability of uniqueness."[64]

Summary Assessment

Toolmark and firearms analysis suffers from the same limitations discussed above for impression evidence. Because not enough is known about the variabilities among individual tools and guns, we are not able to specify how many points of similarity are necessary for a given level of confidence in the result. Sufficient studies have not been done to understand the reliability and repeatability of the methods. The committee agrees that class characteristics are helpful in narrowing the pool of tools that may have left a distinctive mark. Individual patterns from manufacture or from wear might, in some cases, be distinctive enough to suggest one particular source, but additional studies should be performed to make the process of individualization more precise and repeatable.

---

[63] Recent research has attempted to develop a statistical foundation for assessing the likelihood that more than one tool could have made specific marks by assessing consecutive matching striae, but this approach is used in a minority of cases. See A.A. Biasotti. 1959. A statistical study of the individual characteristics of fired bullets. *Journal of Forensic Sciences* 4:34; A.A. Biasotti and J. Murdock. 1984. "Criteria for identification" or "state of the art" of firearms and tool marks identification. *Journal of the Association of Firearms and Tool Mark Examiners* 16(4):16; J. Miller and M.M. McLean. 1998. Criteria for identification of tool marks. *Journal of the Association of Firearms and Tool Mark Examiners* 30(1):15; J.J. Masson. 1997. Confidence level variations in firearms identification through computerized technology. *Journal of the Association of Firearms and Tool Mark Examiners* 29(1):42. For a critique of this area and a comparison of scientific issues involving toolmark evidence and DNA evidence, see A. Schwartz. 2004-2005. A systemic challenge to the reliability and admissibility of firearms and tool marks identification. *Columbia Science and Technology Law Review* 6:2. For a rebuttal to this critique, see R.G. Nichols. 2007. Defending the scientific foundations of the firearms and tool mark identification discipline: Responding to recent challenges. *Journal of Forensic Sciences* 52(3):586-594.

[64] All quotes from National Research Council. 2008. *Ballistic Imaging*. Washington, DC: The National Academies Press, p. 3.

Copyright © National Academy of Sciences. All rights reserved.

A fundamental problem with toolmark and firearms analysis is the lack of a precisely defined process. As noted above, AFTE has adopted a theory of identification, but it does not provide a specific protocol. It says that an examiner may offer an opinion that a specific tool or firearm was the source of a specific set of toolmarks or a bullet striation pattern when "sufficient agreement" exists in the pattern of two sets of marks. It defines agreement as significant "when it exceeds the best agreement demonstrated between tool marks known to have been produced by different tools and is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool." The meaning of "exceeds the best agreement" and "consistent with" are not specified, and the examiner is expected to draw on his or her own experience. This AFTE document, which is the best guidance available for the field of toolmark identification, does not even consider, let alone address, questions regarding variability, reliability, repeatability, or the number of correlations needed to achieve a given degree of confidence.

Although some studies have been performed on the degree of similarity that can be found between marks made by different tools and the variability in marks made by an individual tool, the scientific knowledge base for toolmark and firearms analysis is fairly limited. For example, a report from Hamby, Brundage, and Thorpe[65] includes capsule summaries of 68 toolmark and firearms studies. But the capsule summaries suggest a heavy reliance on the subjective findings of examiners rather than on the rigorous quantification and analysis of sources of variability. Overall, the process for toolmark and firearms comparisons lacks the specificity of the protocols for, say, 13 STR DNA analysis. This is not to say that toolmark analysis needs to be as objective as DNA analysis in order to provide value. And, as was the case for friction ridge analysis and in contrast to the case for DNA analysis, the specific features to be examined and compared between toolmarks cannot be stipulated a priori. But the protocols for DNA analysis do represent a precisely specified, and scientifically justified, series of steps that lead to results with well-characterized confidence limits, and that is the goal for all the methods of forensic science.

ANALYSIS OF HAIR EVIDENCE

The basis for hair analyses as forensic evidence stems from the fact that human and animal hairs routinely are shed and thus are capable of being

[65] J.E. Hamby, D.J. Brundage, and J.W. Thorpe. 2009. The identification of bullets fired from 10 consecutively rifled 9mm Ruger pistol barrels—A research project involving 468 participants from 19 countries. Available online at http://www.fti-ibis.com/DOWNLOADS/Publications/10%20Barrel%20Article-%20a.pdf.

Copyright © National Academy of Sciences. All rights reserved.

transferred from an individual to the crime scene, and from the crime scene to an individual. Forensic hair examiners generally recognize that various physical characteristics of hairs can be identified and are sufficiently different among individuals that they can be useful in including, or excluding, certain persons from the pool of possible sources of the hair. The results of analyses from hair comparisons typically are accepted as class associations; that is, a conclusion of a "match" means only that the hair could have come from any person whose hair exhibited—within some levels of measurement uncertainties—the same microscopic characteristics, but it cannot uniquely identify one person. However, this information might be sufficiently useful to "narrow the pool" by excluding certain persons as sources of the hair.

Although animal hairs might provide useful evidence in certain cases (e.g., animal poaching), animal hair analysis often can lead to an identification of only the type of animal, not the specific breed[66]; consequently, most (90 to 95 percent) of hair analyses refer to analyses of human hair. Human hairs from different parts of the body have different characteristics; Houck cautions strongly against drawing conclusions about hairs from one part of the body based on analyses of hairs from a different body part.[67]

Houck and Bisbing recommend as minimal training for hair examiners a bachelor's degree in a natural or applied science (e.g., chemistry, biology, forensic science), on-the-job training programs, and an annual proficiency test.[68]

Sample Data and Collection

Sample hairs received for analysis initially are examined macroscopically for certain broad features such as color, shaft form (e.g., straight, wavy, curved, kinked), length, and overall shaft thickness (e.g., fine, medium, coarse).

In the second stage of analysis, hairs are mounted on microscopic slides using a mounting medium that has the same refractive index (about 1.54) as the hair, to better view the microscopic features (see next section). One hair or multiple hairs from the same source may be mounted on a glass microscope slide with an appropriate cover slip, as long as each mounted hair is clearly visible. It is most important that questioned and known hairs are mounted in the same type of mounting medium.

During this examination, the hair analyst attempts to identify the part of the body from which the hair might have come, based on certain de-

[66] P.D. Barnett and R.R. Ogle. 1982. Probabilities and human hair comparison. *Journal of Forensic Sciences* 27(2):272-278.

[67] M.M. Houck and R.E. Bisbing. 2005. Forensic human hair examination and comparison in the 21st century. *Forensic Science Review* 17(1):7.

[68] Ibid., p. 12.

Copyright © National Academy of Sciences. All rights reserved.

finable characteristics that distinguish hairs from various body locations. Occasionally, suspects can be eliminated on the basis of these simple microscopic characteristics.

A "control" or "comparison" group of hairs must be collected from a known hair source. A known head hair sample should consist of hairs from the five different areas of the scalp (top, front, back including nape, and both sides). Known hair samples should be obtained by a combination of pulling and combing from the sampled region. Ideally, a total of 50 hairs should be obtained from the scalp. A known pubic hair sample or a sample from any other somatic region should ideally consist of 25 hairs obtained by pulling and combing from different regions. A comparison can still be performed with less than the recommended number of hairs, but this may increase the likelihood of a false exclusion.[69]

Features from human hair analyses can be divided broadly into "major characteristics" and "secondary characteristics." The former category includes features such as color, treatment (e.g., dyed, bleached, curled, permed), pigment aggregation (e.g., streaked, clumped, patchy), and shaft form (e.g., wavy, straight, curly). Other major characteristics may include pigment distribution (e.g., uniform, peripheral, clustered), medulla appearance, if present (e.g., continuous, interrupted, or fragmented—and opaque or translucent), hair diameter, medullary index, and presence or absence of cortical fusi (e.g., root or shaft). Secondary characteristics include cuticular margin (e.g., smooth, serrated, looped, or cracked), pigment density (e.g., absent, sparse, heavy), pigment size (e.g., absent, fine, coarse), tip shape (e.g., tapered, cut, rounded, frayed, split), and shaft diameter (e.g., narrow or wide).[70]

Studies of Accuracy in Identification

In 1974, investigators Gaudette and Keeping described a system of hair analysis and used it in a study of pairwise comparisons among 861 hairs from 100 different persons.[71] They acknowledged that "the hair samples were not chosen from the population at random, but were selected so that the probability of two hairs being similar would be greater, if anything, than in the population at large."[72] From their assignment of probabilities, the authors estimated that the chance of asserting a difference between two

[69] Scientific Working Group on Materials Analysis (SWGMAT). 2005. Forensic human hair examination guidelines. *Forensic Science Communications* 7(2). Available at www.fbi.gov/hq/lab/fsc/backissu/april2005/standards/2005_04_standards02.htm.

[70] Ibid.

[71] B.D. Gaudette and E.S. Keeping. 1974. An attempt at determining probabilities in human scalp hair comparison. *Journal of Forensic Sciences* 19(3):599-606.

[72] Ibid., p. 65.

Copyright © National Academy of Sciences. All rights reserved.

hairs from the same person is small, about 1 in 4,500.[73] This assignment of probabilities has since been shown to be unreliable.[74] Moreover, the study does not confirm the chance of asserting a match between two dissimilar hairs, and the authors acknowledge that, "due to the fact that so many of the characteristics coded are subjective—for example, color, texture—it was not possible to get complete reproducibility between two or more examiners coding the same hair."[75]

Barnett and Ogle raised four concerns with the Gaudette and Keeping study: (1) it relied on idealized (not from real life) test scenarios; (2) there was no objective basis for selecting the features; (3) the statistical analysis of data from the study was questionable; and (4) there was a possible examiner bias.[76] Gaudette attempted to address these concerns through a further study. However, this additional study involved only three hair examiners, in addition to the author. The author concluded that:

> . . . whereas hair is not generally a basis for positive personal identification, the presence of abnormalities or unusual features or the presence of a large number of different unknown hairs all similar to the standard can lead to a more positive conclusion. The problem, at present, lies in finding suitable additional characteristics [of hair, for effecting individualization]. Although there is basic agreement as to the value of the macroscopic and microscopic characteristics used, other characteristics are either unreliable or controversial. Physical characteristics such as refractive index, density, scale counts, tensile strength, and electrical properties have been proposed by some workers but have been attacked by others, and the general consensus is that they are of little use in hair comparison.[77]

In 1990, Wickenheiser and Hepworth attempted a study to address examiner bias in a small study with only two examiners. They reported that "no incorrect associations were made by either examiner."[78] But a study with only two examiners cannot offer accurate and precise estimates of bias in the population of examiners.

An attempt at an objective system for identifying "matches" among hair samples is presented in Verma et al., based on a neural network.[79]

---

[73] A later study on human pubic hairs (Caucasian only) estimated this probability as "about 1 in 800." B.D. Gaudette. 1976. Probabilities and human pubic hair comparisons. *Journal of Forensic Sciences* 21(3):514-517.

[74] P.D. Barnett and R.R. Ogle. 1982. Probabilities and human hair comparison. *Journal of Forensic Sciences* 27(2):272-278.

[75] Gaudette and Keeping, op. cit.

[76] Barnett and Ogle, op. cit.

[77] B.D. Gaudette. 1978. Some further thoughts on probabilities and human hair comparisons. *Journal of Forensic Sciences* 23(4):758-763, pp. 761-762.

[78] Wickenheiser and Hepworth, op. cit., p. 1327.

[79] M.S. Verma, L. Pratt, C. Ganesh, and C. Medina. 2002. Hair-MAP: A prototype automated system for forensic hair comparison and analysis. *Forensic Science International* 129:168-186.

Copyright © National Academy of Sciences. All rights reserved.

According to the authors of this article, "The system accurately judged whether two populations of hairs came from the same person or from different persons 83 percent of the time."[80] The article states that 83 percent was obtained by testing the neural network on all possible pairs among 9 samples of hairs from 9 people (i.e., 81 combinations, of which 9 are "true matches" and 72 are "true mismatches"). Their *Table 3*[81] can be summarized as follows:

	System said "same"	System said "different"	
Same person	5	4	Total= 9
Different persons	9	64	Total=73

Because the total of these 4 numbers is 82, not 81, one presumes a typographical error in the table; as stated, the number of correct calls is (5 + 64)/81=0.85, or 85 percent. (If one of the counts, 5 or 64, is off by 1, the percentage would be 84 percent.) However, the table also shows that the neural network claimed 9 of the 73 different pairs as "same," for a false positive rate of 9/73=12 percent, and 4 sets of hairs from the same person as "different," for a false negative rate of 4/9=44 percent. With such high error rates, one would want to study improvements to such systems before putting them into routine practice.

Houck et al. indicate that proficiency testing is conducted regularly for hair experts in crime laboratories.[82] Collaborative Testing Services[83] offers hair and fiber proficiency tests annually. Unfortunately, mass production of test samples such as hair is problematic. Because known samples exhibit a range of characteristics within each of the major and secondary characteristics, it is not possible to provide comparable samples to multiple examiners.

Scientific Interpretation and Reporting of Results

The success of hair analyses to make a positive identification is limited in important ways. Most hair examiners would opine only that hairs exhibiting the same microscopic characteristics "could" have come from a

[80] Ibid., p. 179.

[81] Ibid., p. 180.

[82] M.M. Houck, R.E. Bisbing, T.G. Watkins, and R.P. Harman. 2004. Locard exchange: The science of forensic hair comparisons and the admissibility of hair comparison evidence: *Frye* and *Daubert* considered. *Modern Microscopy Journal* Available at www.modernmicroscopy.com/main.asp?article=36&searchkeys=Houck%2BBisbing.

[83] See www.collaborativetesting.com.

Copyright © National Academy of Sciences. All rights reserved.

particular individual. Moreover, the "best" or most reliable characteristics will vary by case. For example, "color" may be a critical determinant in a case where it is artificial, because that introduces additional independent variables, such as the time since treatment and the actual hair color, while a natural hair might provide less information.

However, several members of the committee have experienced courtroom cases in which, despite the lack of a statistical foundation, microscopic hair examiners have made probabilistic claims based on their experience, as occurred in some DNA exoneration cases in which microscopic hair analysis evidence had been introduced during trial. Aitken and Robertson discuss some probabilistic concepts with respect to hair analysis.[84]

The availability of DNA analysis has lessened the reliance on hair examination. In a very high proportion of cases involving hair evidence, DNA can be extracted, even years after the crime has been committed. Although the DNA extraction may consist of only mitochondrial DNA (mtDNA), such analyses are likely to be much more specific than those conducted on the physical features of hair. For this reason, cases that might have relied heavily on hair examinations have been subjected more recently to additional analyses using DNA.[85] Because of the inherent limitations of hair comparisons and the availability of higher-quality and higher-accuracy analyses based on mtDNA, traditional hair examinations may be presented less often as evidence in the future, although microscopic comparison of physical features will continue to be useful for determining which hairs are sufficiently similar to merit comparisons with DNA analysis and for excluding suspects and assisting in criminal investigations.

Summary Assessment

No scientifically accepted statistics exist about the frequency with which particular characteristics of hair are distributed in the population. There appear to be no uniform standards on the number of features on which hairs must agree before an examiner may declare a "match." In one study of validity and accuracy of the technique, the authors required exact agreement on seven "major" characteristics and at least two agreements among six "secondary" characteristics.[86] The categorization of hair features depends heavily on examiner proficiency and practical experience.

An FBI study found that, of 80 hair comparisons that were "associ-

[84] C.G.G. Aitken and J.A. Robertson. 1986. A contribution to the discussion of probabilities and human hair comparisons. *Journal of Forensic Sciences* 32(3):684-689.

[85] M.M. Houck and B. Budowle. 2002. Correlation of microscopic and mitochondrial DNA hair comparisons. *Journal of Forensic Sciences* 47(5):964-967.

[86] R.A. Wickenheiser and D.G. Hepworth. 1990. Further evaluation of probabilities in human hair comparisons. *Journal of Forensic Sciences* 35(6):1323-1329.

Copyright © National Academy of Sciences. All rights reserved.

ated" through microscopic examinations, 9 of them (12.5 percent) were found in fact to come from different sources when reexamined through mtDNA analysis.[87] This illustrates not only the imprecision of microscopic hair analyses, but also the problem with using imprecise reporting terminology such as "associated with," which is not clearly defined and which can be misunderstood to imply individualization.

In some recent cases, courts have explicitly stated that microscopic hair analysis is a technique generally accepted in the scientific community.[88] But courts also have recognized that testimony linking microscopic hair analysis with particular defendants is highly unreliable.[89] In cases where there seems to be a morphological match (based on microscopic examination), it must be confirmed using mtDNA analysis; microscopic studies alone are of limited probative value. The committee found no scientific support for the use of hair comparisons for individualization in the absence of nuclear DNA. Microscopy and mtDNA analysis can be used in tandem and may add to one another's value for classifying a common source, but no studies have been performed specifically to quantify the reliability of their joint use.

ANALYSIS OF FIBER EVIDENCE

Fibers associated with a crime—including synthetic fibers such as nylon, polyester and acrylic as well as botanical fibers such as ramie or jute, which are common in ropes or twines—can be examined microscopically in the same way as hairs, and with the same limitations. However, fibers also can be analyzed using the tools of analytical chemistry, which provide a more solid scientific footing than that underlying morphological examination. In some cases, clothing and carpets have been subjected to relatively distinctive environmental conditions (e.g., sunlight exposure or laundering agents) that impart characteristics that can distinguish particular items from others from the same manufacturing lot. Fiber examiners agree, however, that none of these characteristics is suitable for individualizing fibers (associating a fiber from a crime scene with one, and only one, source) and that fiber evidence can be used only to associate a given fiber with a class of fibers.[90]

---

[87] Houck and Budowle, op. cit.

[88] E.g., *State v. West*, 877 A.2d 787 (Conn. 2005); *Bookins v. State*, 922 A.2d 389 (Del. Supr, 2007).

[89] See P.C. Giannelli and E. West. 2001. Hair comparison evidence. *Criminal Law Bulletin* 37:514.

[90] See, e.g., R.R. Bresee. 1987. Evaluation of textile fiber evidence: A review. *Journal of Forensic Sciences* 32(2):510-521. See also SWGMAT. 1999. Introduction to forensic fiber examination. *Forensic Science Communications* 1(1). Available at www.fbi.gov/hq/lab/fsc/backissu/april1999/houcktoc.htm, which includes the following summarization in Section 5.4: "It can never be stated with certainty that a fiber originated from a particular textile because

Copyright © National Academy of Sciences. All rights reserved.

Another type of fiber analysis consists of physically matching two remnants that appear to be torn from one another. By comparing the shapes of the mating edges, and aligning any patterns in the cloth, it can sometimes be possible to associate a fragment with the garment or other item from which it was torn. This is a form of pattern matching, analogous to the matching of shoe and tire prints, but it will not be discussed further here.

Sample Collection and Analysis

The collection of fibers and of a comparison group follows the same procedures as those for mounting hairs. If a macroscopic analysis (e.g., or color, texture, shape) suggests that the two samples appear to be the same, additional procedures such as the following are pursued:

1. Microscopy (reflected light)
2. Polarized light microscopy/fluorescence microscopy
3. Infrared microscopy (to determine man-made fiber composition, such as nylon, polyester)
4. Solubility in a medium
5. Melting point
6. Cross-sectional shape
7. Pyrolysis GC
8. Microspectrophotometry (MSP)
9. Raman spectroscopy

The last of these, Raman spectroscopy, often can provide additional information on polymer chain length (short, medium, long) and branching. Its use in forensic laboratories is rare, although research is under way to develop possible applications. A good overview of fiber evidence is provided by Grieve and Robertson.[91]

Summary Assessment

A group of experienced paint examiners, the Fiber Subgroup of the Scientific Working Group on Materials Analysis (SWGMAT), has produced guidelines,[92] but no set standards, for the number and quality of character-

---

other textiles are produced using the same fiber types and color. The inability to positively associate a fiber to a particular textile to the exclusion of all others, however, does not mean that a fiber association is without value."

[91] M. Grieve and J. Robertson. 1999. *Forensic Examination of Fibres*. London: Taylor and Francis Ltd.

[92] SWGMAT, op. cit. Available at www.fbi.gov/hq/lab/fsc/backissu/april1999/houcktoc.htm.

Copyright © National Academy of Sciences. All rights reserved.

istics that must correspond in order to conclude that two fibers came from the same manufacturing batch. There have been no studies of fibers (e.g., the variability of their characteristics during and after manufacturing) on which to base such a threshold. Similarly, there have been no studies to inform judgments about whether environmentally related changes discerned in particular fibers are distinctive enough to reliably individualize their source, and there have been no studies that characterize either reliability or error rates in the procedures. Thus, a "match" means only that the fibers could have come from the same type of garment, carpet, or furniture; it can provide only class evidence.

Because the analysis of fibers is made largely through well-characterized methods of chemistry, it would be possible in principle to develop an understanding of the uncertainties associated with those analyses.[93] However, to date, that has not been done. Fiber analyses are reproducible across laboratories because there are standardized procedures for such analyses. Proficiency tests are routinely provided and taken annually, and the reports are available from Collaborative Testing Services.

QUESTIONED DOCUMENT EXAMINATION[94]

Questioned document examination involves the comparison and analysis of documents and printing and writing instruments in order to identify or eliminate persons as the source of the handwriting; to reveal alterations, additions, or deletions; or to identify or eliminate the source of typewriting or other impression marks. Questions about documents arise in business, finance, and civil and criminal trials, and in any matter affected by the integrity of written communications and records. Typical analyses include:

- determining whether the document is the output of mechanical or electronic imaging devices such as printers, copying machines, and facsimile equipment;
- identifying or eliminating particular human or machine sources of handwriting, printing, or typewriting;
- identifying or eliminating ink, paper, and writing instrument;
- establishing the source, history, sequence of preparation, alterations or additions to documents, and relationships of documents;

[93] Some relevant questions to be addressed are identified in Bresee, op. cit.

[94] This discussion is primarily based on *Standard Descriptions of Scope of Work Relating to Forensic Document Examiners (American Society for Testing and Materials [ASTM] Designation E 444-98)* (1998), *Standard Guide for Test Methods for Forensic Writing Ink Comparison (ASTM Designation E 1422-01)* (2001), *Standard Guide for Writing Ink Identification (ASTM Designation E 1789-04)* (2004), and *Standard Guide for Examination of Handwritten Items (ASTM Designation E 2290-03)* (2003).

Copyright © National Academy of Sciences. All rights reserved.

- deciphering and restoring obscured, deleted, or damaged parts of documents;
- recognizing and preserving other physical evidence that may be present in documents; and
- determining the age of a document.

Questioned document examiners are also referred to as forensic document examiners or handwriting experts; questioned document examination includes the field of handwriting identification, while handwriting includes cursive or script style writing, printing by hand, signatures, numerals, or other written marks or signs. Forensic document examination does not involve a study of handwriting that purports to create a personality profile or otherwise analyze or judge the writer's personality or character.

Analyses

Equipment used in questioned document examination includes microscopes and other optical aids, photographic and other imaging devices, and a wide variety of imaging materials adaptable for use with numerous lighting methods, including those involving ultraviolet, visible, and infrared light, and other regions of the electromagnetic spectrum. Software tools recently have become available for the analysis of handwriting.[95] The analysis of papers and inks is similar to other forensic chemistry work. The principal procedures used for ink examination are nondestructive optical examinations and chemical examinations. Optical examinations include those that use visible and alternative light sources—for example, determining whether the class of ink is ballpoint pen; using ultraviolet examination to reveal indications that a document has been stained by chemicals; and employing reflected infrared to observe luminescence at different wavelengths. Chemical examination includes spot testing during which solvents are applied in small amounts to the ink line. For example, ballpoint inks, which are either oil based or glycol based, are highly soluble in pyridine. Inks formulated for fountain pens, porous point pens, and roller pens generally are water soluble in ethanol and water. Indelible markers are solvent based and generally would be soluble in pyridine.

Ink examination can have one of two objectives: class identification—for which the intention is to identify the ink formula or type based on a reference library of samples of inks—and comparison, for which the goal is to compare two ink samples to determine whether they are of common

[95] For an overview, see S.N. Srihari and G. Leedham. 2003. A survey of computer methods in forensic document examination. *Proceedings of the 11th International Graphonomics Society Conference*, pp. 278-281. Available at www.ntu.edu.sg/sce/labs/forse/PDF/docExam_7.pdf.

Copyright © National Academy of Sciences. All rights reserved.

origin. Ink comparisons usually are performed to answer four basic categories of questions: (1) whether an ink is the same (in formula) as that on other parts of the same document or on other documents; (2) whether two writings with similar ink have a common origin (e.g., the same writing instrument or ink well); (3) whether the ink of entries over a period of time is consistent with varying ages or indicates preparation at one time; and (4) whether ink is as old as it purports to be.

Most problems with ink examinations arise from confounding factors that interact with the ink. These can be part of the writing process, such as blotting wet ink; variations in the papers; various forms of contamination on the document; or a combination of these factors. Most ink examinations must be performed on paper and without defacing the handwriting, and this creates a number of sampling and analytical challenges.

The examination of handwritten items typically involves the comparison of a questioned item submitted for examination along with a known item of established origin associated with the matter under investigation. Requirements for comparison are that the writing be of the same type (handwritten/cursive versus hand printed) and that it be comparable text (similar letter/word combinations). Special situations involving unnatural writing are forgery (an attempt to imitate/duplicate the writing of another person) and disguise (an attempt to avoid identification as the writer). The basis for comparison is that handwriting/handprinting/numerals can be examined to obtain writing characteristics (also referred to as features or attributes). The characteristics are further classified into class characteristics (the style that the writer was taught), individual characteristics (the writer's personal style), and gross/subtle characteristics.

Specific attributes used for comparison of handwriting are also referred to as discriminating elements, of which Huber and Headrick have identified 21.[96] Comparisons are based on the high likelihood that no two persons write the same way, while considering the fact that every person's writing has its own variabilities. Thus, an analysis of handwriting must compare interpersonal variability—some characterization of how handwriting features vary across a population of possible writers—with intrapersonal variability—how much an individual's handwriting can vary from sample to sample. Determining that two samples were written by the same person depends on showing that their degree of variability, by some measure, is more consistent with intrapersonal variability than with interpersonal variability. Some cases of forgery are characterized by signatures with too little variability, and are thus inconsistent with the fact that we all have intrapersonal variability in our writing.

[96] R.A. Huber and A. M. Headrick. 1999. *Handwriting Identification: Facts and Fundamentals*. Boca Raton, FL: CRC Press.

Copyright © National Academy of Sciences. All rights reserved.

Scientific Interpretation and Reporting of Results

Terminology has been developed for expressing the subjective conclusions of handwriting comparison and identification, taking into account that there are an infinite number of gradations or opinions toward an identification or elimination. Several scales, such as a five-point scale and a nine-point scale, are used by questioned document examiners worldwide. The nine-point scale is as follows:

1. Identification (a definite conclusion that the questioned writing matches another sample)
2. Strong probability (evidence is persuasive, yet some critical quality is missing)
3. Probable (points strongly towards identification)
4. Indications [that the same person] did [create both samples] (there are a few significant features)
5. No conclusion (used when there are limiting factors such as disguise, or lack of comparable writing)
6. Indications [that the same person] did not [create both samples] (same weight as indications with a weak opinion)
7. Probably did not (evidence is quite strong)
8. Strong probably did not (virtual certainty)
9. Elimination (highest degree of confidence)[97]

Summary Assessment

The scientific basis for handwriting comparisons needs to be strengthened.[98] Recent studies have increased our understanding of the individuality and consistency of handwriting and computer studies[99] and suggest that

[97] *Standard Terminology for Expressing Conclusions of Forensic Document Examiners, ASTM Designation E 1658-04.*

[98] M. Kam, G. Fielding, and R. Conn. 1997. Writer identification by professional document examiners. *Journal of Forensic Sciences* 42(5):778-786, reports on proficiency tests given to more than 100 questioned document examiners and to a control group of individuals with similar educational backgrounds. Each subject made 144 pair-wise comparisons. Although the study showed that document examiners are much more accurate than lay people in determining whether or not two samples "match" (based on the "identification" and "strong probability" definitions of ASTM standard E1658), professionals nonetheless declared an erroneous match in 6.5 percent of the comparisons. A similar, more recent study, focusing on whether individual signatures were genuine, is reported in J. Sita, B. Found, and D. Rogers. 2002. Forensic handwriting examiners' expertise for signature comparison. *Journal of Forensic Sciences* 47:1117. That study found that professional handwriting examiners erred in 3.4 percent of their judgments.

[99] E.g., S.N. Sargur, S.-H. Cha, H. Arora, and S. Lee. 2002. Individuality of handwriting. *Journal of Forensic Sciences* 47(4):1-17.

Copyright © National Academy of Sciences. All rights reserved.

there may be a scientific basis for handwriting comparison, at least in the absence of intentional obfuscation or forgery. Although there has been only limited research to quantify the reliability and replicability of the practices used by trained document examiners, the committee agrees that there may be some value in handwriting analysis.

Analysis of inks and paper, being based on well-understood chemistry, presumably rests on a firmer scientific foundation. However, the committee did not receive input on these fairly specialized methods and cannot offer a definitive view regarding the soundness of these methods or of their execution in practice.

ANALYSIS OF PAINT AND COATINGS EVIDENCE

Paint is a suspension of solid pigments in a polymeric binder that, after application by brushing, spraying, dipping, or other means, forms a protective and/or decorative coating. When two objects come in contact with one another and at least one of these objects is painted, a transfer of paint may occur. This transferred paint can be compared to the paint located near the point of damage to determine if the two samples have a common origin. Painted surfaces tend to be repainted over time, providing a characteristic history of layer sequence. Painted surfaces are encountered frequently at crime scenes in the form of vehicles, architectural structures, tools, bicycles, boats, and many other items. The results of the examinations often are valuable both during the investigation and as evidence if a trial results. Paint examinations by their nature can be useful in suggesting possible connections of evidence from the crime scene to its source and therefore are helpful in narrowing or excluding possible witnesses and suspects as well as in providing useful information for investigative leads.

Sample Data and Collection

There are many different types of paint and other coatings, including architectural, vehicular, and marine. Evidence collected from the crime scene may include painted surfaces such as automotive panels, tools, or victims' or suspects' clothing, or spray paint, smears, chips, or flakes. After documentation at the scene, the damaged painted surface is protected and preserved and then submitted to the laboratory. When it is not possible to bring the painted item or a portion of it to the laboratory, paint samples may be removed in such a way that the entire layer sequence is captured intact.

Copyright © National Academy of Sciences. All rights reserved.

Analyses

The proper recognition and collection of paint evidence at the scene precedes the comparison of evidence occurring at the laboratory. The color, texture, type, layer sequence, and chemical composition of known and questioned paints are compared, and a conclusion is rendered. Additionally, in cases for which no suspect vehicle and questioned paint are available, it may be possible to provide at least an investigative lead based on the color and metallic/nonmetallic type of paint present. If appropriate, the Royal Canadian Mounted Police's PDQ (Paint Data Query) database may be searched, and vehicular information may be provided regarding the possible makes, models, and year range of vehicles that used the questioned paint system.

The examination and comparison of paint evidence requires microscopic and instrumental techniques and methods. The examination of questioned and known samples follows an analytical process that identifies and compares the class (or group) characteristics of the evidence.[100] Occasionally, identifying characteristics exist across edges that allow edge or piece fitting. These characteristics include irregular borders, brush stroke striations, polish mark striations, or surface abrasion markings. When paint fragments physically fit back to a sample from a known source, the fragments are identified as having come from that specific source. Only when physical fitting is possible can an individualized source determination be made

Examiners involved with the analysis of paint evidence in the laboratory typically possess an extensive scientific background, because many of the methods and analyses rely heavily on chemistry.[101] The suggested minimum education requirement is a bachelor's degree in a natural[102,103] or applied science,[104] with many candidates possessing a graduate degree. Coursework needs to include one year (or equivalent) of general chemistry with laboratory, organic chemistry with laboratory, analytical/instrumental analysis, and light microscopy to include basic polarized light microscopy—the latter obtained through structured coursework if it is not available at the graduate or undergraduate level.[105] On-the-job training continues in the laboratory, with its length depending on the examiner's experience. Before examiner trainees can work cases independently, they must observe and

[100] SWGMAT. 1999. Forensic paint analysis and comparison guidelines. *Forensic Science Communications* 1(2). Available at www.fbi.gov/hq/lab/fsc/backissu/july1999/painta.htm.

[101] SWGMAT. 2000. Trace evidence quality assurance guidelines. *Forensic Science Communications* 2(1). Available at www.fbi.gov/hq/lab/fsc/backissu/jan2000/swgmat.htm.

[102] G.S. Anderson (ed.). Canadian Society of Forensic Science. 2007. *CSFS Careers in Forensic Science*, p. 15. Available at www.csfs.ca/contentadmin/UserFiles/File/Booklet2007.pdf.

[103] SWGMAT 2000, op. cit.

[104] Ibid.

[105] Ibid.

Copyright © National Academy of Sciences. All rights reserved.

work under the supervision of an experienced examiner. The completion of a laboratory's training program in paint analysis can range between 12 to 18 months.[106]

Scientific Interpretation and Reporting of Results

SWGMAT sets guidelines for this field, but it has not recommended report wording, and there are no set criteria for determining a conclusion, although a range of conclusions may be used to show the significance of the examination results. The strength of a conclusion depends on such variables as the number of layers present, the sample condition, and the type of paint (vehicular or structural). Terms such as "matched," "indistinguishable," "consistent," or "similar" are used along with the properties of the paints that were compared in stating the results of the comparison.

If there are no significant differences in the properties compared, the examiners may conclude that the paint or coating samples could have had a common origin. This does not mean they came from the same source to the exclusion of all others, but rather that they may have originated from the same source or from different sources that were painted or coated in the same manner. As the number of different layers associated increases (e.g., multiple different layers on a repainted surface), it may be concluded that it is unlikely that the questioned paint originated from any source other than that of the known paint.

SWGMAT has suggested forensic paint analysis and comparison guidelines[107,108] that discuss the examination procedure and instrumentation options, and ASTM has published the general guidelines.[109] However, neither includes report wording suggestions. Additional work should be done to provide standard language for reporting conclusions and sources of uncertainty. Such work has been completed by working groups for other forensic disciplines. Proficiency testing requirements are agreed upon by the predominant accrediting organization, the American Society of Crime Laboratory Directors-Laboratory Accreditation Board (ASCLD/LAB), which requires testing (internal or external) once per calendar year.

---

[106] Anderson, op. cit.; SWGMAT.

[107] SWGMAT. 1999. Forensic paint analysis and comparison guidelines. *Forensic Science Communications* 1(2). Available at www.fbi.gov/hq/lab/fsc/backissu/july1999/painta.htm.

[108] SWGMAT. 2002. Standard guide for using scanning electron microscopy/X-ray spectrometry in forensic paint examinations. *Forensic Science Communications* 4(4). Available at www.fbi.gov/hq/lab/fsc/backissu/oct2002/bottrell.htm.

[109] Ibid.

Copyright © National Academy of Sciences. All rights reserved.

Summary Assessment

As is the case with fiber evidence, analysis of paints and coatings is based on a solid foundation of chemistry to enable class identification. Visual and microscopic examinations are typically the first step in a forensic examination of paints and coatings because of the ability to discriminate paints/coatings based on properties determined with these examinations. Several studies have been conducted that included hundreds of random automotive paint samples.[110] These studies have concluded that more than 97 percent of the samples could be differentiated based on microscopic examinations coupled with solubility and microchemical testing. Another study[111] determined that more than 99 percent of 2,000 architectural paint samples could be similarly differentiated. However, the community has not defined precise criteria for determining whether two samples come from a common source class.

ANALYSIS OF EXPLOSIVES EVIDENCE AND FIRE DEBRIS

Explosives evidence encompasses a wide range of materials from unburned, unconsumed powders, liquids, and slurries, to fragments of an explosive device, to objects in the immediate vicinity of an explosion thought to contain residue from the explosive. A typical analytical approach would be to identify the components and construction of an explosive device and conduct an analysis of any unconsumed explosives and residues. In addition to the analysis and identification of low and high explosives, chemical reaction bottle bombs are also analyzed. The scene of an explosion can require special investigative attention. What may appear to be a small piece of scrap metal could in fact be an important piece of the device that caused the explosion. The very nature of an explosion has a direct impact on the quality of evidence recovered. Pristine devices or device fragments, or appreciable amounts of unconsumed explosive material, should not be expected.

Analyses

Generally speaking, laboratories will not accept devices until they have been rendered safe. Examiners involved with the analysis of explosives evidence in the laboratory typically have an extensive scientific background, because the methods used entail a large amount of chemistry and instru-

[110] S.G. Ryland and R.J. Kopec. 1979. The evidential value of automobile paint chips. *Journal of Forensic Sciences* 24(1):140-147; J.A. Gothard. 1976. Evaluation of automobile paint flakes as evidence. *Journal of Forensic Sciences* 21(3):636-641.

[111] C.F. Tippet. 1968. The evidential value of the comparison of paint flakes from sources other than vehicles. *Journal of the Forensic Sciences Society* 8(2-3):61-65.

Copyright © National Academy of Sciences. All rights reserved.

mentation. The Technical Working Group for Fire and Explosives (TWGFEX), a group of fire debris and explosives examiners, suggests that an explosives examiner be required to possess a bachelor's degree in a natural or applied science, with recommended coursework in chemistry and instrumental analysis.[112] The group also recommends that the examiner complete a training program that includes the analysis of low and high explosives, instruction in the use of instrumentation used in routine analyses, the construction of explosive devices, and participation in a postblast investigation course. Although there is no official certification program for explosives examiners, TWGFEX has devised a suggested training guide. The guide is divided into seven modules, each with a reading list, practical exercises, and methods of evaluation.[113] To ensure that examiners maintain a level of competency, proficiency testing (internal or external) is required by ASCLD/LAB once per calendar year.[114]

The ultimate goal of an explosives examination is the identification of the explosive material used, whether it is through the analysis of an intact material or of the residue left behind when the material explodes. Intact material lends itself to being more easily identified. The individual components of postblast residue may often be identified (e.g., potassium chloride and potassium sulfate). The training and experience of examiners allows them to deduce what types of explosive material were originally present from possible combinations of explosive materials.

Whether it is a low explosive or high explosive, the analysis of an intact explosive material follows a procedure that begins with a macroscopic and microscopic examination of the material, followed by a burn test, when appropriate. The results of the initial observations will dictate how the rest of the analysis will proceed. Typically it will involve the use of instrumentation that provides both elemental and structural information about the material, such as X-ray diffraction, scanning electron microscope-energy dispersive X-ray analysis, or infrared spectroscopy. TWGFEX has devised guidelines for the analysis of intact explosives that categorize the instruments that can be used based on the level of information they provide.[115] The information gathered, if sufficient, can be useful in identifying the material.

The analysis of postblast explosive residues begins much like the analy-

---

[112] TWGFEX Explosive Examiners Job Description. Undated. Available at http://ncfs.ucf.edu/twgfex/documents.html.

[113] TWGFEX Training Guide for Explosives Analysis Training. Undated. Available at http://ncfs.ucf.edu/twgfex/Documents.html.

[114] American Society of Crime Laboratory Directors International. 2006. *Supplemental Requirements for the Accreditation of Forensic Science Testing Laboratories*, p. 20. See www.ascld-lab.org/international/indexinternational.html.

[115] TWGFEX Recommended Guidelines for Forensic Identification of Intact Explosives. Undated. Available at http://ncfs.ucf.edu/twgfex/documents.html.

Copyright © National Academy of Sciences. All rights reserved.

sis of intact explosives, with the macroscopic and microscopic analysis of the evidence submitted (whether it is an expended device, fragments of a device, or debris from near the site of the explosion). If no intact explosive material is found, a sequence of extracts may be used to capture any organic and/or inorganic residues present. These extracts are then analyzed employing the same instrumentation used for intact explosives. However, the results produced differ in their specificity, and it is here that the training and expertise of the examiner plays a large role. To interpret the results properly, the examiner must have knowledge of the composition of explosives and the reaction products that form when they explode. Interpretation can be further complicated by the presence of contaminants from, for example, the device or soil.[116]

Examination conclusions for postblast residues range from "the residue present was consistent with an explosive material" to "the residue is only indicative of an explosive" to "no explosive residues were present." TWGFEX recently has developed a set of guidelines for the analysis of postblast explosive residues,[117] but has yet to make any recommendations for report wording.

The examination of fire debris not associated with explosions often aims to determine whether an accelerant was used. To assess the effects of an accelerant, one might design an experiment, under a range of conditions (e.g., wind speed, temperature, presence/absence of other chemicals) with two groups: one in which materials are burned in the presence of an accelerant ("treatment") and one with no accelerant ("control"). The measured outcomes on the burned materials might be measures that characterize the damage patterns (e.g., depth of char, size of bubbles on surfaces). Differences in the ranges of these measurements from the materials in the two groups (treatment versus control) suggest a hypothesis about the effects of an accelerant. Following this exploration, one should design validation studies to confirm that these measures do indeed characterize the differences in materials treated or untreated with an accelerant.

Summary Assessment

The scientific foundations exist to support the analysis of explosions, because such analysis is based primarily on well-established chemistry. As part of the laboratory work, an analyst often will try to reconstruct the bomb, which introduces procedural complications, but not scientific ones.

---

[116] C.R. Midkiff. 2002. Arson and explosive investigation. In: R. Saferstein (ed.). *Forensic Science Handbook*. Vol. 1, 2nd ed. Upper Saddle River, NJ: Prentice Hall.

[117] TWGFEX Recommended Guidelines for Forensic Identification of Post-Blast Explosive Residues. 2007. Available at http://ncfs.ucf.edu/twgfex/action_items.html.

Copyright © National Academy of Sciences. All rights reserved.

By contrast, much more research is needed on the natural variability of burn patterns and damage characteristics and how they are affected by the presence of various accelerants. Despite the paucity of research, some arson investigators continue to make determinations about whether or not a particular fire was set. However, according to testimony presented to the committee,[118] many of the rules of thumb that are typically assumed to indicate that an accelerant was used (e.g., "alligatoring" of wood, specific char patterns) have been shown not to be true.[119] Experiments should be designed to put arson investigations on a more solid scientific footing.

FORENSIC ODONTOLOGY

Forensic odontology, the application of the science of dentistry to the field of law, includes several distinct areas of focus: the identification of unknown remains, bite mark comparison, the interpretation of oral injury, and dental malpractice. Bite mark comparison is often used in criminal prosecutions and is the most controversial of the four areas just mentioned. Although the identification of human remains by their dental characteristics is well established in the forensic science disciplines, there is continuing dispute over the value and scientific validity of comparing and identifying bite marks.[120]

Many forensic odontologists providing criminal testimony concerning bite marks belong to the American Board of Forensic Odontology (ABFO), which was organized in 1976 and is recognized by the American Academy of Forensic Sciences as a forensic specialty. The ABFO offers board certification to its members.[121]

Sample Data and Collection

Bite marks are seen most often in cases of homicide, sexual assault, and child abuse. The ABFO has approved guidelines for the collection of evidence from bite mark victims and suspected biters.[122] The techniques for obtaining bite mark evidence from human skin—for example, various forms of photography, dental casts, clear overlays, computer enhancement, electron microscopy, and swabbing for serology or DNA—generally are

[118] J. Lentini. Scientific Fire Analysis, LLC. Presentation to the committee. April 23, 2007. Available at www7.nationalacademies.org/stl/April%20Forensic%20Lentini.pdf.

[119] NFPA 921 Guide for Explosion and Fire Investigations, 2008 Edition. Quincy, MA: National Fire Protection Association.

[120] E.g., J.A. Kieser. 2005. Weighing bitemark evidence: A postmodern perspective. *Journal of Forensic Science, Medicine, and Pathology* 1(2):75-80.

[121] American Board of Forensic Odontology at www.abfo.org.

[122] Ibid.

Copyright © National Academy of Sciences. All rights reserved.

well established and relatively noncontroversial. Unfortunately, bite marks on the skin will change over time and can be distorted by the elasticity of the skin, the unevenness of the surface bite, and swelling and healing. These features may severely limit the validity of forensic odontology. Also, some practical difficulties, such as distortions in photographs and changes over time in the dentition of suspects, may limit the accuracy of the results.[123]

Analyses

The guidelines of the ABFO for the analysis of bite marks list a large number of methods for analysis, including transillumination of tissue, computer enhancement and/or digitalization of the bite mark or teeth, stereomicroscopy, scanning electron microscopy, video superimposition, and histology.[124] The guidelines, however, do not indicate the criteria necessary for using each method to determine whether the bite mark can be related to a person's dentition and with what degree of probability. There is no science on the reproducibility of the different methods of analysis that lead to conclusions about the probability of a match. This includes reproducibility between experts and with the same expert over time. Even when using the guidelines, different experts provide widely differing results and a high percentage of false positive matches of bite marks using controlled comparison studies.[125]

No thorough study has been conducted of large populations to establish the uniqueness of bite marks; theoretical studies promoting the uniqueness theory include more teeth than are seen in most bite marks submitted for comparison. There is no central repository of bite marks and patterns. Most comparisons are made between the bite mark and dental casts of an individual or individuals of interest. Rarely are comparisons made between the bite mark and a number of models from other individuals in addition to those of the individual in question. If a bite mark is compared to a dental cast using the guidelines of the ABFO, and the suspect providing the dental cast cannot be eliminated as a person who could have made the bite, there is no established science indicating what percentage of the population or subgroup of the population could also have produced the bite. This follows from the basic problems inherent in bite mark analysis and interpretation.

As with other "experience-based" forensic methods, forensic odontology suffers from the potential for large bias among bite mark experts in evaluating a specific bite mark in cases in which police agencies provide the suspects for comparison and a limited number of models from which

[123] Rothwell, op. cit.
[124] American Board of Forensic Odontology, op. cit.
[125] Bowers, op. cit.

Copyright © National Academy of Sciences. All rights reserved.

to choose from in comparing the evidence. Bite marks often are associated with highly sensationalized and prejudicial cases, and there can be a great deal of pressure on the examining expert to match a bite mark to a suspect. Blind comparisons and the use of a second expert are not widely used.

Scientific Interpretation and Reporting of Results

The ABFO has issued guidelines for reporting bite mark comparisons, including the use of terminology for conclusion levels, but there is no incentive or requirement that these guidelines be used in the criminal justice system. Testimony of experts generally is based on their experience and their particular method of analysis of the bite mark. Some convictions based mainly on testimony by experts indicating the identification of an individual based on a bite mark have been overturned as a result of the provision of compelling evidence to the contrary (usually DNA evidence).[126]

More research is needed to confirm the fundamental basis for the science of bite mark comparison. Although forensic odontologists understand the anatomy of teeth and the mechanics of biting and can retrieve sufficient information from bite marks on skin to assist in criminal investigations and provide testimony at criminal trials, the scientific basis is insufficient to conclude that bite mark comparisons can result in a conclusive match. In fact, one of the standards of the ABFO for bite mark terminology is that, "Terms assuring unconditional identification of a perpetrator, or without doubt, are not sanctioned as a final conclusion."[127]

Some of the basic problems inherent in bite mark analysis and interpretation are as follows:

(1) The uniqueness of the human dentition has not been scientifically established.[128]
(2) The ability of the dentition, if unique, to transfer a unique pattern to human skin and the ability of the skin to maintain that uniqueness has not been scientifically established.[129]
    i. The ability to analyze and interpret the scope or extent of distortion of bite mark patterns on human skin has not been demonstrated.
    ii. The effect of distortion on different comparison techniques is not fully understood and therefore has not been quantified.

[126] Bowers, op. cit.
[127] American Board of Forensic Odontology, op. cit.
[128] Senn, op. cit.
[129] Ibid.

Copyright © National Academy of Sciences. All rights reserved.

(3) A standard for the type, quality, and number of individual characteristics required to indicate that a bite mark has reached a threshold of evidentiary value has not been established.

Summary Assessment

Despite the inherent weaknesses involved in bite mark comparison, it is reasonable to assume that the process can sometimes reliably exclude suspects. Although the methods of collection of bite mark evidence are relatively noncontroversial, there is considerable dispute about the value and reliability of the collected data for interpretation. Some of the key areas of dispute include the accuracy of human skin as a reliable registration material for bite marks, the uniqueness of human dentition, the techniques used for analysis, and the role of examiner bias.[130] The ABFO has developed guidelines for the analysis of bite marks in an effort to standardize analysis,[131] but there is still no general agreement among practicing forensic odontologists about national or international standards for comparison.

Although the majority of forensic odontologists are satisfied that bite marks can demonstrate sufficient detail for positive identification,[132] no scientific studies support this assessment, and no large population studies have been conducted. In numerous instances, experts diverge widely in their evaluations of the same bite mark evidence,[133] which has led to questioning of the value and scientific objectivity of such evidence.

Bite mark testimony has been criticized basically on the same grounds as testimony by questioned document examiners and microscopic hair examiners. The committee received no evidence of an existing scientific basis for identifying an individual to the exclusion of all others. That same finding was reported in a 2001 review, which "revealed a lack of valid evidence to support many of the assumptions made by forensic dentists during bite mark comparisons."[134] Some research is warranted in order to identify the circumstances within which the methods of forensic odontology can provide probative value.

---

[130] Ibid.

[131] American Board of Forensic Odontology, op. cit.

[132] I.A. Pretty. 2003. A Web-based survey of odontologists' opinions concerning bite mark analyses. *Journal of Forensic Sciences* 48(5):1-4.

[133] C.M. Bowers. 2006. Problem-based analysis of bite mark misidentifications: The role of DNA. *Forensic Science International* 159 Supplement 1:s104-s109.

[134] I.A. Pretty and D. Sweet. 2001. The scientific basis for human bitemark analyses—A critical review. *Science and Justice* 41(2):85-92. Quotation taken from the abstract.

Copyright © National Academy of Sciences. All rights reserved.

BLOODSTAIN PATTERN ANALYSIS

Understanding how a particular bloodstain pattern occurred can be critical physical evidence, because it may help investigators understand the events of the crime. Bloodstain patterns occur in a multitude of crime types—homicide, sexual battery, burglary, hit-and-run accidents—and are commonly present. Bloodstain pattern analysis is employed in crime reconstruction or event reconstruction when a part of the crime scene requires interpretation of these patterns.

However, many sources of variability arise with the production of bloodstain patterns, and their interpretation is not nearly as straightforward as the process implies. Interpreting and integrating bloodstain patterns into a reconstruction requires, at a minimum:

- an appropriate scientific education;
- knowledge of the terminology employed (e.g., angle of impact, arterial spurting, back spatter, castoff pattern);
- an understanding of the limitations of the measurement tools used to make bloodstain pattern measurements (e.g., calculators, software, lasers, protractors);
- an understanding of applied mathematics and the use of significant figures;
- an understanding of the physics of fluid transfer;
- an understanding of pathology of wounds; and
- an understanding of the general patterns blood makes after leaving the human body.

Sample Data and Collection

Dried blood may be found at crime scenes, deposited either through pooling or via airborne transfer (spatter). The patterns left by blood can suggest the kind of injury that was sustained, the final movements of a victim, the angle of a shooting, and more. Bloodstains on artifacts such as clothing and weapons may be crucial to understanding how the blood was deposited, which can indicate the source of the blood. For example, a stain on a garment, such as a shirt, might indicate contact between the person who wore the shirt and a bloody object, while tiny droplets of blood might suggest proximity to a violent event, such as a beating.

Analyses

Bloodstain patterns found at scenes can be complex, because although overlapping patterns may appear simple, in many cases their interpreta-

Copyright © National Academy of Sciences. All rights reserved.