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Final Technical Report

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Evaluation of the Routine Use of CT Scanning to Supplant or Supplement Autopsy in a High-
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**Final Technical Report
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**Evaluation of the Routine Use of CT Scanning to Supplant or Supplement
Autopsy in a High-Volume Medical Examiner's Office**

Natalie L. Adolphi, PhD

Summary of the project

Introduction

There are many potential advantages of utilizing post-mortem computed tomography (PMCT) for medicolegal death investigation; however, its impact on forensic medical practice in the U.S. has so far been minimal. An important problem is the need for clearer definition of the utility of this emerging technology in order to justify changes in funding priorities. A previous NIJ-funded prospective, double-blinded study (NIJ 2010-DN-BX-K205, PI Nolte) conducted by the New Mexico Office of the Medical Investigator (OMI) has demonstrated the utility of PMCT (interpreted independently, by a radiologist) for supplanting or supplementing autopsy for particular case cohorts. This study demonstrated that both PMCT and traditional autopsy reveal findings that are missed by the other method, and overall, the combination of PMCT and autopsy reveals substantially more findings (by typically 10-30%) than autopsy alone, suggesting that the combination of PMCT and autopsy may be a more appropriate “gold standard” than autopsy alone. The double-blinded approach (radiologists reading PMCT; pathologists performing autopsies; with each blinded to the other’s findings), enabled the evaluation of each examination method, independently; however, that study design does not reflect how imaging has come to be used, in routine practice, at the OMI. One important difference is that forensic pathologists, rather than radiologists, now do the vast majority of image interpretation. The other difference is that forensic pathologists are not blinded, and in fact use PMCT in advance of physical examination to decide how to manage their cases, for example, by aiding in the decision of whether to perform an autopsy, partial autopsy, or external exam, or by affecting the choice of ancillary tests or the ability to honor a family’s request for no autopsy.

Research questions

The research aims to answer the following questions, which arise when PMCT is routinely integrated into the practice of death investigation:

- How well do forensic pathologists perform at interpreting PMCT images?
- How does PMCT impact work flow, costs, and staffing?
- Is the integration of PMCT with other examinations effective?
- When should a radiologist be consulted?

Goals and Objectives

The primary goal of this study was to evaluate the integration of PMCT scanning into the practice of death investigation, based on current OMI practices, which includes routine scanning of >90% of decedents to aid in case triage, with image interpretation performed primarily by forensic pathologists. The study aimed to address the research questions and primary goal in three Phases:

- **Phase 1** aimed to evaluate the PMCT image interpretation performance of forensic pathologists for identifying injuries or disease in four types of fatalities – Blunt Force Injury, Firearm Injury, Pediatric Trauma, and Drug Poisoning – for 200 total cases, with direct comparison to previous findings (radiologist interpretation of the CT scan and autopsy findings).
- **Phase 2** aimed to evaluate how PMCT imaging is used by forensic pathologists in daily practice and how PMCT impacts their investigations in terms of case management, work flow, and resource utilization, by collecting data using a questionnaire completed by the case pathologist for 2000 cases.
- **Phase 3** aimed to evaluate the effectiveness of integrating PMCT into routine investigation, by retrospectively auditing 10% of Phase 2 cases (200 total cases) to determine whether significant imaging findings (visible to a radiologist on CT) were appropriately identified and incorporated into the death investigation report and the determination of the cause and manner of death.

Research design and methods

In the studies we are describing here, the Phase 1 study, evaluating forensic pathologist image interpretation, utilized a blinded approach, to enable direct comparison to previous data obtained for those cases under the previous NIJ award. Specifically, 200 (retrospective) cases were chosen from the previous study, representing 4 specific case types (blunt force injury,

firearm injury, drug poisoning, and pediatric trauma). Each case already had independent autopsy and radiology reports, and abbreviated injury scale (AIS)-coding of those findings. In the current study, two forensic pathologists were asked to review the PMCT and record all observed findings for each of these 200 retrospective cases, and the findings were AIS-coded, to enable comparison of the two pathologists' PMCT findings (number, location, and severity) to each other and to the findings of the radiologist and the original pathologist. In this Phase, as in the previous study, the forensic pathologists were blinded to other observers' findings.

By contrast, the Phase 2 (survey) and Phase 3 (audit) studies reported here were designed with the recognition that PMCT in routine practice in an ME setting does not, as a practical matter, involve blinding, assuming that a primary purpose of PMCT is for pathologists to triage cases at morning case conference and potentially supplant autopsy in some cases based on CT findings. Thus, the Phase 2 and Phase 3 studies aim to provide information to the ME/C community about the use of PMCT under more “organic” conditions, involving pathologists interpreting CT scans in a routine manner for all case types brought in to the OMI.

For the Phase 2 study, a 15-question online survey was created in RedCap to assess how PMCT was used (or not used) in every consecutive case brought in to the OMI over a 9-month period (N=2037) from October 2018 to June 2019. Each survey was completed by the forensic pathologist for that case. Questions included whether PMCT was performed (and if not, why not); how the images were interpreted (when, where, and by whom); whether the PMCT impacted the choice of exam type or determination of cause and/or manner; and other impacts on the case. In addition to the forensic pathologist survey data, PMCT workflow was analyzed (number of studies per day, length of study) using data from the PACS (picture archiving and communications system) where image data is archived, which includes time and date stamps. Costs related to PMCT were tallied, and the (aggregate) impact of PMCT on forensic pathologist exam type and staffing requirements was analyzed (before PMCT and after) using OMI Annual Report data. The “before PMCT” data was obtained from 2005-2007, which was a period during which the numbers of full autopsies and pathologist external exams were separately presented in the annual report, and PMCT had not yet been practiced at the OMI. PMCT was utilized beginning in 2010 (primarily for research initially) and gradually became routine over the period 2013-2018.

The Phase 3 study involved an audit of 10% of the cases surveyed in Phase 2. A total of 200 cases from 4 categories were reviewed: 1) autopsy without a radiology consult (RC) (n=77), 2) external exam or partial autopsy without RC (n=79), 3) autopsy with RC (n=26), 4) external exam with RC (n=18). Due to the limited number of RC cases, all available RC cases were included, while categories 1 and 2 were sampled randomly.

A forensic radiologist with 10-years of experience (who did not consult previously on the cases) reported the PMCT findings. The radiologist and a pathologist (not the case pathologist) reviewed the death investigation report in tandem to document any PMCT findings identified by the study radiologist omitted from the original death investigation report. In order to classify omitted findings, we developed a modified Goldman classification with 7 different error types described in detail in the results section.

Expected applicability of the research

In New Mexico, the annual number of reported cases and the number of forensic pathologist examinations our office performed has grown steadily since 2013. At the same time, we observed that the number of full autopsies we were performing remained flat, or slightly decreased. Presumably this trend (increasing cases but decreasing full autopsies) was primarily due to our Office's use of PMCT, because PMCT, together with an external exam, enables the determination of cause and/or manner in some cases that previously would have required a full autopsy. Therefore, an expected impact of this research was to better define the impact of PMCT on our practice (both quantitatively and qualitatively) with sufficient granularity to be helpful to other ME/C offices considering the use of PMCT. Currently only a handful of ME offices in the U.S. have experience utilizing PMCT on a routine basis, and we are the only ME/C office in the U.S. (to our knowledge) that performs PMCT on the vast majority (>90%) of decedents.

A further anticipated impact is providing data regarding whether PMCT has a quantifiable impact on accreditation-mandated Forensic Pathologist staffing levels in a high-volume office such as the New Mexico OMI.

In addition to cost, personnel, and technical requirements, another concern related to the use of PMCT is accuracy. Two specific anticipated impacts are demonstrating how accurately forensic pathologists interpret PMCT (addressed by both Phase 1 and Phase 3).

The over-arching goal of this research was to obtain and disseminate data about the effectiveness and cost implications of the OMI's use of PMCT to other ME/C offices nationwide, so that they can make informed decisions about the use of PMCT in their practices.

Participants & Other Collaborating Organizations

The primary participants in the study were faculty, staff, and forensic pathology fellows at the New Mexico Office the Medical Investigator, a special program of the School of Medicine at the University of New Mexico. These individuals include:

Natalie Adolphi PhD (PI), Kurt B. Nolte MD, Kethery Haber MHA, Gari Bodor MS, Matthew Cain MD, Ross Zumwalt MD, Karen Cline-Parhamovich DO, Ian Paul MD, Lori Proe DO, Hannah Kastenbaum MD, Lauren Decker MD, Lauren Dvorscak MD, Heather Jarrell MD, Gary Mlady MD, and fellows Lindsay Taute MD, Mark Giffen MD, Andrew Guajardo MD, Henry McNett MD.

Additionally, two UNM Medical Students, Melissa J. Fang and Mitchell R. Byrd, each volunteered their efforts to this project for one semester.

Two Forensic Pathologists from other ME offices (Dr. Lauren Edelman from Travis County, Texas; and Dr. Christopher Liverman from Hennepin County, Minnesota) participated as consultants in the pathologist image interpretation in Phase 1. Both Dr. Edelman and Dr. Liverman previously completed their Forensic Pathology fellowships at the New Mexico Office of the Medical Investigator, and were therefore familiar with interpreting PMCT.

Finally, two researchers from Japan, Dr. Yohsuke Makino and Dr. Kana Unuma, participated in the project, each full-time for 6 months, as visiting scholars to complete the Phase 3 study during 2019. Dr. Makino is a forensic radiologist (also trained as a forensic pathologist) who practices at the University of Tokyo. Dr. Unuma is a Forensic Pathologist who practices at Tokyo Medical and Dental University.

Changes in approach

The Phase 2 and Phase 3 studies were completed as originally proposed. However, modifications to the original plan for Phase 1 were necessary. The plan to have 3 different pathologists (2 attendings and 1 fellow) retrospectively read each of 200 cases was, in retrospect, overly ambitious. The Phase 1 research plan was therefore revised to have each of the 200

PMCT cases reviewed by 2 pathologists (either 2 attendings, or 1 attending/1 fellow). Because we are comparing the pathologist interpretations to existing radiologist interpretations of the same cases (funded under a previous NIJ award), and we are assessing interobserver agreement between pathologists, if we had proceeded with 3 pathologist reports (P1, P2, P3) and 1 radiologist report (R), this would require 6 interobserver comparisons to be performed in a pairwise fashion (R-P1, R-P2, R-P3, P1-P2, P2-P3, P1-P3). It became clear that 1) having an additional pathologist and an additional radiologist (who couldn't be the same people as any of the original 4 readers) evaluate 6 pairwise comparisons would take too much time, and 2) the statistical analysis for 6 pairwise comparisons would also be more time-intensive and complicated than originally anticipated. After considering the situation from the standpoint of time, and also from the standpoint of what is standard practice in the field for inter-observer studies, we decided it would be more prudent to limit the number of pathologist readers to 2 for each of the 200 cases. With 2 pathologist readers and 1 existing radiology report, only 3 pairwise comparisons (R-P1, R-P2, and P1-P2) are required for each case, which was manageable, given available funds and personnel. Further, this approach is more consistent with standard practice for interobserver comparisons in our field; pairwise comparisons are standard in the literature, while 3-way comparisons are not.

Results and Findings

Phase 1 Results:

In the Phase 1 study, 200 cases were randomly selected from a previous study comparing autopsy and radiology. Each case was assigned to 3 forensic pathologist readers initially, but as noted above, the study design was modified to 2 forensic pathologist readers per study. Each pathologist was provided the scene investigator's report of death and the PMCT image data. For firearm cases, the pathologists were additionally provided a "clean" body diagram showing only the location of defects to the external body surface. The pathologist reader was unfamiliar with the case, having not previously been the case pathologist, nor a reviewer of the case during a previous research study. A structured reporting template was provided that organized findings by body region. All but one pathologist reader utilized the template, while one pathologist reader preferred to report results in paragraph form. The reports (word documents) were sent to

a certified abbreviated injury scale (AIS) coder, and the findings were assigned AIS codes in Redcap.

In addition to recording individual AIS codes for each code-able finding, the maximum AIS severity (MAISS) score for each body region is recorded (ranging from 0 to 6, where 6 is fatal), and the Injury Severity Score is computed. The ISS is the sum of the squares of the 3 highest individual MAISS scores.

In total, 401 forensic pathologist reports were completed. Of the 200 cases, 18 have 3 completed forensic pathologist reports, 165 cases have 2 forensic pathologist reports, and 17 have one forensic pathologist report. All pathologist reports have received AIS codes.

In addition to the forensic pathologist image interpretation, the radiology and autopsy reports (and AIS) codes from the previous study are available for comparison.

At this time, the AIS codes (individual, MAISS, and ISS) have been extracted into Excel for each report (2 pathologist PMCT reports, 1 radiologist PMCT report and the autopsy report) for each case and are being cleaned and analyzed.

Another means of comparing results is to directly compare the natural language injury descriptions. For each case, the findings from the two forensic pathologist PMCT reports and the radiologist PMCT report have been entered into a table in RedCap to enable a pairwise qualitative assessment of whether or not the findings match, and example of which is shown in the table below. This matching assessment is ongoing.

Radiologist	Forensic Pathologist 1	Match (0,1)	Comment
C2-3 fracture dislocation	Posterior dislocation of at C2-C3 with posterior displacement of C3	1	
	Compressions of cervical spinal cord with surrounding subarachnoid hemorrhage	N/A	elaboration of same injury noted above
Intraventricular hemorrhage	Lateral and 3 rd ventricular hemorrhage	1	
Subarachnoid hemorrhage	Subarachnoid hemorrhage of posterior fossa, base of brain, and brainstem	1	
Left distal radius metaphysis fracture closed		0	
Left distal ulna metaphysis and left mid shaft ulna fracture	Fracture of left ulna	1	
Left tibia fracture		0	
Cerebral edema: Present without compression of the ventricles or cisterns.		0	
Tiny bilateral locules of air located posterior costophrenic sulcus thought to represent posterior pneumomediastinum.		0	
Small bilateral pleural effusions thought to represent hemothorax	Trace bilateral lung fields, possible hemorrhage	1	
Pulmonary contusion 2 lobes	Diffuse reticular opacities	1	

Phase 2 Results:

A PMCT utilization survey, completed by OMI forensic pathologists, characterizing their use of PMCT and its impact on case management was conducted. During the study period, whole body PMCT was performed routinely on OMI cases, using a 16-slice Philips Big Bore scanner (resulting in 3-mm and 1-mm reconstructions, soft tissue and bone algorithms). PMCT images were reviewed by the forensic pathologist assigned to each case, individually, and/or in case conferences and consults with radiologists, for the purpose of determining examination type (external, partial autopsy, full autopsy) and, when possible, cause and/or manner of death. An on-line survey consisting of 15 questions was created in REDCap and completed (over 9 months, from October 2018 through June 2019) for each of N=2027 cases by the case pathologist.

During this period, 1913 PMCT studies were performed, representing 94% of the 2027 cases undergoing an in-office examination. The reasons for not performing CT included: not needed (4%), body habitus (0.6%), hardware issue (0.4%), and other (1%). Based on a detailed analysis of PACS data from March 2019, the average time required to image one subject was 16 minutes (inclusive of scanning and body movement on and off of the CT table), with an average of 7 PMCT studies performed per day (range 0 – 16 per day).

For the N=1913 PMCT exams surveyed, the PMCT images were reviewed prior to examining the body in 95% of cases; PMCT was reviewed during morning case conference in 79% of cases; PMCT was reviewed during the examination of the body in 2.4% of cases, and a radiologist was consulted in only 2.3% of cases.

PMCT had a significant impact on case management, impacting the choice of exam type (full autopsy, partial autopsy, or external only) in 31% of cases, impacting the final determination of cause and manner of death in 20% of cases, and demonstrating a significant finding that would not have been seen at autopsy in 2.6% of cases. Additionally, PMCT was helpful in addressing a specific concern raised by the decedent's family (e.g., religious, cultural, medical, or legal concern) in 1.8% of cases.

Over 5 years of incorporating PMCT into daily practice, the New Mexico OMI has been able to slightly decrease the number of full autopsies performed each year, even as the total number of cases reported has risen. Specifically, based on OMI Annual Report data, the annual number of forensic pathologist examinations grew by more than 15% from 2013-2018, but the number of full autopsies decreased by 10% over the same period, largely due to the impact of

PMCT. This change is attributable to a doubling in the proportion of pathologist cases that were investigated using an external examination rather than a full autopsy.

Prior to 2010 (when PMCT first started being used), the proportions of pathologist examinations that were full autopsies vs. external exams were 83% full autopsy/17% external exam. In 2018, the proportions had changed to 64% full autopsy/36% external exam. This substantial reduction in the proportion of full autopsies has reduced the number of annual autopsy equivalents, which has, in turn, reduced the number of forensic pathologist FTEs required to handle the OMI case load (while remaining within NAME accreditation guidelines). Using 2018 numbers, the savings is 1.5 FTE, equivalent to a 17% reduction in required forensic pathologist staffing at the OMI, as shown in the table below.

	Total Cases	Total Pathologist Exams	Path Autopsies (1 autopsy equivalent)	Path-Supervised Fellow Autopsies (0.5 autopsy equivalent)	Path Externals (0.333 autopsy equivalent)	FTE required (250 autopsy equivalents/FTE)
2018 actual	7538	2915	1066	800	1049 (36%)	7.26
2018 estimated assuming no PMCT (based on autopsy vs external proportions in 2006)	7538	2915	1619	800	496 (17%)	8.74

Considering that OMI faculty have other responsibilities (teaching, scholarship, and administrative) in addition to their clinical effort, OMI would need to hire 2 additional forensic pathologists in order to achieve a 1.5 clinical FTE increase. The approximate cost of two full time forensic pathology faculty was estimated to be \$500k in 2018 (including salary, fringe benefits, and professional funds).

The annual cost of the PMCT service at the OMI remains much less than the cost of 2 full-time forensic pathologists, at approximately \$295k total per year. The annual costs that were considered in this estimate include the service agreement on the CT scanner (\$130k/y), PACS fees (\$15k/y), and imaging personnel (\$150k/y for salary and fringe benefits). The imaging personnel include: a PhD imaging scientist (0.3 FTE as director of the imaging service), a full-time registered radiologic technologist/imaging supervisor, and several “per diem” radiologic

technologists. The technologists provide coverage for scanning 7 days per week from 6 AM to approximately 9:30 AM each morning, and the supervisor has additional duties such as scheduling, training; and assisting the director with protocol development, maintenance of radiation safety and accreditation-related documentation, interfacing with vendor service and PACS IT; and support of research.

The \$295 k/year estimate neglects amortization of the capital cost of a scanner, but also neglects likely savings in autopsy personnel and supplies achieved through the reduced rate of full autopsies. We expect the latter two excluded cost categories to approximately cancel each other. Also neglected here are any capital costs associated with construction, if building modifications are required to install a CT scanner. The services of a PACS IT professional are included here in the “PACS fees” paid to the University Hospital, which enable the OMI to utilize existing PACS infrastructure and technical support within our health system. During the study period, consulting by a University of New Mexico Hospital radiologist was performed as a professional courtesy for the small fraction (2.3%) of cases (~60 per year) requiring a radiology consult. Clearly, costs for a much greater amount of radiologist involvement should be considered when first establishing a PMCT service, prior to the point when the pathologists are comfortable with interpreting the imaging for the vast majority of cases. Alternatively, in modeling costs, one could consider that the ratio of full autopsies to external exams would not be decreased initially, but would gradually decrease over time as the pathologists gained familiarity with PMCT through their own personal PMCT/autopsy correlations. (The pathologist, if uncertain about a CT finding, may always choose to do an autopsy, whether or not radiology support is available.) Nonetheless, consultation with radiologists when first establishing a PMCT service, and the possibility of continuing radiology consultation, are costs that should be considered, particularly by offices which don’t have institutional access to radiology support.

Based on the above cost estimates, the way in which the New Mexico OMI utilizes PMCT (performing PMCT on 95% of cases, using PMCT to determine exam type) results in a significant operating cost savings (>\$100k per year of operating costs). However, even for a somewhat smaller jurisdiction, or a jurisdiction with higher costs for PACS or radiology support, it seems likely that PMCT can still be employed in a manner that is at least cost-neutral. In any case, the question of forensic pathologist supply arises. If forensic pathologists are sufficiently scarce, it may be possible to establish a PMCT service but not possible to hire an adequate

number of forensic pathologists for the same cost (or at all). Furthermore, due to scarcity, forensic pathologist salaries may increase faster than the other costs outlined here, changing the cost-benefit analysis.

Beyond the 1.5 FTE savings already realized at the New Mexico OMI by 2018, we further project that the OMI's adoption (in mid-2019) of a rapid urine drug screen (UDS) protocol, in conjunction with PMCT, has resulted in further reductions in the rate of full autopsies (specifically in drug overdose deaths) which we estimate may now be saving an additional 0.5-1 clinical FTE. The analysis of 2020 autopsy vs. external examination rates (post-UDS adoption) awaits finalization of the 2020 OMI Annual Report. The analysis of the impact of the UDS-PMCT protocol will be forthcoming when those data are available.

Phase 3 Results:

The New Mexico OMI is a high-volume medical examiner's office that performs postmortem computed tomography (PMCT) on >90% of cases brought in for autopsy or external exam. As demonstrated by the results of the PMCT usage survey (Phase 2), more than 97% of these PMCT studies performed at the OMI are interpreted by forensic pathologists. In order to determine whether significant imaging findings are appropriately identified and incorporated into the death investigation report and the cause and manner of death, a retrospective audit of 10% of cases receiving PMCT over a 9-month period was performed. (This period coincided with the period during which the Phase 2 survey was administered.)

A total of 200 cases from 4 categories were reviewed. In order to classify omitted findings, we developed a modified Goldman classification with 7 different error types:

- Major 1: Unrecognized fatal injury or pathology that would change cause of death (COD) and/or manner of death (MOD),
- Major 2: Unrecognized fatal injury or pathology that would not change COD and/or MOD (e.g., polytrauma)
- Minor 3-1: Incidental finding unrelated to COD, but potentially important (e.g., for public health),
- Minor 3-2: Additional finding related to the mechanism of a recognized COD,
- Minor 4-1: Incidental finding unrelated to COD, and not important,
- Minor 4-2: Additional findings related to recognized COD, but not important,
- Minor 5: Anatomic error (e.g., rib number).

Errors that were difficult to classify were reviewed by 4 co-investigators (Makino, Unuma, Kurt Nolte, and Adolphi) to reach consensus.

A total of 13 Major errors (4 Major-1, and 9 Major-2) were identified (6.5% of cases). In all cases where major errors were identified, the MOD was certified as either accident or natural. The 4 Major-1 errors were found in cases that received external examinations without a RC. Of 9 Major-2 errors, 2 occurred in cases receiving full autopsies without RC, and 6 occurred in cases receiving external examinations without RC. Only 1 Major error was found in RC case (Major-2, external examination). In only one case did the major error suggest a possible change in the MOD (a missed humerus fracture in a decomposed, non-suspicious death certified as natural). In none of the 200 cases reviewed did a missed PMCT finding definitively change the MOD.

Three of 4 Major-1 and 2 of 9 Major-2 errors in external examinations were fatal abdominal pathologies (e.g., panperitonitis). Six of 9 Major-2 errors, including one RC case, were fatal injuries (e.g., cervical spine injury) missed in cases with multiple other fatal injuries. The RC was requested specifically for evaluation of a fetus found in a female motor-vehicle accident victim and not for COD confirmation.

Minor unrecognized (or undocumented) PMCT findings were extremely common, occurring in 95% of cases overall. Little difference was observed in minor error frequency between the 4 case categories. Of the minor error types, Minor 4-1 (unrelated to COD, and not important) was the dominant type, occurring in 83.5% of cases.

In conclusion, pathologists reliably interpret PMCT scans, avoid major errors, and accurately certify deaths in the vast majority of cases. As major errors occur more frequently in external examinations (for which the manner of death is primarily either natural or accident), some educational interventions, such as increased training for pathologists in the radiological appearance of abdominal pathologies and trauma, may be considered. The data suggest that RCs may reduce major errors, although the statistical significance of RC efficacy cannot be determined from this study due to the small number of cases utilizing RC.

Limitations

One limitation of this study is the extent to which these findings are applicable to smaller jurisdictions. The New Mexico OMI investigates over 7000 death reports annually, and performs >3000 in-office examinations per year, and we are cognizant that offices with smaller

case volumes may not derive as much benefit from a PMCT service, relative to the capital and annual costs. Another potential limitation of the study is the lack of specific inclusion criteria. The aggregated results therefore represent the mix of case types at the OMI, which may or may not reflect the mix of case types in other large jurisdictions. To address this limitation, additional analysis of the Phase 2 results to break down findings by case type (manner, and a broad classification of cause, e.g. “trauma” or “substance abuse”) will be undertaken in the future. Finally, a limitation of the Phase 3 audit is that there were very few radiology consults (2.3%) performed, such that the apparent efficacy of radiology consults for reducing missed findings could not be statistically evaluated.

Products

Presentation: “Evaluation of the Routine Use of Post-Mortem Computed Tomography (PMCT) by a High-Volume Medical Examiner's Office in the U.S.,” 8th Congress of the International Society of Forensic Radiology and Imaging, Berlin, Germany, May 2019. Presenter: Natalie Adolphi

Poster, “Optimization of Whole Body Post-Mortem Computed Tomography (PMCT) Protocol and Workflow for a High-Volume U.S. Medical Examiner’s Office,” Kethery Haber, Natalie Adolphi, and Matthew D. Shultz, 8th Congress of the International Society of Forensic Radiology and Imaging, Berlin, Germany, May 2019. Presenter: Kethery Haber.

Presentation: “Development of a Forensic CT Service in a High-Volume U.S. Medical Examiner Office,” American Academy of Forensic Sciences Workshop 24, *Forensic Postmortem Radiology: Crossing the Border Between Radiology and Pathology*, Anaheim, CA, February 18, 2020. Presenter: Natalie Adolphi

Presentation (virtual): “Evaluating the impact of PMCT at the New Mexico Office of the Medical Investigator,” Matthew D. Cain, Natalie L. Adolphi, Garon Bodor, and Kurt Nolte, National Association of Medical Examiners 2020 Annual Meeting (virtual), October 17, 2020. Presenter: Natalie Adolphi

Presentation (virtual): “The Evaluation of the Routine Use of Postmortem Computed Tomography (PMCT) In a High-Volume United States Medical Examiner’s Office,” Makino Y (presenter), Unuma K, Nolte KB, and Adolphi NL. American Academy of Forensic Sciences, February 19, 2021.

Presentation (webinar): “PMCT Basics: Facility and Technical Aspects,” Part 1 of the Post-Mortem Computed Tomography Webinar Series, produced by the Forensic Technology Center of Excellence (funded by NIJ), presented synchronously to a national audience on April 13, 2021. Presenter: Natalie Adolphi

Presentation (virtual): “The Use of Computed Tomography for Death Investigation,” New Mexico Society of Radiologic Technologists Annual Meeting, April 10, 2021. Presenter: Natalie Adolphi

Datasets

1. AIS-coded reports of PMCT findings (601), representing 200 cases. Of these 601 AIS-coded PMCT reports, 401 represent image interpretation by forensic pathologists and 200 reports (funded under a previous NIJ grant) represent image interpretation by radiologists for the same cases. AIS-coded autopsy findings for the same cases (also funded under the previous grant) are available as well. Natural language PMCT findings (from 2 pathologists and one radiologist) are also available. Data is stored in Redcap and Excel.
2. Survey results (N=2037 non-duplicate responses) regarding PMCT usage in OMI cases from October 2018-June 2019. Original data is in Redcap, with cleaned data in Excel.
3. Audit findings (findings observed on PMCT by a radiologist but not noted in the death investigation report) for 200 cases, classified according to a modified Goldman classification, in Excel.

Dissemination Activities

In addition to the research and educational presentations with a regional (1), national (4), and

international (2) audience described above, Dr. Adolphi regularly communicates, informally, with medical examiners from other jurisdictions in the U.S., who are in the process of deciding whether to adopt post-mortem CT into their practice, are actively planning for and purchasing a CT scanner, or who are upgrading old CT scanners. These communications have included agencies such as Orange County (Orlando, Florida), Hennepin County (Minneapolis, MN), Jackson County (Kansas City, MO), Franklin County (Columbus, OH), Pierce County (Tacoma, WA), and the Maryland OCME. These communications involve, primarily, answering technical and cost questions (about CT scanners, service, site planning requirements, personnel requirements, and data storage requirements) and sharing protocols.

Two manuscripts, one based on the Phase 2 study (survey) and one based on the Phase 3 study (audit), are currently in progress. Phase 1 data require further cleaning and analysis, prior to publication.