STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES

A PATH FORWARD

Committee on Identifying the Needs of the Forensic Science Community

Committee on Science, Technology, and Law
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Medical Examiner and Coroner Systems: Current and Future Needs

The role of coroner emerged in England in the ninth or tenth century. In the twelfth century, under King Richard I, the role of coroner was formalized in the Articles of Eyre.[1] Coroners or "crowners" were "guardians of the crown's pleas." The office originally was created to provide a local official whose primary duty was to protect the financial interest of the crown in criminal proceedings. On behalf of the crown, the crowner was responsible for inquests to confirm the identity of the deceased, determine the cause and manner of death, confiscate property, collect death duties, and investigate treasure troves. Through the implementation of British Common Law, settlers in North America brought coroner laws to the early colonies.[2] Moreover, early state constitutions explicitly mentioned the position of coroner, often without defining the role.[3] Georgia's state constitution was the first. Article XL stated that, "[i]n the absence of the chief justice, the senior justice on the bench shall act as chief justice with the clerk of the county, attorney for the State, sheriff, coroner, constable, and the jurors."[4]

The first formal acknowledgment of the need for medical training for coroners occurred in 1860, when Maryland passed legislation allowing coroners to require that a physician be present at an inquest. In 1877, Massachusetts became the first state to replace its coroners with medical

[1] Institute of Medicine (IOM). 2003. *Medicolegal Death Investigation System: Workshop Summary*. Washington, DC: The National Academies Press, p. 8.
[2] Ibid.
[3] Ibid.
[4] GA. CONST. of 1777, art. XL.

examiners, who were required to be physicians. Physician medical examiners began performing autopsies for coroners in Baltimore in 1890. In 1918, New York City instituted a medical examiner system.[5]

The National Academy of Sciences first addressed the state of death investigation in 1928. The National Research Council's (NRC's) Committee on Medical Legal Problems, whose members included Roscoe Pound, Dean of Harvard Law School, and John Henry Wigmore, Dean of Northwestern Law School, released a harshly critical report entitled *The Coroner and the Medical Examiner*.[6] In its first four recommendations, the 1928 committee suggested the following: (1) that the office of coroner be abolished. It is an anachronistic institution which has conclusively demonstrated its incapacity to perform the functions customarily required of it; (2) that the medical duties of the coroner's office be vested in the office of medical examiner; (3) that the office of medical examiner be headed by a scientifically trained and competent pathologist, selected and retained under civil service, and compensated by a salary which will attract men of genuine scientific training and ability; and (4) that the office of medical examiner be provided with the services of a staff competent in toxicology, bacteriology and other sciences necessary in the scientific investigation of causes of death, and with adequate scientific equipment. . . .[7]

Additionally, the 1928 committee recommended the development of medicolegal institutes, which would affiliate medical examiners with hospitals and universities.[8] In 1932, another NRC committee produced a review of existing medicolegal collaborations, which were mostly located in Europe.[9] This committee again advised a larger role for medical doctors within forensic science and criminal proceedings.[10]

In 1954, the National Conference of Commissioners on Uniform State Laws issued the Model Post-Mortem Examinations Act (the Model Act).[11] In its prefatory note, the Model Act stated the following:

> The purpose of the Post-Mortem Examinations Act is to provide a means whereby greater competence can be assured in determining causes of death where criminal liability may be involved. Experience has shown that many

[5] IOM, 2003, op. cit.

[6] Bulletin of the National Research Council, No. 64. 1928. *The Coroner and the Medical Examiner.* Washington, DC: National Research Council.

[7] Ibid., p. 89.

[8] Ibid., p. 90.

[9] Bulletin of the National Research Council, No. 87. 1932. *Possibilities and Need for Development of Legal Medicine in the United States*. Washington, DC: National Research Council.

[10] Ibid., pp. 111-112.

[11] The model act has been posted by the National Association of Medical Examiners (NAME) at http://thename.org/index.php?option=com_content&task=view&id=97&Itemid=41.

> elected coroners are not well trained in the field of pathology, and the Act should set up in each state an Office headed by a trained pathologist, this Office to have jurisdiction over post-mortem examinations for criminal purposes. The Office would supersede the authority of Coroner's Offices in this field.[12]

Following the release of the Model Act, a number of states implemented the proposed guidelines. Between 1960 and 1979, 12 states converted from coroners to medical examiners.[13] However, in the subsequent decades, updates to death investigation organizations slowed considerably. Between 1980 and 1999, only three states converted from coroner to medical examiner systems.[14] Since then, 11 states with coroners have remained unchanged, and only a handful of individual counties have independently implemented recommendations from the Model Act.[15] Several of the remaining coroner states have provisions in their state constitutions requiring that coroners be elected.[16] Although these provisions may be amended or removed, to do so will require political momentum. However, these provisions do not prohibit the addition of appointed medical examiners. For example, Kentucky has maintained county coroners, as dictated by its constitution, while also implementing medical examiners to serve at the state and district levels.[17]

MEDICAL EXAMINERS AND CORONERS (ME/C)

About 2,342 medical examiner and coroner offices provided death investigation services across the United States in 2004.[18] Individual state statutes determine whether a medical examiner or coroner delivers death investigation services, which include death scene investigations, medical investigations, reviews of medical records, medicolegal autopsies, determination of the cause and manner of death, and completion of the certificate of death.

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[12] Ibid.

[13] Hanzlick, 2003, op. cit.

[14] Ibid.

[15] Ibid.

[16] ARK. CONST. art. VII, § 46; COLO. CONST. art. XIV, § 8; IDAHO CONST. art. XVIII, § 6; IND. CONST. art. VI, § 2; MISS. CONST. ANN. art. V, § 135.

[17] KY. CONST. § 99; KY. REV. STAT. ANN § 72.210 (2007).

[18] Hanzlick, 2007, op. cit. The Bureau of Justice Statistics omits Louisiana and classifies Texas as a medical examiner state, and accordingly reports the total as 1,998. According to Hanzlick, many of Texas's 254 counties maintain justice of the peace/coroner's offices.

ME/C JURISDICTION

ME/C jurisdiction is determined by each state code and generally extends to deaths that are sudden and unexpected, deaths that have no attending physician, and all suspicious and violent deaths. The actual classes of death over which the ME/C assumes jurisdiction vary from state to state. Classes may include deaths resulting from injury, such as by violence or poisoning; by circumstance, such as related to fire or under anesthesia; by decedent status, such as prisoners or mental health patients; or by timeframe, such as deaths that occur within 24 hours of admission to a hospital. About 1 percent of the U.S. population (about 2.6 million people) dies each year. In 2004, ME/C offices received nearly 1 million reports of deaths, constituting between 30 to 40 percent of all U.S. deaths, and accepted about one half of those (500,000, or 1 in 6 deaths) for further investigation and certification.[19] Depending on the jurisdiction, about 40 to 50 percent of deaths referred to the ME/C will, after investigation and examination, be attributed to natural causes, 27 to 40 percent to accident, 12 to 15 percent to suicide, 7 to 10 percent to homicide, and 1 percent as undetermined.[20]

ME/C MISSIONS

ME/Cs serve dual purposes. First, they serve the criminal justice system as medical detectives by identifying and documenting pathologic findings in suspicious or violent deaths and testifying in courts as expert medical witnesses. Second, as public health officers, they surveil for index cases of infection or toxicity that may herald biological or chemical terrorism, identify diseases with epidemic potential, and document injury trends.

Additional ME/C responsibilities include the response to and investigation of all deaths resulting from all hazards, including terrorism and mass fatality events, and the identification of the unidentified dead. In addition, some 13,000 unidentified individuals are currently entered into databases for the unidentified dead, and many thousands more are entered as missing persons, as thousands of families search for them. Accessing these databases and matching them to the many thousands of individuals entered as missing persons is a major challenge for all organizations. Eighty percent of surveyed ME/C systems "rarely or never" utilize the National Crime Information Center Unidentified and Missing Persons (NCIC UP/MP) files to match their dead bodies to those reported as missing by law enforcement

[19] J.M. Hickman, K.A. Hughes, K.J. Strom, and J.D. Ropero-Miller. 2004. *Medical Examiners and Coroners' Offices, 2004*. U.S. Department of Justice, Bureau of Justice Statistics Special Report NCJ216756.

[20] *Office of the Chief Medical Examiner's Annual Report: 2006*. Available at www.vdh.state.va.us/medExam/Reports.htm.

agencies, even though NCIC recently granted access to the files by ME/Cs. Access, however, is not uniform, and the information that may be available could be limited.[21]

The newly established National Institute of Justice (NIJ) Office of Justice Programs, National Missing and Unidentified Persons System, NamUs, remains underutilized. Identification efforts for either of the national government databases require multiple investigative as well as data entry skills, and they are labor intensive. ME/Cs need a functional death investigation system; staff to develop identification features; and the necessary education, training, and equipment to utilize the multiple databases that are necessary to identify the unidentified dead and to meet the increasing societal expectations that ME/C systems should be able to identify the unidentified.[22] Critically needed is a federal requirement that ME/C systems enter information on the unidentified into federal databases. A later section in this report discusses the medical examiner/coroner role in homeland security.

VARIATIONS IN ME/C SYSTEMS

As of 2004, administratively, 16 states had a centralized statewide medical examiner system, 14 had a county coroner system, 7 had a county medical examiner system, and 13 had a mixed county ME/C system.[23] Eight states had hybrid arrangements, with coroners and a state medical examiner office that performed medicolegal duties. The District of Columbia relies on a medical examiner system (see Figure 9-1). In large cities and counties, forensic pathologists serve both as medical examiners and pathologists. A few large systems, such as those of Los Angeles, California, and Cuyahoga County, Ohio, bear the historical name of a coroner system, but function essentially under a medical examiner structure. Eighty percent of ME/C offices are run by county coroners.

In total, there are approximately 2,342 separate death investigation jurisdictions.[24] Of 1,590 coroner offices in the United States, 82 serve jurisdictions with more than 250,000 people; 660 medium-sized offices serve between 25,000 and 249,999 people; and 848 offices serve small jurisdictions

[21] J.C.U. Downs, Board Member and Chair, Governmental Affairs Committee, National Association of Medical Examiners; Vice Chair, Consortium of Forensic Science Organizations; Coastal Regional Medical Examiner, Georgia Bureau of Investigation. Presentation to the committee. June 5, 2007.

[22] National Missing and Unidentified Persons System, NamUS. See www.namus.gov.

[23] Downs, op. cit.

[24] R. Hanzlick. "An Overview of Medical Examiner/Coroner Systems in the United States–Development, Current Status, Issues, and Needs." Presentation to the committee. June 5, 2007.

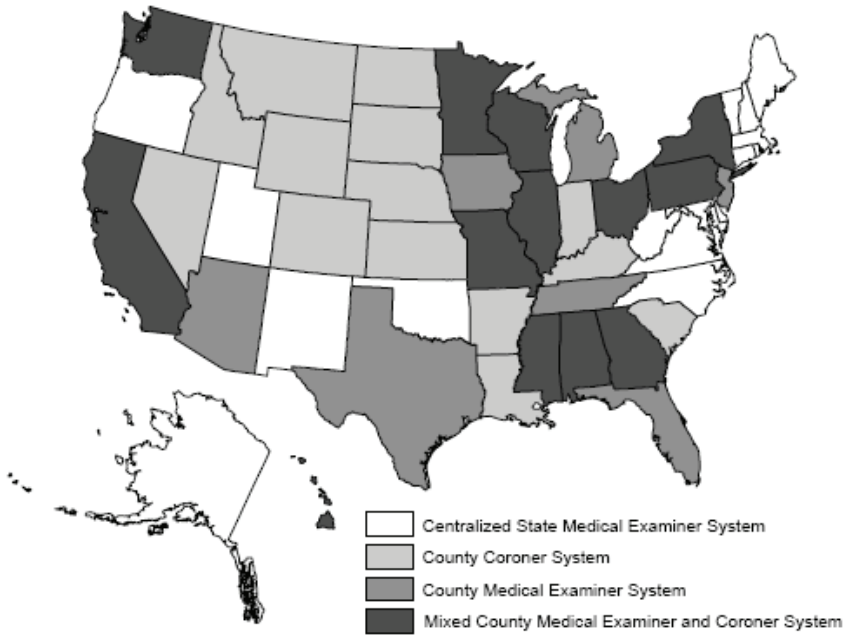

FIGURE 9-1 Death investigation systems in the United States, 2004.

SOURCE: J.M. Hickman, K.A. Hughes, K.J. Strom, and J.D. Ropero-Miller. 2004. Medical Examiners and Coroners' Offices, 2004. U.S. Department of Justice, Bureau of Justice Statistics Special Report NCJ216756. (In 2007, Kentucky became legally a mixed county ME/C system.[a])

[a] Constitution of the State of Kentucky, § 99.

of fewer than 25,000 people.[25] The hodgepodge and multiplicity of systems and controlling statutes makes standardization of performance difficult, if not impossible. Some observers believe that a revisiting of the model code is required, as has been proposed by numerous study groups over the years, in order to work toward the development of a modern model code for death investigation systems that utilizes new and available technologies that are responsive to the needs of the citizens.[26]

[25] Ibid.
[26] Ibid.

QUALIFICATIONS OF CORONERS AND MEDICAL EXAMINERS

Jurisdictions vary in terms of the required qualifications, skills, and activities for death investigators. Coroners are constitutional officers, with 82 percent being elected and 18 percent appointed.[27] Coroners as elected officials fulfill requirements for residency, minimum age, and any other qualifications required by statute. They may or may not be physicians, may or may not have medical training, and may or may not perform autopsies (see Box 9-1). Some serve as administrators of death investigation systems, while others are responsible solely for decisions regarding the cause and manner of death. Typical qualifications for election as a coroner include being a registered voter, attaining a minimum age requirement ranging from 18 to 25 years, being free of felony convictions, and completing a training program, which can be of varying length. The selection pool is local and small (because work is inconvenient and pay is relatively low), and medical training is not always a requirement. Coroners are independent of law enforcement and other agencies, but as elected officials they must be responsive to the public, and this may lead to difficulty in making unpopular determinations of the cause and manner of death.

Recently a 17-year-old high school senior successfully completed the coroner's examination and was appointed a deputy coroner in an Indiana jurisdiction.[28] In one state, justices of the peace are charged with determining cause and manner of death, but they are not medical death investigators. Whether coroners refer cases to pathologists for autopsy is largely budget driven (an autopsy costs about $2,000), although access to pathologists may be an issue if regional interjurisdictional arrangements do not exist. Even so, 84 percent of coroner offices see a need for professional standards,[29] and they identify resources for infrastructure, staff, and training as continuing needs.

Options for improving death investigation by coroners include (1) replacing coroner systems with medical examiner systems; (2) increasing the statutory requirements for performance of coroners; or (3) infusing funding to improve the capabilities of coroners.[30]

Some coroners have suggested establishing a "Coroner College."[31] Coroners want grants for equipment, accreditation incentives, and access to forensic laboratories, NCIC, and automated fingerprint identification

[27] P.M. Murphy, Coroner, Clark County Coroner's Office, Las Vegas, Nevada. "The Coroner System." Presentation to the committee. June 5, 2007.

[28] "Teen Becomes Indiana's Youngest Coroner." See http://happynews.com/news/5122007/teen-becomes-indiana-youngest-coroner.htm.

[29] Murphy, op. cit.

[30] Ibid.

[31] Ibid.

Box 9-1
What Is an Autopsy?

An autopsy is the systematic external and internal examination of a body to establish the presence or absence of disease by gross and microscopic examination of body tissues. The pathologist makes a surgical incision from shoulder to shoulder and from the midpoint of the shoulder to shoulder incision to the pubic bone. The skin is reflected, and each organ in the chest, including the neck structures, abdomen, and pelvis is removed and carefully examined. An incision is also made from the mastoid bone on the right to the mastoid bone on the left, and the scalp is pulled forward and the bony cap removed to reveal the brain. The brain is removed and examined. The pathologist takes a small sample or biopsy of all tissues and archives them in formalin to maintain them for future reference. In medicolegal autopsies, all tissues other than the biopsies are replaced in the body, except for perhaps the brain or heart, which may be retained and examined by consultants for diagnoses causing or contributing to death. For hospital autopsies, depending on the list of permissions given by the person qualified to give permission, tissues and organs may be retained for study, research, or other investigations. The pathologist submits small 2 × 2 cm sections of tissue to the histology laboratory, where thin slices a few microns thick are subjected to chemical treatment to preserve them. The tissue blocks are shaved, so that a thin layer can be mounted on a glass slide and stained with dyes to differentiate cells. The pathologist can recognize diseases in the stained tissue. Medicolegal autopsies are conducted to determine the cause of death; assist with the determination of the manner of death as natural, suicide, homicide, or accident; collect medical evidence that may be useful for public health or the courts; and develop information that may be useful for reconstructing how the person received a fatal injury.

systems.[32] Lack of direct access to laboratories and insufficient funding for testing impair the expertise of coroners. Some coroners are amenable to protocols that would ensure the use of forensic pathologists for autopsy. However, even with these improvements, the assessment of the dead for disease, injury, medical history, and laboratory studies is a medical decision, as opposed to a decision that would be made by a lay person with investigative and some medical training. The disconnect between the determination a medical professional may make regarding the cause and manner of death and what the coroner may independently decide and certify as the cause and manner of death remains the weakest link in the process.

In contrast, medical examiners are almost always physicians, are appointed, and are often pathologists or forensic pathologists. They bring

[32] Murphy, op. cit.

the body of knowledge of medicine to bear when assessing the history and physical findings and when deciding on the appropriate laboratory studies needed to determine the cause and manner of death. In statewide systems, cities and counties have local medical examiners that are physicians trained to receive the reports of death, decide jurisdiction, examine the body, and make a determination of the cause and manner of death. They certify locally many obvious natural and accidental deaths. In statewide and regionalized statewide systems, local medical examiners do not need to be forensic pathologists and do not perform autopsies, but they do refer, according to protocols, deaths from violence—particularly suicides, homicides, and deaths occurring under suspicious circumstances—to a central or regional autopsy facility for autopsy and further follow-up by a forensic pathologist. In hybrid or mixed state systems, coroners may refer cases for autopsy to forensic pathologists, but there is no supervision or quality assurance to ensure that the coroner's certification of the cause of death and manner of death is concordant with the pathologist's conclusions.

ME/C ADMINISTRATION AND OVERSIGHT

ME/Cs have varying forms of organizational oversight. Forty-three percent of the U.S. population is served by systems that are independent, 33 percent by offices residing administratively in public safety or law enforcement organizations, 14 percent by offices in health departments, and 10 percent by offices within a forensic laboratory. Government reports over the years have recommended that a medical examiner system should be an independent agency or should report to a commission so that it avoids any conflicts of interest and so that it reports directly to the jurisdictional governing body. When this is not possible, incorporation into a health department, instead of into law enforcement agencies, seems to provide the next most compatible location.[33]

ME/C STAFFING AND FUNDING

ME/C offices serving populations of less than 25,000 people employ 1 to 2 full-time equivalent (FTE) staff members, while offices serving populations of 1 million or more employ an average of 50 FTEs.[34] Competent death investigations require that trained medical death investigators attend scenes; medically credentialed persons perform external physical examinations; and forensic pathologists perform medicolegal autopsies, employ and

[33] V. Weedn. "Legal Impediment to Adequate Medicolegal Death Investigation." Presentation to the committee. June 5, 2007.

[34] Downs, op. cit.

interpret radiographs, prepare records, maintain databases, and provide competent and credible testimony in courts. Staff requires training and expensive equipment to utilize and integrate new technologies. Efforts are restricted by budgets, and budgets vary widely, ranging from $18,000 to $2.5 million annually for county systems, depending on the size of the population. A 2007 survey conducted for the National Association of Medical Examiners (NAME) by Hanzlick revealed that county systems' per capita cost ranged from $1.31 to $9.19, with a mean of $2.89. State systems benefit from economies of scale and function more economically at $.64 to $2.81, with a mean of $1.76.[35] The large variation in qualifications, staffing, budgets, and the multiple skills required for competent death investigations, especially in small jurisdictions, has resulted in marked variation in the quantity and quality of death investigations in the United States.

Physical facilities also vary in adequacy. Only one-third of offices have in-house facilities to perform the histology needed to make microscopic diagnoses on tissues sampled at autopsy. Only one-third have in-house toxicology capabilities to identify drugs present in the deceased that either contributed to or were the primary cause of death. One-third do not have radiology services in-house that would allow the identification of missiles, disease, bony injury or identification features in decedents.[36] Some coroner systems do not have any physical facility at all.

It is clear that death investigations in the United States rely on a patchwork of coroners and medical examiners and that these vary greatly in the budgets, staff, equipment, and training available to them, and in the quality of services they provide. No matter what the level of quality of other forensic science disciplines that are supported by a particular jurisdiction may be, if the death investigation does not include competent death investigation and forensic pathology services, both civil and criminal cases may be compromised.

All ME/Cs share the following deficiencies to some degree:

- imperfect legal structure/code controlling death investigations;
- inadequate expertise to investigate and medically assess decedents;
- inadequate resources to perform competent death investigations;
- inadequate facilities and equipment for carrying out body views and conducting autopsies;
- inadequate technical infrastructure (laboratory support);
- inadequate training of personnel in the forensic science disciplines;

[35] R. Hanzlick. "An Overview of Medical Examiner/Coroner Systems in the United States—Development, Current Status, Issues, and Needs." Presentation to the committee. June 5, 2007.

[36] Murphy, op. cit.

- lack of best practices and information standards;
- lack of quality measures and controls;
- lack of information systems; and
- lack of translational research and associations with university research.[37]

THE MOVEMENT TO CONVERT CORONER SYSTEMS TO MEDICAL EXAMINER SYSTEMS

As mentioned above, the movement to improve death investigations by bringing in medical expertise in the form of medical examiner systems is not new. Early NRC reports were followed in 2003 by an Institute of Medicine Workshop on the Medicolegal Death Investigation System, which also concluded that the medical examiner system is the best organizational structure for utilizing medical expertise to assess the presence or absence of disease and injury and for correlating the medical findings and investigative information to arrive at a determination of cause of death and manner of death. Progress has been very slow.

Additional impediments to progress include the need for some states to change state constitutions or codes, the political constituent base underpinning local coroners, insufficient population and budget to support a competent independent system in small localities, an unwillingness to develop cooperative regionalization for provision of autopsy services, the shortage of physicians—especially pathologists and forensic pathologists—and lack of interest, advocacy, or the perception of need.[38] To implement such conversions, the United States will require a national vision, a model code, increased numbers of forensic pathologists, and funding for infrastructure, staff, education, training, and equipment.

One possible model for providing incentives for these conversions could be an initiative similar to the Law Enforcement Assistance Administration (LEAA). LEAA was a federal agency operating from 1968 to 1982 with the purpose of funneling federal funding to state and local law enforcement agencies. The agency created state planning agencies and funded educational programs, research, and matching grants for physical plants and a variety of local crime control initiatives. For example, an $8 million grant to Virginia established the Virginia Department of Forensic Science, a premier state forensic laboratory that provides forensic science services to all state agencies and the Medical Examiner System in Virginia. [39] If

[37] Downs, op. cit.

[38] Downs, op. cit; Weedn, op. cit., Hanzlick, op. cit.

[39] Law Enforcement Assistance Administration at www.archives.gov/research/guide-fed-records/groups/423.html.

the capitalization of a medical examiner system is the major impediment to progress, an LEAA model can remove that barrier. However, a Medical Examiner Assistance Administration, or MEAA, would need to be structured so that the medical examiner would not be considered a servant of law enforcement and thus would not be placed in a position in which there is even an appearance of conflict of interest. Sensitive cases, such as police shootings and police-encounter deaths, jail and prison deaths, deaths in public institutions, and others, require an unbiased death investigation that is clearly independent of law enforcement. All previous studies have recommended that the medical examiner be independent of other agencies, or if they are to be under the umbrella of a central agency that the reporting chain should be through a health department. The medical examiner is first and foremost a physician, whose education, training, and experience is in the application of the body of medicine to situations that have a legal dimension that must be answered by a practitioner of medicine.

UTILIZATION OF BEST PRACTICES

The tremendous variation in death investigation systems also impedes interagency and interjurisdictional communication and the development of standardized best practices both in death investigation and in the performance of medicolegal autopsies.

NIJ and NAME have attempted to provide guidance for best practices. The NIJ document *Death Investigation: A Guide for the Scene Investigator; Medicolegal Death Investigator: A Systematic Training Program for the Professional Death Investigator*; the NAME Autopsy Standards and Inspection Checklist; and NAME's Forensic Pathology Autopsy Standards are available, but there is no incentive for death investigation systems to adopt them for use.[40]

Compliance is further limited because of heavy case loads, deficiencies in trained staff, absence of equipment, nonavailability of required day-to-day and consultative services, and the presence of contradictory policies and practices.

[40] U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. *Death Investigation: A Guide for the Scene Investigator*. Available at www.ojp.usdoj.gov; S.C. Clark, M.F. Ernst, W.D. Haglund, and J.M. Jentzen. 1996. Medicolegal Death Investigator: A Systematic Training Program for the Professional Death Investigator. Occupational Research and Assessment. Grand Rapids; NAME Autopsy Standards and Inspection Checklist at www.thename.org; and G. Peterson and S. Clark. 2006. Forensic Autopsy Performance Standards at www.thename.org.

POTENTIAL SCIENTIFIC ADVANCES THAT MAY ASSIST ME/CS

In addition to current technologies, which are often unavailable and underutilized, new technologies are on the horizon to assist death investigators, medical examiners, and forensic pathologists.

Computerization of case records and the development of case information databases should be standard in any death investigation office, so that death data may be tracked for trends, response to public health and public safety interventions can be streamlined and accelerated, and continuing quality assurance measures can be implemented. There is no standard method of sample and data collection for ME/C systems. Multiple systems are commercially available that can be structured to meet the particular needs of any death investigation system. The initial cost of such systems is significant, and they require continuing maintenance, which rules out their utilization by small and/or underfunded offices. Even if such computer systems were present in each office, there is no standardization that would allow them to talk to one another, a necessity in a multijurisdictional event such as the Hurricane Katrina disaster, for which databases across states were critical to the identification of the dead and the tracking of survivors.

Laboratory information systems are available for the management of medical evidence, laboratory specimens, laboratory data, forensic samples, and personal effects. Effective database management allows information to be gathered and utilized by staff and analyzed for trends and quality issues. Effective databases are essential for managing any multiple fatality event. Rapid electronic transmission of reports is feasible if encryption software is available. At this time, ME/C information systems are less interoperable than current Automated Fingerprint Identification Systems (see Chapter 10). Although the standard autopsy report generally covers the internal examination by organ systems, reporting formats are not standardized among jurisdictions. And, although the NAME Forensic Autopsy Performance Standards provide a model for reporting autopsy findings,[41] it is not widely used.

Imaging equipment is critical to documenting findings sufficient for courts, for review by outside experts, and for reevaluation as medical knowledge advances. Fluoroscopy is helpful for locating missiles. Computed tomography scanning and nuclear magnetic resonance imaging may often present a better visual picture of some injuries and would likely reduce the number of autopsies carried out to rule out occult injury and to document in greater detail the extent of injury in accidents. The "Virtual

[41] G. Peterson and S. Clark. 2006. Forensic Autopsy Performance Standards. Available at www.thename.org.

Autopsy," or "virtopsy," utilizes multislice computed tomography and magnetic resonance imaging combined with 3-D imaging technology to create vivid images of the interior of the human body.[42]

The advantages of the virtopsy are that it is not invasive or destructive of tissue and can provide dramatic pictures of skeletal and soft tissue injury. It also provides some information when there is a religious objection to autopsy. Virtopsy has the potential to detect internal bleeding, missile paths, bone and missile fragmentation, fracture patterns, brain contusion, and gas embolism, in addition to occult fractures that are technically difficult to demonstrate during the traditional autopsy. Although a standard forensic autopsy is needed to recover evidence such as bullets or bomb fragments within the body and to collect specimens for testing, virtopsy offers a valuable tool for examination when dissection of the body is not feasible, when evidence is hard to visualize, or when a more complete assessment of injury is desired in noncriminal cases. For example, instead of a simple external examination for an obviously lethal injury in a vehicular violence death, virtopsy would permit more extensive cataloging of the injury to help automotive engineers design safer vehicles. The same technology can enhance bite mark impressions and some patterned injuries. Only a few ME/Cs have access to virtopsy at this time, and very few have the budget to purchase the expensive equipment or to build a suitable facility and staff and maintain it.

Scanning electron microscopy is not new but few ME/Cs have access to it to assist in identifying the metal conductor(s) in electrocution injuries, gunpowder residues in gunshot injuries, and other trace metals on skin or in tissues.

The anthrax bioterrorism attack that occurred in Connecticut, Maryland, New York, Virginia, and Washington, DC, highlighted the need to have biosafety capability for autopsy facilities. Currently, most autopsy facilities are 20 years old, on average, and are outdated in physical plant, technology, and biosafety capability. One-third of them lack design/airflow control of pathogens, and most function at biosafety level 2 rather than level 3.[43] Upgrading facilities to handle the potential biohazards associated with bioterrorism will require a massive infusion of funds that localities currently are unable or unwilling to provide. Laboratory safety in an era in which bioterrorism is a real threat remains an ongoing issue.

In-house toxicology services utilizing state-of-the-art equipment are essential for identifying drugs, intoxicants, and poisons and for detecting unsuspected homicides, suicides, and child and elder abuse. Yet only 37

[42] See www.nlm.nih.gov/visibleproofs/galleries/technologies/virtopsy.html.
[43] Downs, op. cit.

percent of systems have in-house toxicology capabilities.[44] The cost for complete toxicology utilizing private sector laboratories for cases is high, resulting in insufficient toxicology screening and minimal testing on cases even when they are clearly indicated.

Molecular diagnosis conducted on blood and tissue samples is routine in hospital laboratories to diagnose disease. Investigations of unexplained sudden deaths, especially in young people and infants, would benefit from greater access to molecular diagnostics. Molecular diagnostic procedures are available, but most ME/C offices cannot afford to conduct these procedures and do not have the medical expertise to request them or the skills to interpret them. For example, testing for inborn errors of metabolism should be a part of any examination of the unexpected death of an infant or toddler, and testing for long QT syndrome is important in determining the cause of cardiac death in young people or in those whose family pedigree discloses other sudden unexpected deaths. Molecular testing is available for the etiology of multiple causes of sudden cardiac death, including abnormalities in ion channels in cell membranes or channelopathies, hypertrophic cardiomyopathy, long QT syndrome, Marfan syndrome, right ventricular cardiomyopathy, dilated cardiomyopathy, and Ehlers-Danlos syndrome.[45]

Some testing can be carried out on a dried blood sample long after death has occurred.[46] Some molecular diseases are heritable, and it could be argued that the ME/C has a duty to identify these diseases and alert families about their presence. Many medical examiner offices archive a card with a dried blood sample on decedents, primarily to document personal identification, should the need arise, but also for future study. In the future, kin may request the archived blood cards, as the molecular diagnosis of disease improves and families seek to identify their risk. Thus, ME/Cs need education and training in and access to the specialized laboratory testing available to establish the molecular basis of disease and of sudden unexpected natural death.

[44] Ibid.

[45] S.E. Lehnart, M.J. Ackerman, D.W. Benson, R. Brugada, C.E. Clancy, J.K. Donahue, A.L. George, A.O. Grant, S.C. Groft, C.T. January, D.A. Lathrop, W.J. Lederer, J.C. Makielski, P.J. Mohler, A. Moss, J.M. Nerbonne, Y.M. Olson, D.A. Przywara, J.A. Towbin, L.H. Wang, A.R. Marks. Inherited arrhythmias: a National Heart, Lung, and Blood Institute and Office of Rare Diseases workshop consensus report about the diagnosis, phenotyping, molecular mechanisms, and therapeutic approaches for primary cardiomyopathies of gene mutations affecting ion channel function. *Circulation* 13;116(20):2325-2345.

[46] Personal communication between M.J. Ackerman and Marcella Fierro. June 16, 2008.

THE SHORTAGE OF MEDICAL EXAMINERS AND FORENSIC PATHOLOGISTS

Medical examiners are physicians who are appointed and charged with determining the cause and manner of death. In some states, medical examiners are forensic pathologists, while in other statewide systems, local, city, and county medical examiners are physicians but do not need to be forensic pathologists. They receive death investigation training and are responsible for examining bodies that do not require medicolegal autopsy and, according to system guidelines, for referring cases that need autopsy to regional offices where forensic pathologists perform the examinations and initiate further investigation as needed. Well-trained local medical examiners keep costs in line by reducing transportation costs to regional or central offices and are more accessible than pathologists in distant offices. Changes in the delivery of health care, increased patient caseloads, the inconvenience of attending scenes, the need for before and after hours examination of decedents, and the level of remuneration have made it difficult for statewide systems to recruit busy physicians to serve as community or local medical examiners. If this trend continues, systems will rely more heavily on lay medical death investigators and will need to develop training programs that assure competency.

Forensic pathology is the subspecialty of medicine devoted to the investigation and physical examination of persons who die a sudden, unexpected, suspicious, or violent death. Forensic pathology derives its name from "forensis" (public), or pertaining to the forum, and "pathos" (suffering), referring to pathos or suffering. The term ultimately evolved to encompass the study of deaths due to injury and disease and of deaths that are of interest to the legal "forum." Forensic pathologists are physicians who have completed, at a minimum, four years of medical school and three to four years of medical specialty training in anatomical pathology or anatomical and clinical pathology, followed by an accredited fellowship year in forensic pathology. They are certified by examination and assessment of their credentials by the American Board of Pathology in, at a minimum, anatomical pathology, and by subspecialty examination, as having special competence in forensic pathology.

As of 2008, approximately 38 forensic pathology residency programs accredited by the Accreditation Council for Graduate Medical Education sponsored approximately 70 training fellowships. Some positions are unfunded, and others did not find suitable candidates. Forty-two candidates were certified in forensic pathology by the American Board of Pathology in January 2008. Pathologists must recertify by examination every 10 years to maintain their certifications, in addition to maintaining a professional license in the state in which they are practicing, by submitting a descrip-

tion of practice for pathologists that do not practice as hospital staff and by earning continuing medical education credits.[47]

Forensic pathologists examine the dead to identify specific classes of injury, collect medical evidence, determine the presence or absence of natural disease, and determine the physiological cause of death. They document their findings in reports for the civil and criminal courts and provide information to family members and others who have a legitimate need to know. They may sign the death certificate describing the manner or circumstances under which death occurred (natural, accident, suicide, homicide, or undetermined). The examinations forensic pathologists carry out may be inspections or "views" of the external surfaces of a body or a medicolegal autopsy, which comprises an external and internal examination of the head, thorax, abdomen, and any other body region pertinent to the case. The nature of the death and its circumstances dictate which type of examination the forensic pathologist performs on an individual case. Pathologists who are not certified in forensic pathology perform many of the medicolegal autopsies in the United States.

Forensic pathologists practice in multiple settings. Most operate within death investigation systems and are appointed as civil servants and serve as medical examiner forensic pathologists. Some function as private practitioners, while others serve as consultants. They may operate under a fee-for-service agreement or be under contract to a city or county jurisdiction to provide medical examiner services. Others may serve as coroner's pathologists, and perform autopsies and prepare reports for coroners, who by statute assign the cause and manner of death and sign the death certificate.

An estimated 1,300 pathologists have been certified in forensic pathology since the American Board of Pathology first offered the certification in 1959 (about 5,000 medical residents enter internal medicine programs each year). Currently, approximately 400 to 500 physicians practice forensic pathology full time. Although there are only about 70 positions available each year, recent data indicate that only 70 percent of the slots are filled. NAME recommends an autopsy caseload of no more than 250 cases per year. The estimated need is for about 1,000 forensic pathologists; about 10 percent of available positions are vacant because of manpower shortages and/or insufficient funding of pathologist positions.[48] Although many forensic pathologists earn between $150,000 and $180,000 annually, this range is much lower than the average income of most hospital-based pathologists starting at the entry level.

An Association of American Medical Colleges (AAMC) survey indi-

[47] American Board of Pathology at www.abpath.org/200801newsltr.htm; *ABP Examiner* 39. January 1, 2008 at www.abpath.org/200802newsltr.htm.

[48] Hanzlick, 2007, op. cit.

cates that the average medical school graduate in 2006 finished with debt in excess of $130,571 (including premedical school borrowing), with 72 percent having a debt of at least $100,000.[49] Interested pathology residents are less likely to elect to practice forensic pathology as a career if they are already burdened by debt load, and a program of loan forgiveness for years of service in a medical examiner system would be a major enticement to students who are considering a career in pathology. The shortage of qualified forensic pathologists required to staff aspiring medical examiner systems constitutes a major challenge not only for offices that are currently seeking staff, but for the future as well.

STANDARDS AND ACCREDITATION FOR DEATH INVESTIGATION SYSTEMS

Currently, the standard for quality in death investigation for medical examiner offices is accreditation by NAME. Accreditation attests that an office has a functional governing code, adequate staff, equipment, training, and a suitable physical facility and produces a forensically documented accurate, credible death investigation product. Of all ME/C systems nationally, only 54 are accredited by NAME. The NAME accreditation checklist is available online and describes the requirements for accreditation.[50] Accreditation is for a period of five years. NAME also offers an individualized assessment program to enable jurisdictions to identify what they need to meet accreditation standards. Impediments to developing systems that meet accreditation requirements include the following:

- Most coroner systems cannot qualify for accreditation because of problems related to size, insufficient staff and equipment, and insufficiently trained personnel, which inhibit their ability to perform a competent physical examination, make and/or exclude medical diagnoses on dead bodies, and make determinations of the cause and manner of death. The historic role of the coroner is insufficient to accurately perform the medicolegal and public health functions related to sudden, unexpected, or violent death.
- Many medical examiner systems are constrained by budget, lack of staff, lack of equipment, and insufficient facilities and cannot meet NAME standards.
- The accreditation process requires considerable staff work, including written policies and procedures.

[49] Association of American Medical Colleges at www.ama-assn.org/ama/pub/category/5349.html.

[50] NAME Autopsy Standards and Inspection Checklist at www.thename.org.

- The process requires renewal.
- There is administrative cost of the process.
- Many offices do not see any benefit to accreditation.

Federal incentives are lacking for states to perform an assessment of death investigation systems to determine status and needs, using as a benchmark and goal compliance with NAME current professional standards, guidelines, and accreditation requirements.

QUALITY CONTROL AND QUALITY ASSURANCE

Quality control and quality assurance begin with the implementation of standardized policies and procedures by qualified staff. For lay medical investigators, registration and certification by the American Board of Medicolegal Death Investigators requires standard performance procedures as outlined in the NIJ document *Death Investigation: A Guide for the Scene Investigator* and other published education and training documents.[51] For forensic pathologists, basic competence is initially documented by examination and certification and subsequently by recertification by the American Board of Pathology. Written office and morgue policies and procedures with scheduled reviews and updates help ensure consistent performance over time. Professional performance parameters, such as the NIJ investigation guidelines for investigators and the NAME forensic autopsy standards, are offered as national documents that all systems should be able to follow. Professional continuing education must be available and supported, and it should be mandatory.

CONTINUING MEDICAL EDUCATION

For pathologists to maintain professional standing they must earn Continuing Medical Education (CME) credits in accordance with the number required by their state medical licensing board. Attendance at forensic educational meetings, such as the annual meetings of NAME and the American Academy of Forensic Sciences (AAFS), help keep medical staff current. Other opportunities that offer valuable CME credits are meetings that focus on pediatric forensic issues and general pathology updates. AAFS meetings are multidisciplinary and afford an opportunity for updating in forensic anthropology, forensic odontology, and other forensic disciplines. The American Society of Clinical Pathologists offers CheckSample exercises and

[51] U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. *Death Investigation: A Guide for the Scene Investigator*. Available at www.ojp.usdoj.gov.

quizzes on forensic subjects prepared by experts.[52] Regular in-house training on emerging technologies in pathology and forensic science, and journal clubs covering a broad spectrum of journals, can help educate and reeducate forensic pathologists and investigators. Medical death investigators may attend the same meetings. The College of American Pathologists offers self-assessment programs in anatomical and forensic pathology, as well as a continuing education program of forensic pathology case challenges.[53]

HOMELAND SECURITY

As part of homeland security, the National Response Plan (National Response Framework as of March 2008) identifies ME/Cs under Emergency Support Function 8 as responsible for management of the dead resulting from any hazardous event.[54] All deaths resulting from any form of terrorism are under the jurisdiction of the ME/C. MED-X, the bioterrorism surveillance program provided by the Centers for Disease Control and Prevention (CDC) for ME/Cs, utilizes syndromic surveillance of primarily out-of-hospital deaths (deaths occurring before the opportunity occurs for hospitalization and medical assessment and testing) to quickly identify deaths resulting from bioterrorism.[55]

With the exception of some large city, county, and state systems, the level of preparedness of ME/C jurisdictions is generally very low. Larger medical examiner systems may be able to manage events causing several hundred simultaneous single-site recoverable bodies with minimal outside assistance. Any event with thousands of fatalities would require federal assistance. Some statewide systems have developed consortia with neighboring states to supplement staff and equipment, but smaller cities and counties will need to rely entirely on federal assets such as Disaster Mortuary Operational Response Teams and the DOD Joint Task Force Civil Support.[56] Homeland security and disaster response would be well served by universal improvement in ME/C offices to manage mass fatality events such as the multistate Hurricane Katrina tragedy and the World Trade Center attacks, while also surveilling for the links between bioterrorism

[52] American Society of Clinical Pathologists CheckSample. Available at www.ascp.org/Education/selfStudyPublications/checkSample/default.aspx.

[53] See http://cap.org/apps/cap.portal.

[54] Homeland Security National Response Plan (known as the National Response Framework after March 2008) at www.dhs.gov.

[55] Ibid; K.B. Nolte, S.L. Lathrop, M.B. Nashelsky, J.S. Nine, M.M. Gallaher, E.T. Umland, J.L. McLemore, R.R. Reichard, R.A. Irvine, P.J. McFeeley, R.E. Zumwalt. 2007. "Med-X": A medical examiner surveillance model for bioterrorism and infectious disease mortality. *Human Pathology* 38:718-725.

[56] Disaster Mortuary Operational Response Team at www.dmort.org; Joint Task Force Civil Support at http://jtfcs.northcom.mil.

deaths. Multiple fatality management across jurisdictional lines, such as was needed in response to Hurricane Katrina, is nearly impossible under current conditions, given the absence of medical expertise in some systems, the absence of standards of performance, and the noninteroperability of systems and procedures. The recent infusion of funds to the states through the Department of Health and Human Services (DHHS) and the Department of Homeland Security (DHS) is of little assistance when there are no competent systems able or willing to employ those funds. Uniform statewide and interstate standards of operation, consolidation of small systems, regionalization of services, and standardization of staff training are needed to assist in the management of interstate and cross-jurisdictional events. A software program is needed that is universally usable and available, and its use should be promulgated by ME/C systems for multiple fatality management. (See also Chapter 11.)

FORENSIC PATHOLOGY RESEARCH

Currently, little research is being conducted in the areas of death investigation and forensic pathology in the United States. Individual ME/C offices mainly utilize their databases for epidemiological retrospective reviews. Individual forensic pathologists operating in any system carry heavy caseloads and often have no dedicated time, expertise, facilities, or funding for research. Research is further limited because many offices operate training programs independent of university medical schools. Occasionally, a specific case may inspire "litigation research" directed to the elucidation of a specific problem related to a case that is being litigated actively, but this does not replace broad and systematic research of a forensic issue. Few university pathology departments promote basic pathology research in forensic problems such as time of death, injury response and timing, or tissue response to poisoning. In general, research interest often is inspired by a national goal that is funded through grants. A review of the forensic literature for basic research in forensic pathology reveals that efforts are originating largely from Europe, Scandinavia, and Japan. In other countries, universities house a department of legal medicine and/or departments of forensic medicine and pathology where forensic pathologists have the time, expertise, and funding needed to perform basic forensic research.

The Accreditation Council for Graduate Medical Education (ACGME) requires forensic pathology training programs to provide fellows an opportunity for scholarly research or other scholarly activities.[57] These research projects are usually small and limited in scope because of the constraints of a one-year fellowship, legislation that does not permit most basic research

[57] Accreditation Council for Graduate Medical Education. Available at www.acgme.org/acWebsite/downloads/RRC_progReq/310forensicpath07012004.pdf.

on tissues that are available upon autopsy without the permission of next of kin, lack of funding, and lack of space. Historically, the consent issue derives from the fact that forensic autopsies are carried out for medicolegal purposes and thus do not require permission from the next of kin. But without this permission, research that utilizes tissue from medical examiner offices does not take place. The time constraints for the performance of medicolegal autopsies make finding families and obtaining consent difficult. Many projects consist of epidemiological reviews that while of interest are not basic science.

Some U.S. universities may administer some forensic pathology fellowship programs, while others may include forensic pathologists within their departments of pathology. In these instances, the forensic pathologist usually supervises a departmental autopsy service that performs hospital and forensic autopsies. A university connection usually provides the university with the opportunity to rotate pathology residents and medical students through an ME/C office for a brief period, usually several months, and provides exposure to forensic pathology as part of an overall education program for medical students or as required by ACGME for training residents in general pathology. Even in universities that have a department of forensic science, research is limited to the forensic science disciplines, and little or no research is devoted to forensic pathology or forensic medicine. In some cases, there may be collaborative, ongoing epidemiological activities, such as when forensic pathologists work with members of departments of trauma surgery to develop statistical studies or when a forensic pathologist presents data at surgical or pediatric death review conferences. Of the many impediments to academic research in forensic pathology in the United States, the most significant are the lack of understanding of forensic research challenges, the lack of a perceived need and national goals, the lack of grant funding of any kind to support research, the lack of forensic pathology researchers, and the lack of recognition for efforts directed to forensic pathology research within the university community. Grant funding drives research, but virtually no funding is available to encourage departments of pathology to make forensic pathology research a focus, and there is little tradition of collaboration between academic and forensic pathologists.

Translational research bridges the gap between basic science discoveries and their practical applications. In the case of forensic pathology/medicine, this means taking basic science research knowledge to the autopsy table.[58] Given the large numbers of autopsies performed in the

[58]NIH Roadmap for Medical Research: Re-engineering the Clinical Research Enterprise–Translational Research. Available at http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp.

United States in medical examiner offices, there is a great need for new knowledge that will filter down to the autopsy pathologist and for opportunities for practicing forensic pathologists to identify problems that need basic research.

COMMON METHODS OF SAMPLE AND DATA COLLECTION

State statute determines the sample or collection of cases that ME/Cs investigate and examine. The minimal data collected on each case is demographic and is entered on the certificate of death by the state division of vital records and death statistics, which also maintains the data. The data are reported nationally each year to the National Center for Health Statistics. ME/C offices with databases may keep records pertaining to their particular jurisdiction and collect additional data on specific diagnoses, or classes, of death. They collect useful death data through child fatality review teams, adult fatality review teams, surveillance programs for family and intimate partner violence, and the National Violent Death Review System.[59] None of these data collection projects is federally mandated, and for small systems there is no perceived benefit. ME/C reports are available to next of kin and others as provided by statute. ME/C investigations recognize product and equipment failures leading to death and report them to appropriate agencies. Before 2005, when funding was withdrawn, CDC maintained the Medical Examiner and Coroner Information Sharing Program (MECISP) to receive reports of product-associated deaths, which allowed early recognition of problem products.[60] Originally, MECISP was established to obtain data from all deaths investigated by ME/Cs and to share such information with relevant agencies. The major goals of MECISP were to improve medicolegal death investigation and to facilitate the sharing of death investigation information.[61] Many agencies depend on ME/C investigations and autopsies to complete their work, such as the Occupational Health and

[59] National Violent Death Reporting System. Available at www.cdc.gov/ncipc/profiles/nvdrs/default.htm.

[60] Centers for Disease Control and Injury Prevention Medical Examiner Coroner Information Sharing Project. Available at www.cdc.gov/ncphi/disse/nndss/contact.htm#mecisp.

[61] MECISP was established in 1986 by CDC with goals that included improving the quality of death investigation in the United States mainly by achieving uniformity and improving the quality of information obtained during the investigation of deaths by ME/Cs. The program was active and productive and very well received by medical examiners. It constituted the major interface between the public health and the ME/C systems. Approximately 10 years ago, CDC went through a period of internal reorganization and administratively began decreasing the budget for MECISP. MECISP was moved from the CDC National Center for Environmental Health to the CDC Epidemiology Program Office. The budget was eliminated in 2004, despite the efforts of NAME. R. Hanzlick. 2006. Medical examiners, coroners, and public health. *Archives of Pathology and Laboratory Medicine* 130:1247-1282.

Safety Administration, social services agencies, victim witness compensation programs, and workers compensation agencies.

Systems with in-house forensic pathologists may collect autopsy data, but often the data are collected in a format that is different from the one used for the underlying (proximate) cause of death data as listed on death certificates. The reporter may use a pathology classification system such as SNOMED (Systematized Nomenclature of Medicine) or an individually devised system that tracks diseases or injuries of personal or system-specific interest.[62] There is no universally accepted or required system for collection or maintenance of autopsy data by medical examiners and coroners. Analysis of data may be local or regional, and it may be conducted by review teams or by national organizations or agencies with interests in specific classes of data.

Scientific interpretation and summaries of the results are included in the reports generated by each ME/C office. Reports by medical death investigators that describe the circumstances of death are descriptive and vary in quality depending on the standards of the office. Pathologists produce the autopsy reports and may or may not provide an interpretive summary of findings. Reports vary from the academic pathology report that lists each organ system and any deviations from normal to the problem-oriented autopsy report that prioritizes diagnoses from the most important leading to death followed by any contributory and then noncontributory pathology of interest. Not all pathologists follow the NAME autopsy standards. The general expectation, at least for the legal forum, is that each autopsy will have documented the findings in sufficient detail through narrative and photographs and that review by another pathologist will confirm the adequacy of the examination.

Requiring the adoption of standards for death investigations and autopsies as well as accreditation of all ME/C offices would benefit all parties, including the recipients of ME/C services. Because the credibility of unaccredited offices is rarely challenged, implementing and enforcing standards will require major incentives as well as negative consequences for nonadherence.

CONCLUSIONS AND RECOMMENDATION

ME/C systems function at varying levels of expertise, often with deficiencies in facilities, equipment, staff, education, and training. And, unfortunately, most systems are under budgeted and understaffed. As with other forensic science fields, there are no mandated national qualifications or certifications required for death investigators. Nor is medical expertise

[62] SNOMED. Available at www.snomed.org.

always required. In addition, there is no one recognized set of performance standards or best practices for ME/C systems nor are there incentives to implement one recognized set. Also lacking are universally accepted or promulgated methods of quality control or quality assurance. It is clear that the conversion of coroner systems to medical examiner systems as recommended by many studies has essentially halted and requires federal incentives to move forward.

The Model Post-Mortem Examination Act of 1954 needs to be revisited and updated to include the elements of a progressive and responsive death investigation law. The revised code should include standards for administration, staffing, and training. Any changes to the system will require federal incentives to implement the changes in each state.

The shortage of forensic pathologists speaks to the need to provide incentives for young physicians to train in forensic pathology. Systems with authorized positions cannot fill them, because of this shortage and budget deficits. The National Forensic Sciences Improvement Act (NFSIA) must be fully funded to support the core needs of ME/C grantees for equipment and facilities, training and education, and infrastructure.

Many ME/C systems do not utilize up-do-date technologies that would help in making accurate medical diagnoses. Moreover, many are unable to make use of advances in forensic technology because of staff educational deficiencies, untrained staff, and budget stringencies. Basic and translational forensic pathology research are nearly nonexistent.

Homeland security is compromised because operating units related to forensic pathology are not standardized, and the multiplicity of systems precludes meaningful communication among units. Surveillance for bioterrorism and chemical terrorism is not universal, and database systems cannot operate across jurisdictional lines to share data or manage multiple fatality incidents.

Although steps have been taken to transform the medicolegal death investigation system, the shortage of resources and the lack of consistent educational and training requirements prevent investigators from taking full advantage of tools, such as CT scans and digital X-rays, that the health care system and other scientific disciplines offer. In addition, more rigorous efforts are needed in the areas of accreditation and adherence to standards. Currently, requirements for practitioners vary from an age and residency requirement to certification by the American Board of Pathology in forensic pathology.

Funds are needed to assess and modernize the medicolegal death investigation system, using as a benchmark the current requirements of NAME related to professional credentials, standards, and accreditation. As it now stands, ME/Cs are essentially ineligible for direct federal funding and cannot receive grants from DHHS (including the National Insti-

tutes of Health [NIH]) and the Department of Justice or DHS. The Paul Coverdell NFSIA is the only federal grant program that names ME/Cs as eligible for grants. However, ME/Cs must compete with public safety agencies for Coverdell grants; as a result, the funds available to ME/Cs have been significantly reduced. NFSIA is not funded sufficiently to provide significant improvements in ME/C systems. In addition to more direct funding, other initiatives could be pursued to improve medicolegal death investigation practices.

AAMC and other appropriate professional organizations might organize collaborative activities in education, training, and research to strengthen the relationship between the medical examiner community and its counterparts in the larger academic medical community. Medical examiner offices with training programs affiliated with medical schools should be encouraged to compete for funds. Funding should be available to support pathologists who are seeking forensic fellowships. In addition, forensic pathology fellows could apply for medical school loan forgiveness if they stay full time at a medical examiner's office for a reasonable period of time.

Additionally, the proposed National Institute of Forensic Science (NIFS) should seek funding from Congress to allow it, CDC, and DHS, jointly, to design programs of interest to medical examiners and medical examiner offices in national disaster planning, preparedness, and consequence management. Uniform statewide and interstate standards of operation would be needed to assist in the management of cross-jurisdictional and interstate events. NIFS also might consider whether to support a federal program underwriting the development of software for use by ME/C systems for the management of multisite, multistate, or multiple fatality events.

NIFS also could work with groups such as the National Conference of Commissioners on Uniform State Laws, the American Law Institute, and NAME, in collaboration with other appropriate professional groups, to update the 1954 Model Post-Mortem Examinations Act and draft legislation for a modern model death investigation code. An improved code might, for example, include the elements of a competent medical death investigation system and clarify the jurisdiction of the medical examiner with respect to organ donation. Although these ideas must be developed in greater detail before any concrete plans can be pursued, the committee makes a number of specific recommendations, which, if adopted, will help to modernize and improve the medicolegal death investigation system. These recommendations deserve the immediate attention of NIFS and Congress.

Recommendation 11:

To improve medicolegal death investigation:

(a) **Congress should authorize and appropriate incentive funds to the National Institute of Forensic Science (NIFS) for allocation to states and jurisdictions to establish medical examiner systems, with the goal of replacing and eventually eliminating existing coroner systems. Funds are needed to build regional medical examiner offices, secure necessary equipment, improve administration, and ensure the education, training, and staffing of medical examiner offices. Funding could also be used to help current medical examiner systems modernize their facilities to meet current Centers for Disease Control and Prevention-recommended autopsy safety requirements.**

(b) **Congress should appropriate resources to the National Institutes of Health (NIH) and NIFS, jointly, to support research, education, and training in forensic pathology. NIH, with NIFS participation, or NIFS in collaboration with content experts, should establish a study section to establish goals, to review and evaluate proposals in these areas, and to allocate funding for collaborative research to be conducted by medical examiner offices and medical universities. In addition, funding, in the form of medical student loan forgiveness and/or fellowship support, should be made available to pathology residents who choose forensic pathology as their specialty.**

(c) **NIFS, in collaboration with NIH, the National Association of Medical Examiners, the American Board of Medicolegal Death Investigators, and other appropriate professional organizations, should establish a Scientific Working Group (SWG) for forensic pathology and medicolegal death investigation. The SWG should develop and promote standards for best practices, administration, staffing, education, training, and continuing education for competent death scene investigation and postmortem examinations. Best practices should include the utilization of new technologies such as laboratory testing for the molecular basis of diseases and the implementation of specialized imaging techniques.**

(d) **All medical examiner offices should be accredited pursuant to NIFS-endorsed standards within a timeframe to be established by NIFS.**

(e) **All federal funding should be restricted to accredited offices that meet NIFS-endorsed standards or that demonstrate significant and measurable progress in achieving accreditation within prescribed deadlines.**

(f) **All medicolegal autopsies should be performed or supervised by a board certified forensic pathologist. This requirement should take effect within a timeframe to be established by NIFS, following consultation with governing state institutions.**