Forensic Autopsies

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History of Forensic Medicine

Death Investigation Has Ancient Roots

Although forensic medicine has ancient roots, its evolution has been so very slow that paradoxically it can be considered a new specialty of medicine.

Suetonius (ca 69–122 CE) and others provided the first record of a forensic autopsy by the physician Antistius on Julius Gaius Caesar after he was assassinated in the forum by Brutus and other Roman Senators on the Ides of March, 44 BCE [1]. Antistius determined that of 23 stab wounds, only the second one in the breast was fatal. It has been proposed that the association with the forum gave rise to our present term *forensics* [2].

Credit for the first systematic treatise on forensic medicine is given to Song Ci (Sung Tz'u) (1186–1249) of the Hunan Province in China, for the *Hsi Yuan Lu* (or *Xiyuan jilu*) or *The Washing Away of Wrongs* (also translated as *Collected Cases of Injustice Rectified*), written in 1247 CE, near the end of the Song dynasty [3–6]. Song Ci compiled, corrected, and expanded earlier writings in the manual, which provided instructions on how to conduct medicolegal investigations, examine corpses, and determine the time and cause of death.

Forensic Pathology Becomes a Profession

The origins of forensic pathology practice in the West arose much later, with the development of medical schools and anatomical dissection beginning in the thirteenth century. Shortly thereafter, autopsies were conducted for forensic purposes.

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Hugo de Lucca took an oath as a forensic medicine expert in 1249 in Italy. In 1302, the first forensic autopsy documented in detail was made by Bartolomea de Variagiana and three others in Bologna on the body of Azzolino degli Onesti; they reported that the reason for this death was internal bleeding, not poisoning [7]. In 1410, an autopsy was performed on the Antipope Alexander V to investigate the possibility of poisoning by his successor [8]. Ambrose Paré (1510–1590) is considered to be the first forensic pathologist and wrote first on traumatic injuries of organs and then *Reports* in 1575 [9–11]. It was not until after Paré performed a judicial autopsy in 1562 that forensic autopsies became common [12]. In 1598, Fortunato Fedele (Fortunati Fidelis) (1550–1630) is noted to have made a career of performing autopsies and giving testimony about them in court and wrote *De Relationibus Medicorum Libri Quatuor* in 1602 (four volumes) [13]. In 1651, Paolo Zacchias (Zacchia) (1584–1659) published three volumes on forensic medicine between 1621 and 1651 entitled *Quaestiones Medico-Legales* (*Legal Medicine Questions*); he is considered by many to be the father of forensic medicine (Fig. 7.1) [14, 15].

The Holy Roman Empire extended into France, and in about 806 CE, the *Capitularies of Charlemagne* formalized death investigation and required

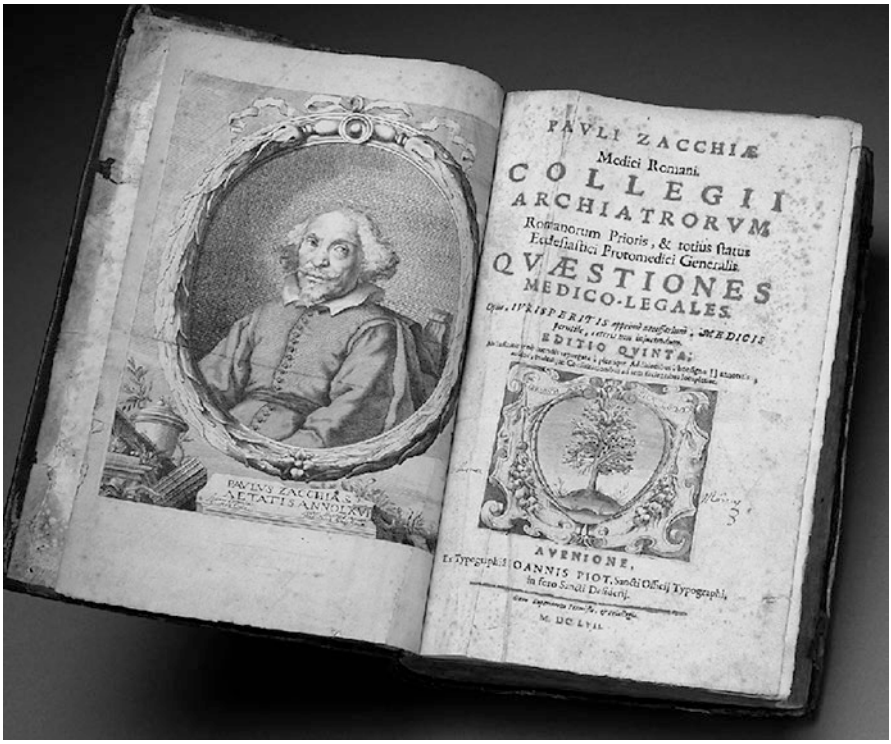

Fig. 7.1 Paolo Zacchias "Father of Forensic Pathology" with page from his published work *Quaestiones Medico-Legales.* https://www.nlm.nih.gov/visibleproofs/galleries/exhibition/rise_image_4.html

consultation of medical practitioners in cases of physical injury, infant deaths, and suspected suicide [16]. The 1507 German *Bamberg Code* required medical courtroom testimony in cases of infanticide, homicide, abortion, or poisoning [17]. Emperor Charles V in the 1532 *Constitutio Criminalis Carolina* penal code (the Caroline Code) extended the practice in all the lands of his empire [18–20]. This led to the development of the medicolegal autopsy primarily by the German Johannes Bohn (1640–1718), who published the textbook, *De Renunciatione Vulnerum Seu Vulnerum Lethalium Examen*, in 1689 [21].

The Enlightenment period of the eighteenth and nineteenth centuries spawned notions of public health, including an interest in understanding why people died, so that informed governmental efforts could help people survive. Throughout Europe, national registries were established, and eventually this came to involve autopsies performed in large numbers to determine the causes of death. Autopsies were performed according to *The Regulations* [22, 23]. Ludwig Casper (1796–1864) and Rudolf Virchow (1821–1902) were prominent in this movement [24–26]. Our current death certificates are part of our national health statistics, particularly our vital statistics system.

Legal medicine (medical jurisprudence) became a separate subject by the seventeenth century, and chairs of legal medicine began to be established in the eighteenth century. Michaelis became the first chair of legal medicine at Leipzig University in Prussia in 1720, followed by chairs in Paris, Strasbourg, and Montpellier, France [27]. In 1807, the University of Edinburgh established the first chair of legal medicine in the English-speaking world, occupied by Andrew Duncan Jr. (1744–1828) [28, 29]. In the United States, although Benjamin Rush (1746–1813) of Philadelphia gave lectures on medical jurisprudence during the American revolutionary period [30], it was not until 1932 that a Chair of Legal Medicine was established at Harvard [31].

England Gives Birth to the Coroner

Investigation of deaths in England developed separately from the European continent, beginning in the medieval period [32–38]. In 925 CE, King Æthelstan (894–939) granted a Charter of Privileges to an English noble, St. John of Beverley, which included a grant of the position of coroner (Latin for appointed by the Crown). This early coroner was a traveling magistrate (circuit judge) who traveled the countryside of the county (*eyre* or *shire*) performing administrative and inquisitorial duties, settling disputes, and levying fines. With time, they became corrupt and lazy, taking years to complete their circuit, and fell into obscurity. Meanwhile, villages were left to the mercy of the greedy county tax collector (*shire-reeve* or *sheriff*), who did not necessarily have the King's interest at heart.

In 1194, Hubert Walter (1160–1205), the crafty administrator of the King, issued the Articles of Eyre to pay for the crusades of King Richard Plantagenet (Richard I, the Lionhearted) (1452–1485). The Articles restructured and formalized the *Justices in Eyre* as three knights and one clerk to be elected in every county as *keepers of the*

pleas of the crown (*custos placitorum coronae*). The coroner was elected by all freeholders in the county court and the appointment was for life. The primary charge of coroners was to generate revenue for the King. Newfound treasures, things washing ashore, and stolen goods were documented and confiscated by the coroner for the benefit of the King.

From the very beginning, among other duties, coroners conducted inquests over dead bodies, because they were a source of windfalls for the crown. The estates of those dying of suicide and of those committing homicide would be forfeited to the crown. Objects causing accidental deaths could be taken. These properties could be sold or given to the church (*deodand*). Coroners would also levy fines against citizens and villages that did not properly follow the rules associated with deaths. First finders of dead bodies had a legal duty to raise a "hue and cry," assemble a posse to hunt for suspects, and notify local officials, who in turn notified the coroner. Meanwhile the bodies had to rest undisturbed. If a Norman was found dead, then a fine called a *murdrorum* was levied—from which we get the term "murder."

Another duty of the coroner was to ensure that sheriffs were giving over taxes to the King as they should; coroners had the power to arrest sheriffs. Although coroners often worked with sheriffs, there were tensions between the positions. Eventually, sheriffs, who kept the peace among the living, became the dominant power, and the coroner's role became restricted to ruling over the dead.

Legislative reforms in Britain in the late nineteenth century led to salaries replacing fees as the source of compensation for coroners, positions being appointed rather than elected, and jurisdiction being broadened to all suspicious, unnatural, and unknown causes of death. Further reform in 1926 required 5 years of experience as a medical practitioner, barrister, or solicitor for qualification to become a coroner in the United Kingdom.

American Medicolegal Death Investigation Develops

The American colonies imported the coroner position at a time when the duties only involved death investigation. However, the positions of coroner and sheriff were often combined; sheriff duties were paid by a percentage of tax collections, and coroner duties were paid per death investigated [39]. Colonial charters gave the power to appoint coroners to the governor, but over time coroners came to be elected, beginning as early as 1636 in Plymouth Colony. The coroner inquest consisted of a set number of citizens assembled where a dead body was discovered and sworn under oath to determine how and in what manner a violent or untimely death occurred. The first recorded inquest in America occurred in 1635 in Plymouth Colony. The first recorded coroner's autopsy was in Maryland and involved the clubbing to death of a servant. In 1691, New York Governor Slaughter was autopsied and found to have died of what is now recognized as pulmonary embolism, and not from poisoning, as had been initially presumed.

In 1789, New York passed the first American anatomy law [12]. In 1860, Maryland law authorized the coroner to require the attendance of a physician in

cases of violent death. In 1877, Massachusetts replaced coroners with physicians known as *medical examiners*. In 1890, Baltimore appointed two physicians with the title of medical examiner to perform autopsies when requested by the coroner or the state's attorney. In 1915, New York City enacted legislation to replace their coroner's office with a medical examiner office, and this became a reality in 1918, when Dr. Charles Norris (1867–1935) was appointed and given the authority to order an autopsy when in his judgment it was necessary [40, 41]. Arguably, the New York City's Office of the Chief Medical Examiner (OCME) was the first modern medical examiner office. Dr. Norris hired Alexander O. Gettler (1883–1968) as the first OCME forensic toxicologist—also the first within any medical examiner/coroner office [42]. In 1939, Maryland established the first state medical examiner office. In 1944, Dr. Alan R. Moritz (1899–1986), then the Chair of the Department of Legal Medicine at Harvard, coined the term *forensic pathology*. In 1956, the American Board of Medical Specialties recognized the subspecialty of forensic pathology. In 1959, the American Board of Pathology held the first board certification examinations in forensic pathology. In 1966, the National Association of Medical Examiners (NAME) was established [43]. Table 7.1 provides an overview of the ancient and historic milestones in the development of forensic pathology.

Table 7.1 Historic forensic pathology milestones

44 BCE	Autopsy of Julius Caesar
1194	Coroner position created in England
1247	Song Ci, *Hsi Yuan Lu*
1249	Hugo de Lucca sworn in as a forensic medicine expert
1302	Bartolomea de Variagiana, first detailed forensic autopsy
1507	Bamberg Code mandates medical courtroom testimony in certain cases of death
1532	Caroline Code extends Bamberg requirement to the Holy Roman Empire
1562	Ambrose Pare performed a court-ordered autopsy, after which they became common
1602	Fortunato Fedele, *De Relationibus Medicorum*
1621–51	Paolo Zacchias, *Quaestiones Medico-Legales*
1635	First Coroner's Inquest in America, Plymouth Colony
1720	Michaelis named Chair of Legal Medicine, University of Leipzig, Prussia
1807	Andrew Duncan, Jr. named Chair of Legal Medicine, University of Edinburgh, Scotland
1800s	German national death registration, The Regulations (Casper, Virchow)
1877	Massachusetts replaces coroners with medical examiners
1918	New York City Office of the Medical Examiner established (Norris, Gettler)
1932	Alan Moritz named Chair of Legal Medicine, Harvard University
1939	Maryland established first true state medical examiner system
1944	Moritz coins term *forensic pathology*
1956	American Board of Medical Specialties recognizes *forensic pathology*
1959	American Board of Pathology holds first certification exam in *forensic pathology*
1966	The National Association of Medical Examiners was established

The Role of Medicolegal Death Investigation

Today, most death certificates are completed by attending and covering physicians. However, 30–40% of the 2.6 million people who die each year in the United States are referred to medical examiner or coroner (ME/C) offices [44–47]. Of these one million annual referrals, the ME/C jurisdictions accept about half, or around 500,000, for investigation and performance of postmortem examinations or autopsies to determine the cause and manner of death.

Medicolegal death investigation is important to public safety, public health, homeland security, and civil administration. Forensic pathologists will see more homicides than a homicide detective and will be critical to determining the deceased who died at the hands of another—an element of the crime. Forensic pathologists will collect evidence, make significant interpretations, and testify. Recognizing deaths from various hazards resulted in the first driver's licensure law, the first handgun law, regulations requiring certain spacing between slats on baby cribs, and the requirement for collapsible steering wheel columns. Forensic pathologists may recognize a public health epidemic, as they did in the case of the Four Corners hantavirus outbreak, and they also carry out surveillance for bioterrorism and chemical weapons use. Forensic pathologists make identifications in mass disasters. The data they generate assists policymakers; for example, the opioid crisis is defined by the number of overdose deaths, and mortality data will be used to evaluate the governmental response. Death certificates provide insurance companies with the information they need to make payments to survivors.

Many federal agencies rely on the data generated by the MDI system to further their missions and therefore share an interest in ensuring that these data are accurate, reliable, and readily accessible. Death certificates feed into the CDC's National Health Statistics Center's National Vital Statistics System's Death Registry [48]. Local physicians are responsible for completing two thirds of the death certificates, but medical examiners and coroners contribute the other third, which includes the nonnatural deaths (accidents, suicides, homicides, and undetermined). Despite many problems with this data set, it is of huge importance to public health and can be searched by researchers and the public through WISQARS [49]. The CDC's National Violent Death Reporting System (NVDRS) is a more in-depth database run by the National Center for Injury Prevention and Control [50]. The CDC has sponsored such efforts as the Sudden Unexpected Infant Death Investigation Reporting Form (SUIDIRF) to help standardize data reporting [51].

Medicolegal Death Investigation Systems

American Medicolegal Death Investigation Systems

Traditionally, coroner systems are medicolegal death investigation authorities headed by an elected official. However, a few states appoint their coroners rather than elect them. Qualifications for elected officials are minimal; typically, a candidate to run for office must be a US citizen of at least 16 years of age, must be

residing in the jurisdiction, and may not be a felon. A few states require coroners to be licensed physicians, but not necessarily forensic pathologists. In Texas, Justices of the Peace act as coroners in addition to their other magisterial duties.

Coroner systems constitute 2000 of the 2400 medicolegal death investigation systems in the United States. Coroner offices are exclusively county jurisdictions and predominate in rural states; thus, they cover only about half of the US population. Coroner offices are independent units within state governments.

The author is critical of coroner offices for the following six reasons: (1) elections politicize coroner offices; (2) elective offices do not allow for national searches and an ability to hire the best person for the job; (3) counties often provide an insufficient population base to adequately fund the office; (4) coroner systems dislink the medicolegal death investigation from the forensic pathologist, who performs the autopsy; (5) coroners are generally non-physicians who certify deaths, not forensic pathologists; and (6) the chief should be a professional rather than an administrator. The National Academy of Sciences has called for the replacement of coroner offices in reports published in 1928, 1932, 2003, and 2009 [52].

Medical examiner systems are medicolegal death investigation authorities in which the chief is an appointed physician—specifically a board-certified forensic pathologist. *Forensic pathology* is the name of the medical discipline recognized by the American Board of Medical Specialties, and *forensic pathologist* is the term for the medical professional practicing forensic pathology. A forensic pathologist fills the government position that has the title *medical examiner.* In practice, medical examiners and forensic pathologists are virtually synonymous terms. However, the term medical examiner is also applied to insurance investigators, state licensure board members, and others. Further complicating the use of the term medical examiner, some medical examiner offices have physician investigators, who are not forensic pathologists and do not perform autopsies; they perform the duties of a medicolegal death investigator as a part-time job.

Medical examiner systems constitute about 400 of the 2400 medicolegal death investigation systems in the United States. Medical examiner offices may be city-, county-, regional-, or state-level jurisdictions. Twenty-two states have a single state medical examiner office, usually in more populated areas of the country. They cover about half of the US population.

Medical examiner offices are sometimes independent, but more often under departments of health and sometimes under law enforcement. NAME espouses the independence of medical examiner operations, even if situated within law enforcement agencies. In *Beecroft v Minnesota* (MN Sup Ct, 2012), the independence of the medical examiner mission was recognized. The New Mexico Office of the Medical Investigator is part of the state university.

Some states have both medical examiner and coroner offices. In many of these states, jurisdictions within the state are serviced either by a coroner office or a medical examiner office. Other states have a state medical examiner office and coroner offices in the counties; in such states, the coroner office provides medicolegal death investigation, and the state medical examiner office performs forensic autopsies for the coroners, who certify the deaths. Examples of medical examiner caseload from three disparate areas of the United States are given in Table 7.2.

Table 7.2 Examples of medical examiner casework distribution

	DC	%	Bexar County	%	King County	%
Population	659,000		1,860,000		2,080,000	
Total deaths	–		13,931		13,898	
Deaths investigated	3063		11,523		12,254	
Cases accepted	1120		2501		2350	
Scenes investigated	712		976		–	
Bodies transported	1222		2408		–	
Cases autopsied	736	66	1470	59	1381	59
Certified as natural	591	53	988	42	940	42
Naturals autopsied	334	55	529	54	501	53
Certified as accident	302	27	897	38	839	38
Accidents autopsied	193	64	486	54	480	57
Certified as suicide	69	6	193	8	293	13
Suicides autopsied	66	96	192	99	254	87
Certified as homicide	107	10	154	7	76	3
Homicides autopsied	107	100	154	100	69	91
Certified as undetermined	34	3	109	5	81	4
Undetermined as autopsied	34	100	108	99	76	94

Source:

District of Columbia Office of the Chief Medical Examiner Annual Reports webpage, accessible at: https://ocme.dc.gov/page/ocme-annual-reports

Bexar County Medical Examiner's Office Medical Examiner Annual Reports webpage, accessible at: https://www.home/bexar.org/medicalexaminer/annual-report.html

King County Medical Examiner's Annual Report webpage, accessible at: http://www.kingcounty.gov/depts/health/examiner/annual-eport.aspx

International Medicolegal Death Investigation Systems

In most countries of continental Europe, medicolegal death investigation is a police function that focuses on suspicious deaths [53]. In these countries, forensic pathologists are generally in academic universities and work as consultants to the police. England and most of the commonwealth countries have coronial systems, although they differ from one another in many respects. These coroner systems are generally independent of law enforcement and make magisterial/administrative pronouncements of the cause of death. In England, unlike in America, coroners must have an advanced degree, and many hold both a medical degree and a law degree. An American-style medical examiner office exists in a few countries, particularly in the Middle East, where there are forensic pathologists and an emphasis on a medical/scientific determination of the cause of death. Medicolegal death investigation offices in some countries may be constrained by the government or religious philosophies. Forensic pathologists in many countries conduct autopsies but leave any histology in these cases to surgical pathologists. Forensic medicine in many countries includes clinical forensic medicine and workers' compensation claims. Forensic medicine in many countries also includes other forensic sciences, particularly forensic molecular biology.

Current Forensic Pathology Practice

Authority for Forensic Autopsies

Hospital autopsies are conducted with the consent of the next of kin and are private affairs, but forensic autopsies conducted in ME/C offices are authorized by statute and are performed in the public interest. Forensic autopsies can be performed over the objections of the next of kin. For example, it would make no sense that a father suspected of child abuse could object to and prevent the autopsy of the child and the potential development of evidence against him. Some jurisdictions permit objection to autopsies based upon religious grounds, but such legislation includes a process to bring the issue to a judge to balance the private interest with the public interest to overcome the objection if need be. Even in forensic autopsies, consent for organ and tissue donation is based upon the consent of the next of kin. A common misconception is that bodies are the property of the next of kin, but in the United States, bodies are not considered property, but rather *quasi–property*, and then family only has a custodial right of sepulcher.

State legislation usually describes the jurisdiction of the office and upon which cases autopsy is permitted and in which cases autopsy is mandated. Autopsies are typically performed in the following situations: the death is known or suspected to have been caused by apparent criminal violence; the death is unexpected and unexplained in an infant or child; the death is associated with police action; the death is apparently nonnatural and in custody of a local, state, or federal institution; the death is due to acute workplace injury; the death is caused by apparent electrocution; the death is caused by apparent intoxication by alcohol, drugs, or poison; the death is caused by an unwitnessed or suspected drowning; the body is unidentified; the body is skeletonized; the body is charred; the deceased is involved in a motor vehicle incident, and an autopsy is necessary to document injuries and/or determine the cause of death; and the forensic pathologist deems a forensic autopsy is necessary to determine the cause or manner of death, to document injuries/disease, and to collect evidence or is otherwise in the public interest.

Medicolegal Death Investigation at Scenes

It is useful for forensic pathologists to physically go to death scenes; however, it is impractical to do so given their heavy caseload, and they therefore depend upon others to do the initial investigation for them. Most medical examiner offices now have their own medicolegal death investigators (MDIs). Some offices rely on police for their investigations, particularly small coroner offices and California Sheriff-Coroner and Texas Justices of the Peace jurisdictions. ME/C offices should defer to the police for criminal investigation involving formal interrogations and sworn statements, but routine medicolegal investigation should be performed by MDIs. As the goals of the ME/C office and police differ, they emphasize different aspects of the investigation. ME/C offices have no interest in the

determination of who committed a homicide, while police have little interest in the medical aspects of the case, nor do they have interest in occupational accidents. Medical examiners generally desire independence from law enforcement. Medicolegal death investigators work for the medical examiners and know the information they need to do their job.

In the New York City Office of the Chief Medical Examiner, all MDIs are physician assistants, but the qualifications in most offices are less stringent, and MDIs include a varied mix of retired law enforcement officers, paramedics, forensic nurses, forensic scientists, and morticians, among others.

The American Board of Medicolegal Death Investigators (ABMDI) offers basic registry and advanced certification of MDIs, based upon the National Institutes of Justice Death Investigation Guidelines [54]. The professionalization of medicolegal death investigator community has significantly contributed to the quality of ME/C offices.

Forensic Autopsy Performance

A forensic autopsy is generally conducted similarly to a hospital autopsy and not too differently from autopsies conducted hundreds of years ago. A forensic autopsy involves an "as is" examination of the body as it arrives in the morgue, an external examination after the clothes have been removed, and an internal examination of the head, neck, and torso. Specimens are routinely collected for toxicology examination, for microscopic examination, and for storage for further microscopic examination. A DNA bloodstain card is usually collected and archived. The brain may be retained and fixed for subsequent neuropathology examination and in this case is not returned to the family with the body.

The primary difference between a hospital autopsy report and a forensic autopsy report is the *Evidence of Injury* section. In this section, the forensic pathologist assembles the descriptions of the injuries in a logical fashion. For example, all findings relating to a gunshot wound of the chest are compiled in this section, whereas without such a section, the aspects of the wound might be distributed among separate sections including the skin, chest wall, lungs, and heart.

NAME has promulgated Forensic Autopsy Performance Standards that define what the forensic pathology community collectively believes is a statement of minimal standards for the performance of forensic autopsies by practitioners (Table 7.3) [55]. NAME has also established Inspection and Accreditation Standards for ME/C offices [56]. These standards are in relatively close alignment but also speak to the facilities, staffing, quality assurance system, mass fatality plan, and other office needs. These standards include caseload limits, such that 250 autopsies/year/pathologist is the limit for a Phase I deficiency, but greater than 325 autopsies/year/pathologist is the limit for a Phase II deficiency that will prevent full accreditation. In addition to the Core Accreditation Program, NAME has contracted with the ANSI-ASQ National Accreditation Board (ANAB) for ISO/IEC 17020 international accreditation.

Table 7.3 2016 NAME forensic autopsy performance standards

Section A: Medicolegal Death Investigation
Standard A1 Responsibilities
Standard A2 Initial Inquiry
Section B: Forensic Autopsies
Standard B3 Selecting Deaths Requiring Forensic Autopsies
Standard B4 Forensic Autopsy Performance
Standard B5 Interpretation and Opinions
Section C: Identification
Standard C7 Standard Identification Procedures
Standard C8 Procedures Prior to Disposition of Unidentified Bodies
Section D: External Examinations: General Procedures
Standard D9 Preliminary Procedures
Standard D10 Physical Characteristics
Standard D11 Postmortem Changes
Section E: External Examinations: Specific Procedures
Standard E12 Suspected Sexual Assault
Standard E13 Injuries: General
Standard E14 Photographic Documentation
Standard E15 Firearm Injuries
Standard E16 Sharp Force Injuries
Standard E17 Burn Injuries
Standard E18 Patterned Injuries
Section F: Internal Examination
Standard F19 Thoracic and Abdominal Cavities
Standard F20 Internal Organs and Viscera
Standard F21 Head
Standard F22 Neck
Standard F23 Penetrating Injuries, Including Gunshot and Sharp Force Injuries
Standard F24 Blunt Impact Injuries
Section G: Ancillary Tests and Support Services
Standard G25 Radiography
Standard G26 Specimens for Laboratory Testing
Standard G27 Histological Examination
Standard G28 Forensic Pathologists' Access to Scientific Services and Equipment
Standard G29 Content of Toxicology Lab Report
Standard G30 Evidence Processing
Section H: Documentation and Reports
Standard H31 Postmortem Examination Report
Terms and Definitions

Source: https://thename.org/inspection-accreditation

Death Certification

The primary goal of a medicolegal death investigation is the determination of the cause and manner of death and their inclusion on a death certificate [57, 58]. The cause of death is the underlying injury or illness that results in the death. *Cardiac arrest* is not a cause of death; it is a result of the cause of death. A gunshot wound is the cause of death; exsanguination is a mechanism of death. The manner of death is

a nosological classification on the death certificate for public health statistical purposes. This classification includes natural, accident, suicide, homicide, and undetermined. The manner of death is dependent upon the circumstances of death as known at the time of the death certification. Since the manner has a public health function and is not made for a determination of criminal responsibility, prosecutors and courts should not feel compelled to base their case on the certification of the death by the medical examiner or coroner.

Identification of Remains

Death certificates require the name of the deceased and constitute the formal governmental document that a person has died. As such, the identification of remains is a function and responsibility of medical examiner and coroner offices, even though police fingerprint experts or crime laboratory DNA scientists may be used to make the identification. Missing persons investigations are the responsibility of law enforcement. Identification and missing person efforts are interrelated and require cooperation between medicolegal death investigation authorities and law enforcement agencies.

Although many decedents are identified by family or coworkers from the outset, many others are only tentatively identified by personal effects, tattoos, or other means of identification. Generally, formal identification is made within hours or a few days, by family members or fingerprints. NAME accreditation requirements call for x-rays, DNA collection, and odontologic examinations on unidentified remains. Bodies which remain unidentified for 30 days are generally officially counted as unidentified.

The National Crime Information Center (NCIC) is the primary national database for missing persons information that is run by the FBI for law enforcement agencies, but most medical examiner offices do not have access to this database [59]. The National Missing and Unidentified System (NamUS) is a resource accessible to police, medical examiner offices, and the public [60]. NamUS has been key to many identifications. It was created by Dr. Randy Hanzlick, then Chief of the Fulton County Medical Examiner Office, and Steve Clark of ORA, Inc. The National Institute of Justice (NIJ) has contracted NamUS operations to the University of North Texas, which also performs DNA testing of the unidentified remains when needed.

In mass disasters, the primary role of forensic pathologists is to identify the remains. Visual identification is generally considered not sufficient in such situations due to the large number of combinatorial comparisons involved. “Scientific” means of identification, particularly by fingerprints, odontology, or DNA, should be used. The terms “definitive identification” and “positive identification” are frowned upon.

On April 26, 2006, a van carrying nine students and university staff members collided with a tractor-trailer in Indiana [61]. Five people died at the crash scene, including a young blonde woman identified by the coroner as Whitney Cerak. “Whitney” was interred in a marked grave at a funeral with 1400 people in attendance. Meanwhile, a similar-looking woman survived the crash but was unable to

communicate, and she was thought to be Laura van Ryn. The van Ryn family kept a bedside vigil over the patient they believed was their daughter. It took 5 weeks before the mistaken identity was caught. This incident prompted Indiana and Michigan to enact legislation requiring *scientific identification* of unknowns.

Forensic Toxicology

Forensic toxicology is critical to the practice of forensic pathology. Particularly in the midst of an opioid epidemic, a large proportion of cases are from drug overdoses. Many medical examiner offices have their own forensic toxicology laboratories, although they may send out cases for further testing, while other offices will send all their casework to a private laboratory.

Forensic toxicology differs from hospital toxicology in many ways. Since forensic toxicology testing must withstand courtroom scrutiny, screening tests are always confirmed by more definitive testing (GC-MS, LC-MS/MS, Q-TOF), the specimens are documented with chain of custody, and the testing is broader, more specific, and more sensitive and includes quantitation. Specimens collected for toxicology typically include central and peripheral blood, urine, vitreous humor, bile, gastric contents, and liver and brain tissue.

Although tables of therapeutic, toxic, and lethal levels exist, these should only be taken as general guidance in interpreting postmortem drug levels. The levels of morphine which can cause death can vary by several orders of magnitude. Whether the decedent is naive or tolerant makes an enormous difference in interpretation. Pharmacogenetics and other factors that bear on the drug pharmacodynamics and health of the individual, such as age and weight, are important to consider. The history and circumstances of death are also important to consider when determining the cause of death. The postmortem interval and the possibility of postmortem metabolism are further considerations. Thus, the forensic pathologist should not overly depend upon drug levels in determining the cause of death.

Mass Fatality Management

Medical examiners and coroners are responsible for mass fatality management in disaster incidents, which include natural disasters such as hurricanes, terrorist events such as 9/11, transportation accidents such as airplane crashes, or others such as building collapses. ME/C offices are also part of surveillance for chemical and biologic attacks and infectious epidemics.

NAME Inspection and Accreditation standards require that the medical examiner office maintains a Mass Disaster Plan (A.7.a), which involves coordination with other local agencies, hospitals, and surrounding jurisdictions. The plan should include sections for chemical, biological, and radiation/nuclear incidents. The standards further require a list of emergency contacts, a list of alternative morgue sites, and that the office engages in disaster exercises.

The ME/C office should have clear guidance as to what triggers mass fatality operations, as well as what would overwhelm its resources and trigger reliance on external resources. NAME advocates that ME/C offices take responsibility for the remains as they are first discovered, which means that the offices should be responsible for the recovery and transport of the remains. If possible, the bodies may be GPS located and diagrammed in position at the scene with the use of a total station. Refrigerated trucks may be used to store the bodies. Operations will normally be split between antemortem and postmortem data collection that will eventuate in the reconciliation and identification of remains. The antemortem data collection will primarily consist of asking families for descriptions of their loved one and what he or she was wearing that day, photographs, contact information for the victim's dentist, and DNA collection. This would typically be accomplished at the Victim Identification Center (VIC), a component of the Family Assistance Center (FAC). Families at the FAC should be daily updated on the operations. First notification of an identification should be to the family. The postmortem data collection will be accomplished in the morgue. Typically, separate stations will be used for triage, personal effects, radiology, pathology/DNA collection, anthropology, fingerprinting, and odontology stations; the remains will be escorted through the various stations.

The National Disaster Medical System (NDMS) is a federal response group run by the Department of Health and Human Services (DHHS) Assistant Secretary for Preparedness and Response (ASPR) for public health emergencies [62]. NDMS includes Disaster Mortuary Operational Response Teams (DMORTs) [63]. Regional DMORTs are composed of forensic pathologists, forensic odontologists, forensic anthropologists, morticians, and others who work in their normal capacities until federally activated to support DVI operations of jurisdictions in need. The DVI team will use their Victim Identification Profile software system to help match antemortem and postmortem identification profiles. Many smaller jurisdictions with few resources and expertise rely on such resources.

NAME published Standard Operating Procedures for Mass Fatality Management in 2010 [64]. Guidelines for mass fatality operations are being produced by the National Institute of Standards and Technology (NIST) Organization of Scientific Area Committees (OSAC) Disaster Victim Identification (DVI) subcommittee [65] and the American Academy of Forensic Sciences (AAFS) Academy Standards Board (ASB) Disaster Victim Identification (DVI) Consensus Body [66].

Medicolegal Testimony

An integral part of forensic medical practice is testimony [67]. The vast majority of homicide cases never go to trial, but are instead resolved by plea bargain. However, when a homicide is litigated, forensic pathologists will usually be called by prosecutors not only to establish that the death resulted from the action of another person as an element of the crime but also to convey to jurors the inhumanity of the death. Although sometimes called upon as an unpaid *fact witness*, the forensic pathologist

is usually called as an *expert witness* to give an opinion, which is beyond the ken of a lay person due to education, training, or experience.

Discovery is the pretrial process in which the attorneys produce evidence and make reciprocal disclosures. Discovery includes disclosure of the witnesses to be called and the basis for their opinions. Interrogatories are formal questions which are asked by the court when asked to do so by the attorneys. Orders to produce documents may be issued. Depositions may be taken before trial, but these are, despite their apparent informal nature, considered formal testimony under oath—the attorneys will be looking for inconsistencies between the deposition and the eventual trial testimony. *Brady material* is any potentially exculpatory evidence known to the prosecution in a criminal case and must be disclosed to the defense. *Giglio material* is any damaging information about the witness known to the prosecution and must also be disclosed to the defense.

Before trial, the witness should have a pretrial conference with the attorney calling him or her to give testimony. During this meeting, the attorney should go over the questions and issues of the case. The attorney should not tell a witness what to say but may suggest wording. The photographs and any other demonstrative evidence should be agreed upon at this time.

A subpoena will be issued to call the witness to appear in court. Initially, the witness will be sworn in by giving an oath before the court. Then the witness will be asked to state their name, to spell it, and to state his or her employment position. Testimony will begin with a description of the educational experience of the witness to establish a foundation for the court to admit the expert testimony. The testimony will begin with direct examination by the attorney, who called the witness. This direct examination will call for longer, descriptive answers, in which the expert will give his or her opinion—often with the help of photographs and other demonstrative evidence. The witness will usually be asked to authenticate the autopsy report and photographs that will be given to the jury. The opposing counsel will then cross-examine the witness, often asking yes or no questions. Leading questions may not be asked on direct examination but may be asked on cross-examination. This may be followed by redirect and recross.

Important Cases

The US Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* (509 U.S. 579, 1994), ruled that the Federal Rules of Evidence (FRE) superseded the earlier *Frye v. U.S.* (293 F. 1013, DC Cir 1923) case that held that novel scientific evidence must gain general acceptance in the specific field or community for it be admitted into court for presentation to the jury. Daubert established the judge as the gatekeeper and that she should find the evidence to be relevant and reliable for admissibility. The court articulated a set of non-exhaustive Daubert factors used to judge the reliability of the evidence including the testability of the asserted science, peer-reviewed publication, known error rates, and general acceptance of the relevant community. In *Kumho Tire Co v. Carmichael* (526 U.S. 137, 1999), the Court also

made clear that technical expertise could also be based upon experience, even if not scientific.

The Federal Rules of Evidence provide the legal framework by which expert testimony may be given. The Federal Rules of Civil Procedure provide additional guidance for civil proceedings. These federal rules are generally mirrored in state evidentiary codes. In general, forensic testimony must be found to be relevant and reliable, and the bases for the testimony must be disclosed.

The US Supreme Court in *Crawford v. Washington* (541 U.S. 36, 2004) overruled previous case law and declared that the Confrontation Clause of the Sixth Amendment of the federal Constitution makes adverse material witnesses available at trial for cross-examination by the defense. This may become problematic when the witness is not available for trial. Crawford was specifically applied to forensic scientists first in *Melendez-Diaz v. Massachusetts* (557 U.S. 305, 2009) and then in *Bullcoming v. New Mexico* (564 U.S. 647, 2011) and *Williams v. Illinois* (567 U.S. 132 S.Ct. 2221, 2012). The result is that forensic scientists who produce evidence used by the prosecution must be made available when called. However, most state courts, such as in *People v. Dungo* (55 Cal.4th 608 & 982, 2012), have found that autopsy reports are not testimonial in nature, and therefore the original forensic pathologist is not required to testify.

The Future of Forensic Autopsy Practice

Current Medicolegal Death Investigation Environment

Medical examiner and coroner offices are historically underfunded. Policymakers often see funding ME/C offices as a waste of money on the dead, even though they function for the living. As a generality, a medical examiner's office can be adequately funded for only $3 to $3.50 per citizen per year [68]. There is not a vocal constituency to strongly advocate for ME/C offices. Nonetheless, facilities and resources are stronger now than ever before, albeit with some significant gaps. So too, the sophistication of the practice of forensic pathology and the quality of medicolegal death investigation overall has vastly improved. Furthermore, expectations have increased as the bar has been raised but also as television has increased awareness and popularized forensic pathology.

The number of board-certified forensic pathologists working in the field is estimated between 500 and 700. This has been thought to represent only half of the number of forensic pathologists needed for adequate medicolegal death investigation across the United States [69]. However, the recent opioid crisis has dramatically increased the need for more forensic pathologists. Between 30 and 40 newly minted forensic pathology fellows become board certified and enter the workforce per year. This is far below what is needed. Of the 70 or so forensic pathology fellowship programs, funding is available for only about half of the slots. Forensic pathology is the only medical training that is not subsidized through federal medical spending, because medical examiner offices fall outside of hospital and clinical care. As of 2017, the

National Institute of Justice has funded seven fellows in the field. Despite CSI, the Kay Scarpetta novels, and other media, there is no clamor for pathology residents to go into the discipline. The forensic pathology community consistently points to a few predominant factors to explain this. The first is the relatively low pay for forensic pathologists. After spending a fellowship year in forensic pathology, a fellow will find that she will make perhaps only half of what a pathologist going straight into hospital practice would earn. However, recently the critical shortage has led to offices hiring forensic pathologists away from other offices and driving salaries higher. The second factor is a lack of exposure of students to forensic pathology. Most pathologists obtain exposure to forensic pathology due to the requirement for performing autopsies during residency, but this requirement has been reduced and continues to be threatened by pathology residency program directors, who perceive it to be a waste. Moreover, there are fewer medical students exposed to pathology, and this appears to be lowering the number going into pathology, threatening the pipeline. Thirdly, in some pathology programs, residents are actively discouraged from going into forensic pathology as many pathology faculty members do not relate well to the field and speak ill of it; most academic pathology programs lack forensic pathologist faculty members.

The Impetus for Change

The opioid crisis that is ongoing at the time of this writing is shining a light on the critical shortage of forensic pathologists in the United States and their importance to society. The opioid crisis is defined in terms of the number of deaths, and the success in combatting it will be measured with mortality data. Every overdose case should be autopsied by a forensic pathologist. Yet surprisingly, the medical examiner community has been left out of the funding to support state and local efforts to combat the crisis—federal, state, and local governmental efforts have focused on prevention, interdiction, and treatment, and medicolegal death investigation is neglected. However, there appears to be the beginning of widespread recognition of the value of medicolegal death investigation in this context, particularly by the Department of Justice, the Centers for Disease Control and Prevention, and among some key legislators, which may lead to support and key changes.

The forensic sciences have recently garnered significant criticism, which may well lead to efforts that may benefit forensic pathology with the rest of the forensic science community. It is significant that the 2013–2017 National Commission on Forensic Science (NCFS) had a Medicolegal Death Investigation (MDI) Subcommittee [70, 71]. So too, the National Institute of Standards and Technology (NIST) Organization of Scientific Area Committees for Forensic Science (OSAC) has a Crime Scene/Death Investigation Scientific Area Committee, a Medicolegal Death Investigation (MDI) Subcommittee, and a NAME representative on the Forensic Science Standards Board [72]. The forerunner to the OSAC MDI Subcommittee was the Scientific Working Group on Medicolegal Death Investigation (SWGMDI), which created numerous important documents that can still be found posted on the web [73].

Beyond these movements, it does appear that the medical examiner community has been slowly gaining ground in terms of resources, respect, and capability, which auspiciously bodes well for still further improvements, even if no support materializes from the opioid crisis or for the forensic science community. As relatively new organs of government, medical examiner offices are still finding their place, and the community has been actively advocating for support for a substantial time. It is significant that the Office of Science and Technology Policy has a Medicolegal Death Investigation Committee that released two reports in 2017 [74].

Legislative Efforts and Proposed New Structures

The Consortium of Forensic Science Organizations (CFSO) is the primary advocacy group for the forensic science community, including the medicolegal death investigation community [75]. The CFSO membership is comprised of NAME, the American Academy of Forensic Sciences, the American Society for Crime Laboratory Directors, the International Association for Identification, the International Association of Forensic Nurses, the Society of Forensic Toxicologists, and the American Board of Forensic Toxicology as members. In aggregate, the CFSO represents 21,000 forensic scientists. Advocacy of the CFSO includes:

- *Mandatory Accreditation of ME/C Offices*: The CFSO, NAME, NCFS, and OSTP have all advocated for mandatory accreditation, which would force at least minimal funding and staffing of such offices.
- *Mandatory Certification of Medicolegal Death Investigators*: Similarly, the CFSO, NAME, NCFS, and OSTP have advocated for certification of medicolegal death investigators, including coroners who function as medicolegal death investigators.
- *CDC Office of Forensic Medicine (OFM)*: There is no voice for forensic pathologists within the US federal government. The Armed Forces Medical Examiner System (AFMES) is the only medical examiner office within the US federal government, and it has not been the voice needed for the state and local offices. A few forensic pathologists are positioned elsewhere in the federal government, but none in positions of substantial influence. The NCFS recommended the establishment of a National Office of Medicolegal Death Investigation, with the unfortunate acronym of "NOMDI" [76]. The CFSO has advocated for the creation of an OFM, headed by a forensic pathologist, within the CDC from consolidating certain existing programs (NVDRS, SIDS), which would be analogous to the current CDC Office for State, Tribal, Local, and Territorial Support (OSTLTS).
- *Workforce Development*: Increasing forensic pathologist manpower has been a top priority for the forensic pathology community, but it is difficult to do. The National Institute of Justice (NIJ) awarded funding for eight forensic pathology fellows in 2017; this program should be continued and expanded. A student loan

forgiveness program would be useful, or at least forensic pathology could be designated a critical area need under existing programs. Granting J1 and H1 Visa waivers for foreign pathology students and foreign medical graduates would help.

- *Operational Funding*: The CFSO has long supported the NIJ Coverdell grant program, which has provided the only federal operational support for crime labs and ME/C offices; however, ME/C offices generally receive only a few thousand dollars, if anything at all. In 2017 NIJ established a grant program specifically for the medicolegal death investigation community for the accreditation of offices and forensic pathology fellowships, which should be continued and expanded.
- *Opioid Crisis Funding*: The CFSO has advocated that some of the Department of Health and Human Services (DHHS) Substance Abuse and Mental Health Assistance (SAMSHA) funding given to states for the medical response should flow to ME/C offices. Congress authorized a half billion-dollar expenditure for the opioid crisis in the 21st Century Cures Act, which was enacted in late 2016, but none has yet been made available to ME/C offices.
- *Research Funding*: The NIH does not fund applied research in forensic pathology; instead funding has come from the NIJ [77]. The CFSO has advocated for the creation of an Office of Forensic Sciences within DOJ, created from the current NIJ Office of Investigative and Forensic Sciences. The OFS would be positioned higher in the structure of DOJ and would be headed by a forensic scientist. It is believed that more research might flow from such reorganization.
- *Model Medical Examiner Legislation*: In 1954, then the National Commission for Uniform State Laws (now the Uniform Law Commission) created a Model Post-Mortem Examinations Act which provided guidance for states to establish medical examiner systems [78]. This model legislation is woefully inadequate, but guidance is still needed for states, which generally have old and spotty statutes. New updated model state legislation would be useful [79]. The NCFS recommended the creation of new model medical examiner legislation [80].

Flowering of the Forensic Autopsy Practice

Autopsy practice has remained largely unchanged for centuries. A number of technologies to augment and advance the autopsy practice within ME/C offices are being implemented or are on the horizon.

Advanced Imaging X-rays are routinely used for unidentified remains, charred remains, gunshot victims, explosion victims, decomposed remains, and in infants to locate bullets, knife tips, and other foreign objects, as well as to document identifying features. The LODOX-Statscan is replacing traditional x-ray units across the United States due to its ease of use, speed, and lower radiation exposure [81]. A few US medical examiner offices have a computed tomography (CT) scanner, and even

fewer offices also have magnetic resonance imaging (MRI) capabilities. However, advanced imaging technologies are routinely used in many medical examiner offices throughout the world; this is an area where the United States lags behind. Advanced imaging can be a very useful adjunct to traditional autopsy practice and is sometimes used in place of autopsy, thus increasing efficiency in those offices that use it in this way [82]. Advanced imaging can be advantageous in revealing pneumothoraces and bony fractures; with angiography it will show thromboemboli, basilar artery and aneurysm ruptures, as well as coronary atherosclerotic narrowing and occlusions. Advanced imaging has the potential to directly visualize myocardial infarctions and strokes, if the body is fresh and not decomposed. Reconstruction using advanced imaging techniques permits visuals that are unparalleled for demonstrations in court [83].

Molecular Autopsies A few medical examiner offices have internal forensic DNA identification testing capability, and even fewer have genetic testing capability, but there is a broad need for both. The ability to diagnose genetic conditions may be of great clinical value to families which harbor an unsuspected genetic trait, as with testing for common conditions such as hemochromatosis, sickle cell anemia, cystic fibrosis, Marfan's syndrome, or even multigenic diseases such as diabetes and hypercholesterolemia. Medical examiners should be interested in possible lethal genetic conditions such as cardiac channelopathies, coagulopathies, vascular wall degenerative diseases, and arrhythmogenic right ventricular dysplasia. Pharmacogenomic testing, such as for fast or slow cytochrome P450 acetylation, may help in toxicology interpretation. Whole-exome testing may be becoming feasible, as well.

Proteomic Biomarker Analyses Cardiac markers have not proven sufficiently useful for routine postmortem application to date. Using new high-sensitivity troponins for the diagnosis of myocardial infarction or brain natriuretic peptide (BNP) for the diagnosis of congestive heart failure has simply not been explored in medical examiner offices. Furthermore, mass spectrometry instrumentation has also greatly advanced, and particularly the Orbitrap MS technology may be of interest. It would be important to a forensic pathologist if proteomic profiling revealed a hypercoagulative state, prolonged hypoxemia, or even significant pain (nociception), for instance. The potential for proteomic analysis of the blood to reveal a cause of death is great.

Microbial Analysis Postmortem cultures are notoriously unreliable, due to conditions no longer conducive to pathogen growth and overgrowth from the skin and gut flora, yet testing for infectious agents continues would be valuable. The development of MALDI-TOF and NGS methods of microbiome testing may prove viable here. Microbiome testing does not require continued growth. It is also sensitive to

broad commensal patterns that might show either a normal or abnormal flora. Postmortem microbiome testing is currently under investigation to determine postmortem interval, but not yet for pathogen detection.

Fluorescence of the Role of the Forensic Autopsy

The author believes that forensic autopsies will take on an increasingly important role in the future. The hope is that there will be an Office of Forensic Medicine within CDC and an Office of Forensic Science within DOJ which may facilitate the growth of medical examiner offices, perhaps in the following ways:

Public Health Medicolegal death investigation has often emphasized suspicious deaths and criminal prosecution, but the public health aspects have been increasingly important. Virchow performed autopsies on the theory that causes of death need to be known to inform public health policy. It is the medical examiner that has a legal responsibility to investigate deaths and is authorized to examine the bodies. Forensic pathologists as medical examiners can answer many questions that are important to public health, but to date, they have been so overwhelmed with other work that their full potential has not been realized. For example, if there is a concern about an environmental toxin in a community, wouldn't it make sense to test the bodies from that jurisdiction for the toxin? Why is it that most trauma statistics refer to the percentage of deaths of any given trauma once they reach the emergency room, rather than also include the deaths of those that never reached the emergency room? Medical examiner offices should be nodes of a national information network for consumer product safety, for medical device efficacy, and for the safety of newly emerging drugs. Death certificates do function in this way, but there is a great deal of more information that could be obtained and shared.

Clinical Forensic Medicine In many countries outside the Unites States, forensic medical doctors examine the injuries of live patients. In the United Kingdom, they have been called *police surgeons*. In some countries, these clinical forensic medical examiners are the primary experts in workers' compensation hearings. It would seem to make sense that forensic medical doctors, perhaps forensic pathologists, with forensic nurses, would work in centers that cater to victims of child abuse, domestic violence, rape, and elder abuse. Forensic pathology of the deceased should help inform the examination of the living, and vice versa.

Hospital Autopsies Medical examiner offices may become centers for autopsies of hospital deaths. The hospital autopsy practice continues to decline, but families still have a need for autopsies to answer their questions. Autopsy pathology expertise is increasingly in the hands of forensic pathologists. Many forensic patholo-

gists perform private autopsies in addition to or instead of public forensic medical examiner work. Furthermore, if the use of autopsies for quality assurance of healthcare makes a resurgence, as it should, then there is an argument that it should fall to the governmental medical examiners. Currently, forensic pathologists are too busy with their forensic autopsies to worry with hospital autopsies, but this could change.

Biomedical Research As autopsies become more powerful diagnostic tools, they also become more valuable for research. The use of animals for biomedical research purposes continues to decline. With the decrease in wide tumor excision and the rise of liquid biopsies and greater use of cytology, tissue specimens will probably become more valuable, perhaps resulting in a greater need for autopsy tissues (see Chaps. 8 and 9). For all of these reasons, autopsy pathology may take on a bigger role in biomedical research.

For your reference, Table 7.4 provides a list of the most important forensic pathology terms discussed and used in this chapter and their definitions.

Table 7.4 Important forensic pathology terms and definitions

Forensic autopsy – An autopsy performed under the auspices of the governmental medicolegal death investigation authority, either a medical examiner's or coroner's office; it does not require consent of the next-of-kin.
Forensic pathology – The subdiscipline of anatomic pathology, recognized by the American Board of Medical Specialties, involved with medicolegal death investigation—the principle tool of which is the forensic autopsy.
Forensic medicine – The area of medicine devoted to the application of medicine to questions of law and subsumes both forensic pathology and clinical forensic medicine.
Forensic pathologist – The medical practitioner of forensic medicine.
Medical examiner – A forensic pathologist, who works for the medicolegal death investigation authority in the employment position title of "medical examiner." In common parlance, "medical examiner" and "forensic pathologist" are often used interchangeably. [New Mexico uses the term "medical investigator."]
Coroner – Usually an elected official, but sometimes an appointed official, and sometimes required to be a physician, who heads an office which is not required to be headed by a forensic pathologist; most coroners are non-physicians and essentially function as medicolegal death investigators. By contrast, a medical examiner's office is headed by a forensic pathologist.
Medicolegal death investigation – The application of medical knowledge to the investigation of death for governmental or legal concerns.
Medicolegal death investigator – A specialized staff member who works for a coroner or medical examiner and is responsible for investigating deaths, going to death scenes, and providing a short history to the forensic pathologist before performing a forensic autopsy.
Legal medicine – A term once used for forensic medicine, but now more generally used as an area of law pertaining to medical concerns.

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