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TECHNICAL NOTE

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Utility of Infectious Disease Coding Sheets for Surveillance in a State Medical Examiner's Office*

ABSTRACT: Medical examiners are often first to recognize unusual occurrences of fatal infectious diseases. Recognition of these deaths allows public health officials to institute appropriate public health measures. Therefore, we developed a simple method of identifying and tracking infectious disease deaths in a statewide medical examiner's office. One-page infectious disease forms were completed for 1566/1949 autopsies (80%) performed at the New Mexico Office of the Medical Investigator in 2004. In 241 cases one infectious disease was identified at autopsy and 58 cases had two infectious diseases. Fourteen of the infectious-diseases caused deaths involved diseases that are notifiable conditions in New Mexico. Pneumonia was the most commonly reported infectious process (47 deaths) followed by sepsis (25 deaths). Tracking infectious disease deaths highlighted the importance of recognizing these deaths, although hand-written entries were unstandardized. Preferably, a tracking system would be built into electronic databases at medical examiner and coroner's offices, expediting the identification of these diseases and contact of public health agencies.

KEYWORDS: forensic science, forensic pathology, infectious diseases, autopsy, surveillance, public health

In the 1970s, the New Mexico Office of the Medical Investigator (OMI) recognized several fatal cases of plague (1), and in 1993, our agency identified an outbreak of fatal respiratory disease that later became known as hantavirus pulmonary syndrome (2). As a consequence of these outbreaks and because the recognition of deaths from infectious diseases is important to ensure appropriate public health measures, we wanted to develop a simple method to recognize and track infectious disease deaths that received medicolegal autopsies.

OMI is the centralized, statewide medical examiner agency for New Mexico, charged with investigating deaths that are sudden, unexpected, violent, suspicious or unattended by a physician. Each year OMI investigates approximately 5000 deaths, or one-third of the total number of deaths in the state. Autopsies are performed on approximately 2000 cases each year. We report the results from using a data collection sheet for tracking infectious disease deaths at OMI during 2004.

Methods

We created a one-page data sheet for collecting information on infectious diseases among autopsied cases, and began using it in 1994. The attending pathologist for each case could choose either "no infectious disease present," "infectious disease suspected but not identified," or list two infectious diseases, enter the infectious process and infecting organism, and circle whether or not the infectious disease was a cause of death (the death could be directly attributed to the infectious process), contributory to death (while not the primary cause of death, the infectious process resulted in impairment or organ failure which hastened the death), or incidental (unrelated to the cause of death). The pathologists used a combination of antemortem symptoms, gross and histologic tissue reaction patterns, and microbiologic data to determine the appropriate category. Microbiologic cultures were performed in those cases where antemortem symptoms or gross pathologic findings were suggestive of a potential infection; specimen selection was determined by the pathologist and could include a variety of sources (blood, lung, nasopharynx, cerebrospinal fluid) subjected to viral, bacterial, mycobacterial, or fungal isolation processes. Tissue blocks were analyzed with immunohistochemistry (IHC) at the Centers for Disease Control and Prevention. IHC was used to test for a variety of potential pathogens in cases of infection where microbiologic cultures had not been performed, e.g., an infection recognized histologically that was not grossly apparent. Viral hepatitis was diagnosed using a combination of serologic data and histologic findings.

Comorbidity information was also collected, in the form of a checklist of 22 characteristics felt to be risk factors for increased incidence of infections, including alcohol abuse, intravenous drug use, diabetes, and trauma. Only primary infections were classified as the cause of death, contributory to the death, or incidental to the death. Infections secondary to other underlying conditions (e.g., pneumonia secondary to lung cancer or trauma) were not classified as infectious disease deaths. Data from all infectious disease coding sheets completed in 2004 were entered into an Excel spreadsheet and analyzed using SAS version 9.1 (SAS Institute, Inc., Cary, NC), to determine this system's potential utility and make any needed revisions. Statistical analysis included chi-square tests for categorical variables and Wilcoxon rank-sum tests for continuous variables, with p values of 0.05 or less considered statistically significant.

Results

In 2004, 1566 infectious disease coding sheets were completed, representing 80% of the 1949 decedents autopsied at OMI that

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year. For the majority of the cases with sheets completed, (1261/1566, 81%), no infectious disease was suspected or identified. In 241 cases one infectious disease was identified, 58 cases had two infectious diseases identified at autopsy, and for six cases, infectious disease was suspected but not identified. For the 299 cases where an infectious disease was identified, the decedents ranged in age from preterm fetuses to 95 years, with a median age of 44. There were no significant differences in age or gender between those decedents with infectious diseases identified and those without, but there was a significant ($p < 0.0001$) difference in racial/ethnic distribution, with a higher proportion of white Hispanics identified with infectious diseases as compared with deaths with no infectious disease identified (46% vs. 35%), and a lower percentage of American Indians (8% vs. 14%).

In the 95 cases where an infectious disease was identified as a cause of death (rather than contributing to death or being an incidental finding), pneumonia was the most commonly implicated infectious process (47 deaths), followed by sepsis (25 deaths). In 44 of these cases, no infecting organism was reported. *Streptococcus pneumoniae* was isolated in seven deaths classified as having been caused by an infectious disease, *Klebsiella* species in nine deaths, and methicillin-resistant *Staphylococcus aureus* in three deaths. *Mycobacterium tuberculosis, Neisseria meningitidis* and *Pneumocystis carinii* (not related to human immunodeficiency virus infection) were each isolated from one of the 95 infectious-disease caused deaths. Sixteen of the 95 deaths with an infectious disease as the cause of death had two infectious processes identified as causing death. Fourteen of the deaths involved an infectious disease, which is a reportable condition in New Mexico, including invasive *Streptococcus pyogenes*, *S. pneumoniae*, *M. tuberculosis*, and *Vibrio* infections. The New Mexico Department of Health (NMDOH) performed any needed follow-up investigation and intervention related to these infections.

Among the 95 decedents identified as having an infectious disease cause of death, the most commonly cited risk factor was advanced age (>65 years), with 24 decedents, followed by debility (21 decedents), alcoholism (15), and intravenous drug abuse (13). Only 8 (8%) of these 95 decedents were identified as having no risk factors. In 52 cases, an infectious disease was found to have contributed to the death, with the most frequently listed being bronchopneumonia (28 deaths). In 158 cases, the infectious disease was merely an incidental finding with hepatitis C being the most common incidental infectious disease finding (81 deaths).

Discussion

As medical examiners and coroners are often the first to recognize unusual occurrences of infectious diseases, it is imperative that they have a reliable yet streamlined mechanism in place for identifying those cases attributable to infectious diseases, and a method of quickly communicating relevant case information to their local or state health department (2,3). Examining 1 year's worth of infectious disease data from a statewide medical examiner's office, we found 19% of the cases autopsied, for which coding sheets were completed, had evidence of some type of infectious disease. In 15% of cases where an infectious disease was the cause of death, the infection was a notifiable condition in the state of New Mexico, requiring a report to NMDOH and potential public health action. Hepatitis C was the most common incidental infection in our data set. Given the prevalence of this infection amongst intravenous drug abusers, it is not surprising that this infection occurred so frequently in our medical examiner autopsy population (4). Our analysis also revealed that in 2004, 44/95 (46%) of deaths because of infectious diseases did not have an organism identified. Recognition of this fact, along with other factors such as availability of funding for more rigorous diagnostic testing, prompted more aggressive subsequent pursuit of infectious agents in these types of deaths.

The one-page form we evaluated is not the ideal method for infectious disease surveillance; however, the findings, including the number of notifiable conditions and recognition of lack of infectious agent identification, provide a good argument for the necessity of tracking infectious disease deaths and monitoring parameters such as notifiable condition incidence. In addition, given the ongoing threat of the use of infectious agents in bioterrorism, it is crucial that medical examiners and coroners find relevant and timely methods of transmitting infectious disease data to their local and state health departments. In the currently evaluated system, handwritten entries were often nonspecific ("pneumonia" and "sepsis"), and varied from pathologist to pathologist. The same infectious processes and organisms were entered differently each time, highlighting the need for standardization of terminology within the data entry system. In addition, as the data were tracked on handwritten data sheets, the availability for subsequent analysis and for public intervention was limited until the data were entered into an electronic system. We have discontinued the use of these sheets, and now use a more comprehensive computerized surveillance system for infectious diseases called Med-X (5). This computerized surveillance system uses drop-down menus and groups of symptoms and syndromes to more consistently classify infectious disease deaths. Advantages of this system include more standardized data entry, inclusion in the electronic autopsy results for ready access, and an easy-to-use email notification sent to NMDOH epidemiologists, allowing faster and more complete notification. With the previously used tracking sheets, NMDOH personnel often had to wait for completed autopsy reports for relevant infectious disease information. Using an electronic notification system has enhanced the timeliness of reporting notifiable conditions to NMDOH, and OMI is working with NMDOH to evaluate the effectiveness of this notification and its possible reduction in preventing further spread of infections.

As more and more medical examiner and coroner's offices move to electronic databases for housing the results of their investigations and autopsies, it would be advantageous for them to build in some method of flagging infectious disease deaths, given their potential public health significance. It would also be desirable to flag infectious disease deaths as hospital-acquired versus community-acquired infections, given the increasing incidence of unusual pathogens in both health-care settings and the community, including methicillin-resistant *S. aureus* and community-acquired *Clostridium difficile* (6,7). While the sheets we used were not a perfect solution, they did provide useful information and laid the groundwork for later computerized surveillance. Ideally, medical examiners and coroners will be able to work closely with their local and state health departments to determine the most effective method of infectious disease identification and notification, without impinging on the already overburdened schedules of everyone involved.

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