

Development of a Forensic CT Service in a Medical Examiner Office



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This project was supported by **Award 2010-DN-BX-K205** from the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this presentation are those of the authors and do not necessarily reflect those of the Department of Justice.

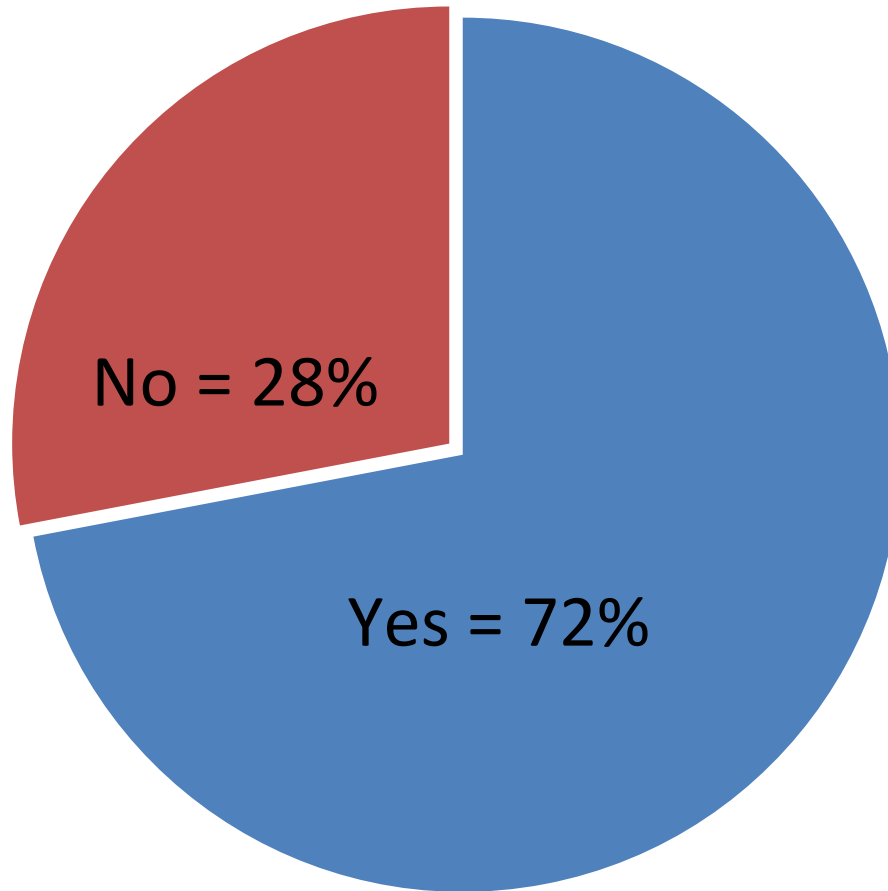


Study data were collected and managed using REDCap electronic data capture tools hosted at the University of New Mexico, supported by **DHHS/NIH/NCRR #1 UL1RR031977-01**



If it is was readily available and affordable, would you integrate the use of computed tomography, (CT) scans into your practice?

2010





“A grand hypothesis is not the usual path for the advancement of medical knowledge. As a rule, first comes a new or improved method whose application to a variety of problems sometimes leads unexpectedly to greater understanding.”

Frank Kittredge Paddock (1841-1901)

Incorporating CT into Forensic Practice: The New Mexico Story

Office of the Medical Investigator: New Facility

1995 Office of Risk Management review

- \$54M potential liability from airborne TB

Architect review – ventilation system cannot be remediated to meet standards

Safety + space needs drove political process for new facility

Early Forensic Imaging Research

- Gil Brogdon- Father of forensic radiology
- Harris-MRI PM brains for courtroom evidence, 1991
- Hart et al- PM cranial MRI & child abuse, 1996
- Patriquin- PM whole body MRI, 2001
- Virtopsy Group, 2000s
- Armed Forces Medical Examiner, 2000s



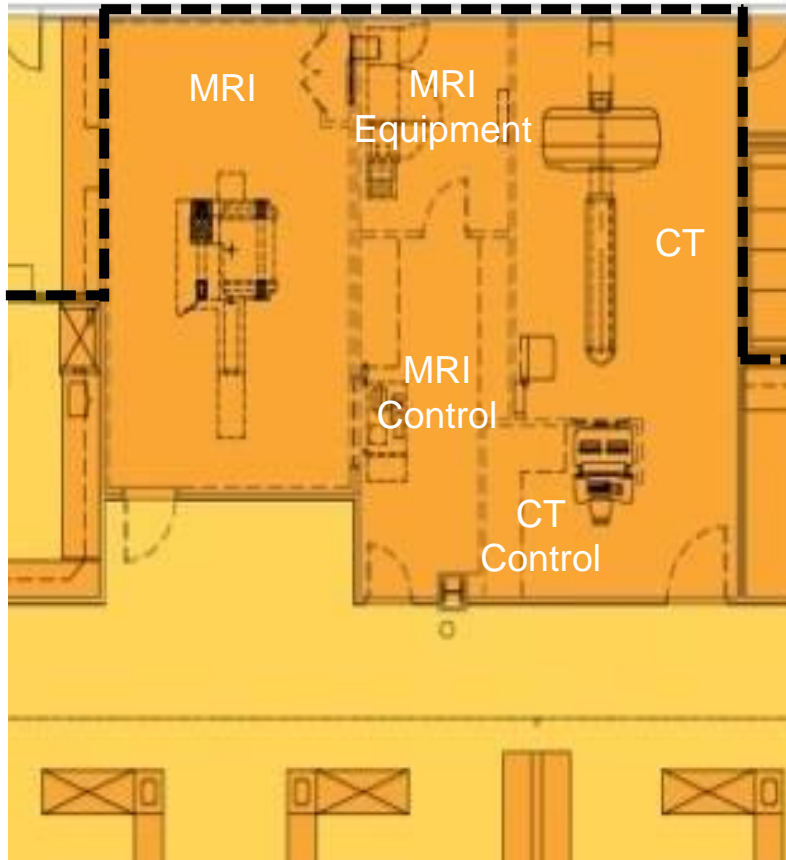
Gil Brogdon

Overall Diagram



Imaging

CT and MRI



16 slice
CT



1.5 T
MRI

Purchasing a CT Scanner

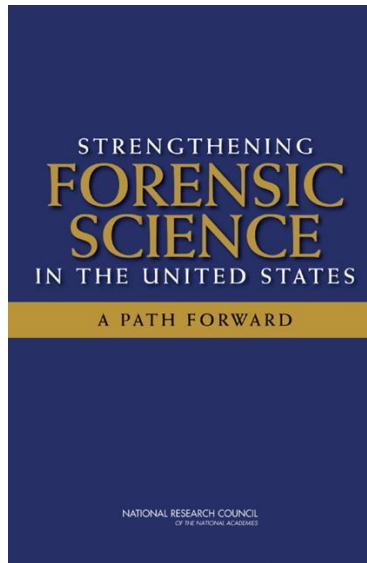
- Competitive RFP
- Need expert help
- Philips Brilliance Big Bore 16 slice scanner
- \$500K
- PACs \$5/case

 NEW MEXICO SCIENTIFIC LABORATORIES



NAS Report

- “Currently, little research is being conducted in .. forensic pathology in the United States.”
- Advanced imaging technology should be further studied.



National Research Council. Strengthening Forensic Science in the United States: A Path Forward, 2009

Postmortem Imaging Research

- European/Australian forensic centers & US military
- Small studies: case reports and series
- Inconsistent evidence
 - Recognizing injuries
 - Identifying cause of death
- Large uniform prospective blinded studies-absent

Why is it important to evaluate this technology?

- Supplant autopsy
 - Reduce autopsy numbers and costs
 - Address shortage of forensic pathologists
 - Decrease biosafety risks
 - Honor cultural/religious wishes for no autopsy
- Supplement autopsy
 - More complete diagnostic information
 - Better courtroom illustrations

NM OMI Research Assets

- Statewide centralized academic ME office
- Radiology, physics & other collaborators
- 2100 autopsies/year
- State-of-the-art facility with 16 slice CT scanner & 1.5 T MR scanner



Utility of Postmortem CT in Supplanting or Supplementing Medicolegal Autopsies

- Evaluate 4 subsets
 - Blunt force injuries (200 cases)
 - Firearm injuries (200 cases)
 - Drug poisoning deaths (460 cases)
 - Pediatric trauma (76 cases)

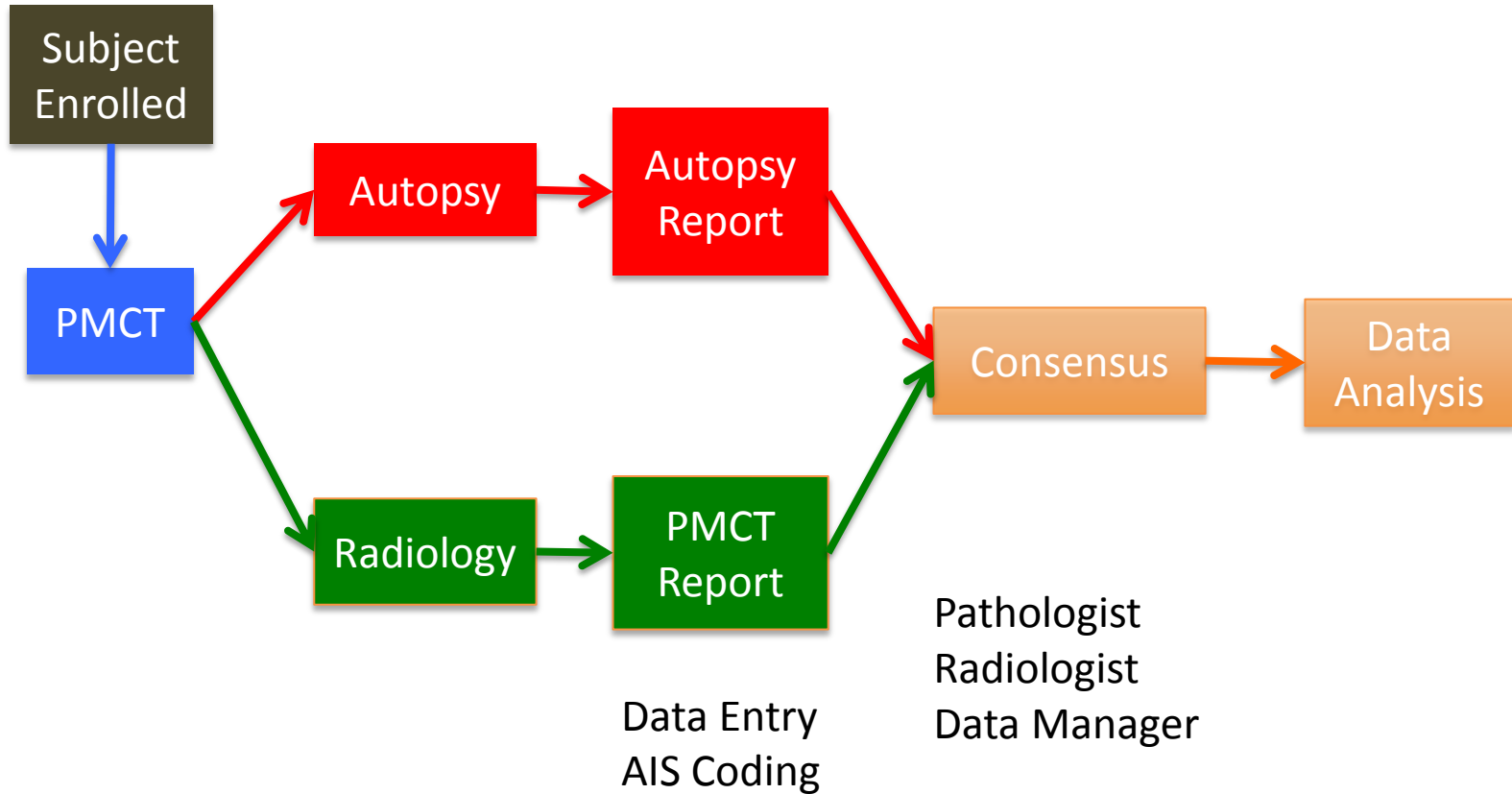
BFI- Hypotheses

- ***Hypothesis:*** PMCT can recognize fatal BFIs and identify the COD so that it can supplant autopsy in certain situations (e.g., motor vehicle collisions).
- ***Hypothesis:*** PMCT will identify sufficient skeletal & soft tissue injuries outside standard autopsy to justify its utility as an adjunct procedure especially where robust injury characterization is important.

Study Methods

- Prospective- CT all autopsy cases prior to autopsy
- Double blind, radiologists have access to history
- Autopsies- board-certified pathologists
- CT scans- board certified radiologists
- CT & autopsy- AIS certified coder
- Consensus conference
 - Different pathologist & radiologist
 - Congruence comparison- autopsy & CT findings, AIS codes, cause of death statements

Design Overview

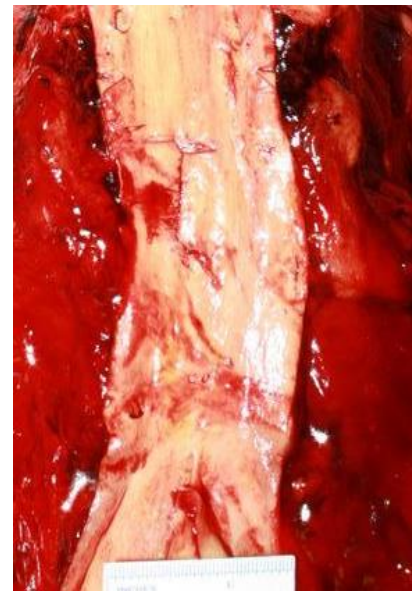
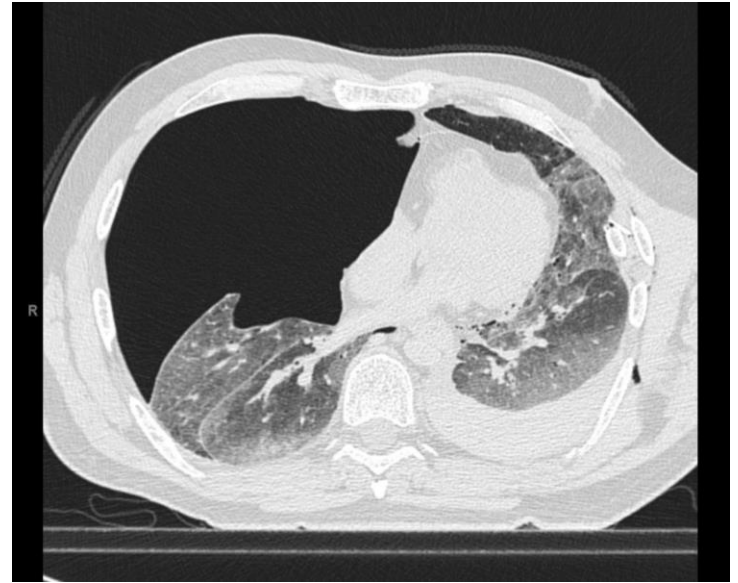


Blunt Force Results

- 126 males, 41 females (total 167)
- Mechanism of injury
 - Motor vehicle collisions (57%)
 - Assault (15%)
 - Pedestrians and bicyclists struck by vehicles (11%)
 - Falls (8%)
 - Other (9%)

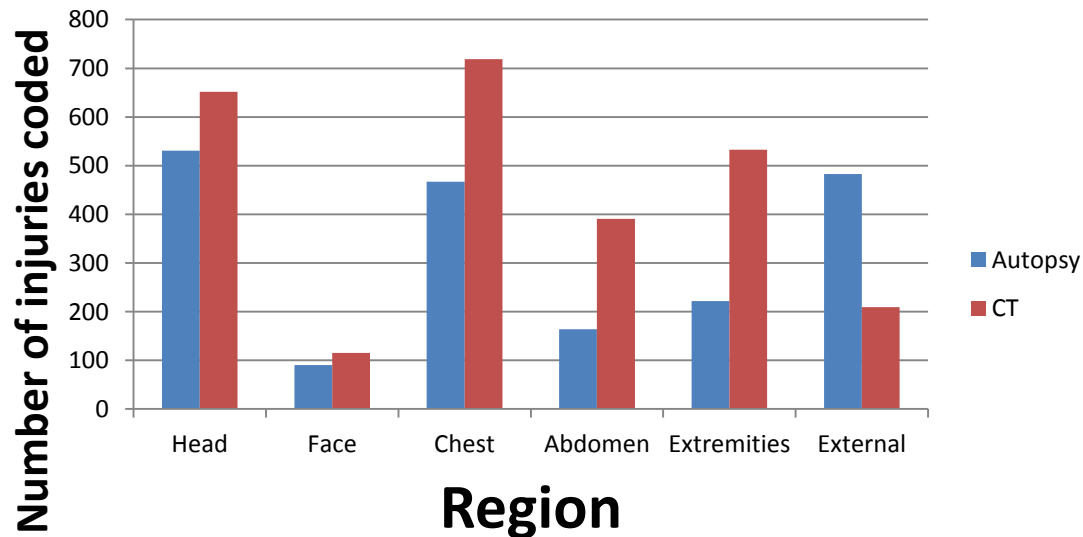
Blunt Force Results

- Total injuries- 3652
 - CT & autopsy- 922
 - CT only- 1700
 - Autopsy only- 1030
- Of total injuries
 - CT discovered 72%
 - Autopsy discovered 53%
- Head region
 - CT- 72%
 - Autopsy- 57%



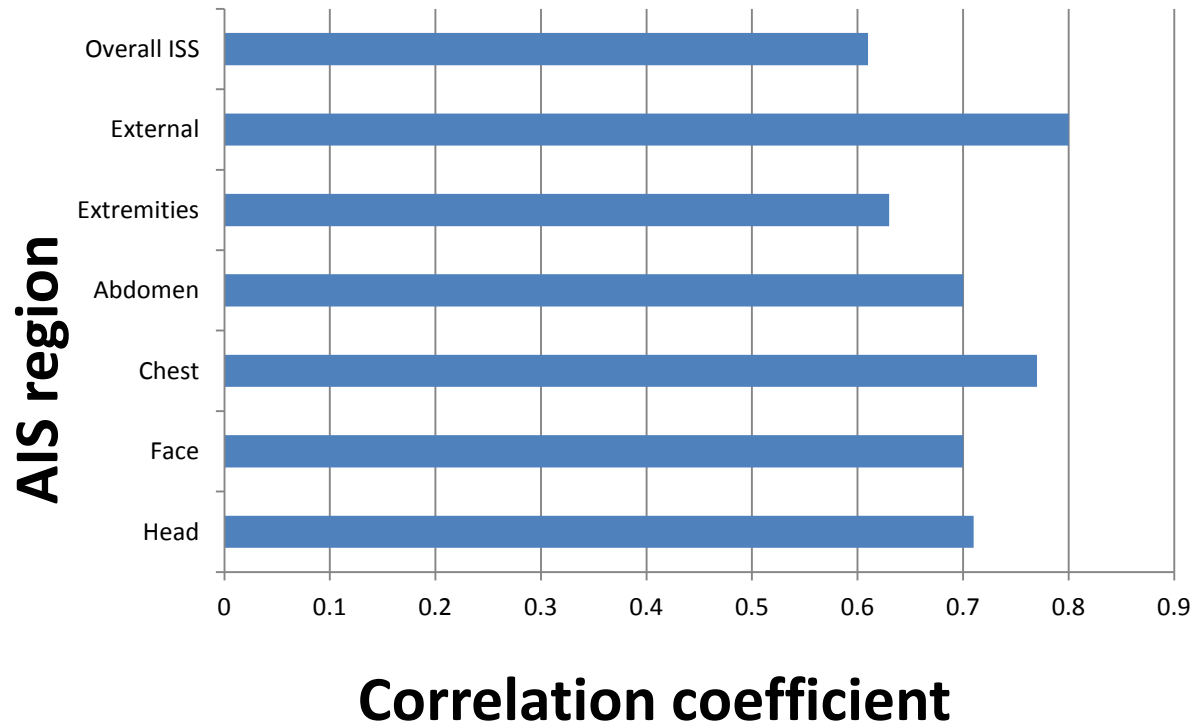
Blunt Force Results

Numbers of blunt force injuries by AIS coding region



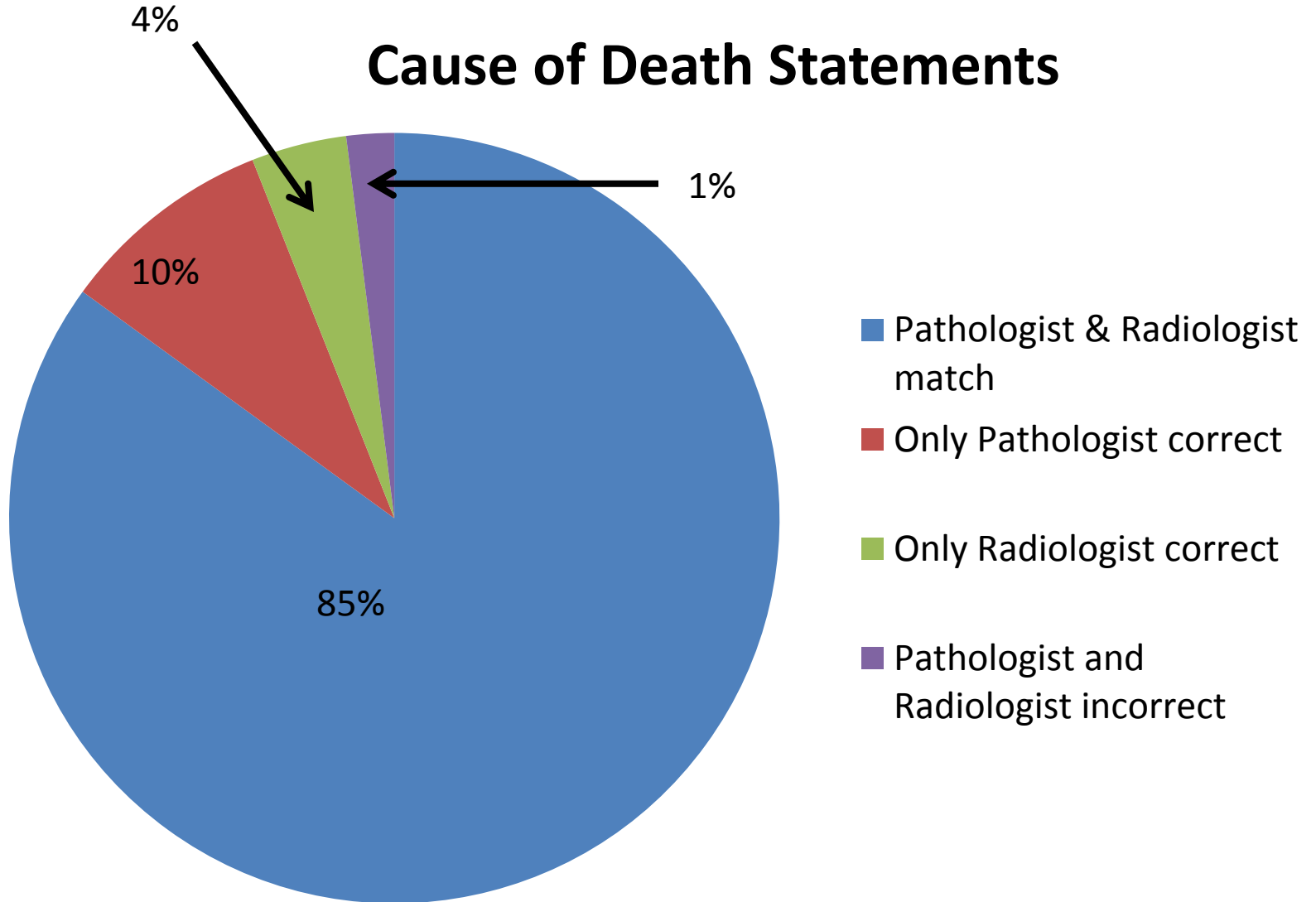
More injuries detected by CT for every coding region except external surface

Correlation between autopsy and CT MAIS



Results

Cause of Death Statements



Conclusions

- Autopsy and CT are imperfect & complementary
- Decedents have multiplicity of injured organs & tissues
 - Neither autopsy nor CT discovers all injuries
 - Each process finds sufficient injuries to accurately establish cause of death

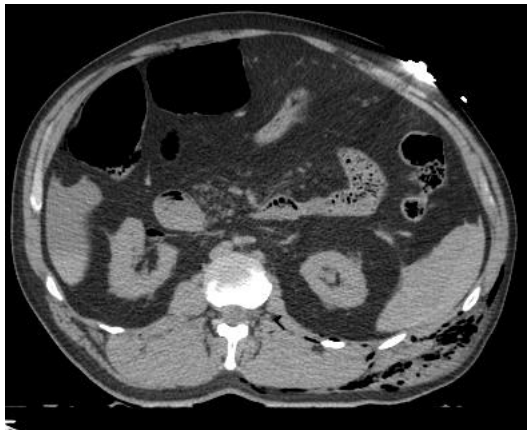
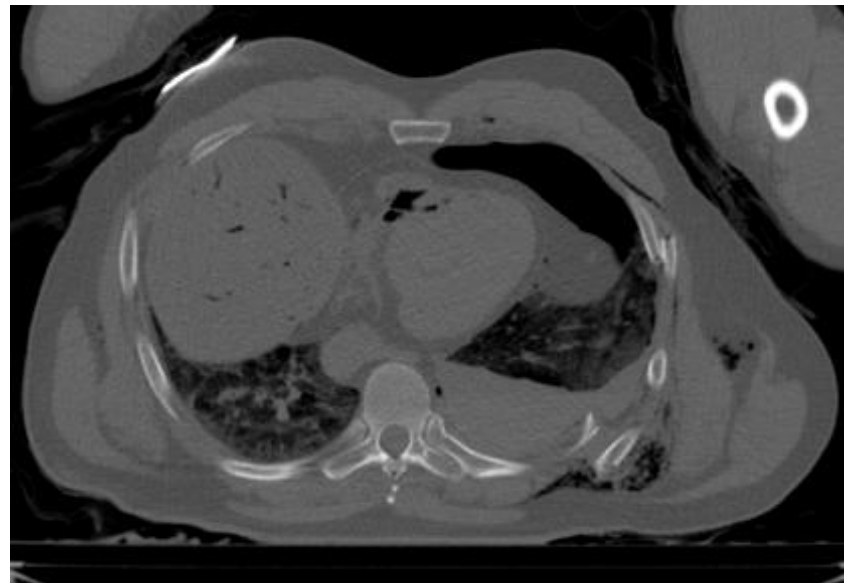
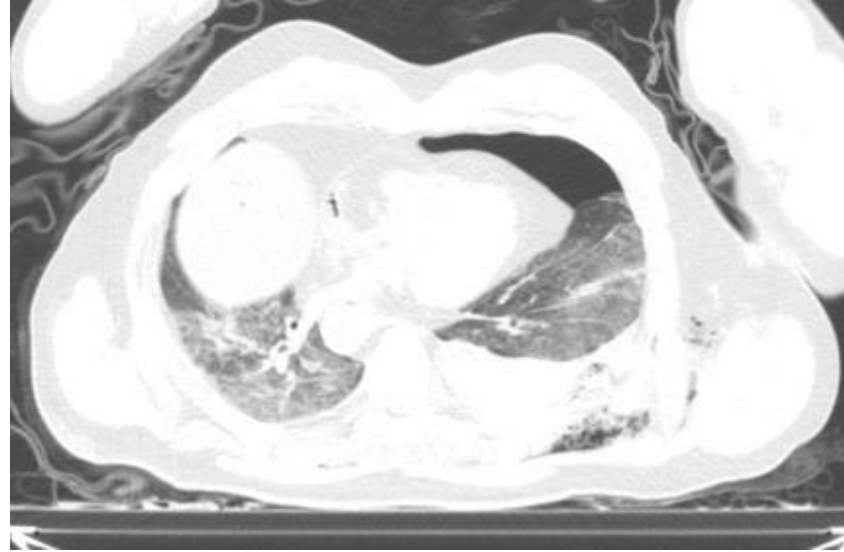
*Nolte KB, Lathrop SL, Hatch GM et al. Utility of postmortem x-ray computed tomography (CT) for medicolegal autopsies on decedents with blunt force injuries. IAFS, Seoul, Korea, 2014.

How has our practice of forensic pathology changed?

Morning Case Conference



50 y/o motorcyclist-lost control



65 y/o man found dead after fight



Advanced Forensic Imaging in US

- CT in house- serving 11% of US Population
 - Armed Forces ME
 - NM OMI
 - MD OCME
 - Schuylkill County, PA Coroner
 - San Francisco OCME
 - Oklahoma OCME
 - LA Co Coroner
 - Cook Co, IL OCME
 - Jefferson Co, AL Coroner/ME
 - Travis Co, TX OCME
 - Orange Co, FL OCME
 - Virginia-Western District OCME
- Use of clinical CT
 - Vermont
 - Oregon
 - Georgia
 - Wisconsin
 - North Carolina
 - New York
 - Colorado
 - 3 US military installations
- MRI in house - NM OMI

Obstacles to Implementation

- Scientifically defining areas of utility
 - Courtroom utility of CT illustrations?
 - More comprehensible? Less unfairly prejudicial?



Obstacles to Implementation

- Who acquires images?
- Who interprets images?
- Cost of equipment- no federal funding
- Threat to professional identities: beleaguered autopsy, practice, income

Opportunities

- Cost savings in high volume offices
 - Supplant autopsy with CT + external for 330 cases
= 1 fewer FP
 - Victorian Institute of Forensic Medicine*
 - Screening and triage tool- 2005
 - Decreased autopsy volume 15%
- Teleradiology
- Forensic radiology fellowships

*O'Donnell C. Diagnostic Histopathol 16:552-5, 2010

Training Forensic Pathologists in CT Interpretation

Pathologist/fellow training 2011-18

- In house 80% FTE radiologist
 - Lectures & hands-on training sessions
 - Review of CTs for case triage at morning report
 - Case consultations (formal & informal)
- Daily practice on cases

Current Processes

- Fellow Imaging Lectures/Hands-on Sessions
 - Postmortem CT overview & artifacts
 - Gunshot wounds
 - Radiologic identification
 - Natural deaths
 - Spine trauma
 - Blunt trauma
- Remote radiologist case consultations

Imaging is transforming forensic pathology

- Implications for:
 - Throughput & skills needed to practice
 - Training
 - Research



Questions?

