

Carol Conroy,¹ Ph.D., M.P.H. and Julie C. Russell,¹ Ph.D.,
M.P.H.

Medical Examiner/Coroner Records: Uses and Limitations in Occupational Injury Epidemiologic Research

REFERENCE: Conroy, C. and Russell, J. C.. "Medical Examiner/Coroner Records: Uses and Limitations in Occupational Injury Epidemiologic Research," *Journal of Forensic Sciences*, JFSCA, Vol. 35, No. 4, July 1990, pp. 932-937.

ABSTRACT: Epidemiologic research often relies on existing data, collected for nonepidemiologic reasons, to support studies. Data are obtained from hospital records, police reports, labor reports, death certificates, or other sources. Medical examiner/coroner records are, however, not often used in epidemiologic studies. The National Institute for Occupational Safety and Health's Division of Safety Research has begun using these records in its research program on work-related trauma. Because medical examiners and coroners have the legal authority and responsibility to investigate all externally caused deaths, these records can be used in surveillance of these deaths. Another use of these records is to validate cases identified by other case ascertainment methods, such as death certificates. Using medical examiner/coroner records also allows rapid identification of work-related deaths without waiting several years for mortality data from state offices of vital statistics. Finally, the records are an invaluable data source since they contain detailed information on the nature of the injury, external cause of death, and results of toxicologic testing, which is often not available from other sources. This paper illustrates some of the ways that medical examiner/coroner records are a valuable source of information for epidemiologic studies and makes recommendations to improve their usefulness.

KEYWORDS: pathology and biology, epidemiology, injuries, occupational injuries

Epidemiology is the science of determining the occurrence and etiology of disease or injury within a population. The population can be defined in many ways—by geography, time, race, age, or other characteristics such as common exposures (occupational). Epidemiologists use a scientific approach to characterize not only the deceased person, but also the energy agent responsible for death and the environment surrounding the death—including the physical environment as well as the cultural atmosphere. A matrix approach, pioneered by Dr. William Haddon [1] in the early 1970s, can be used to evaluate these factors before the injury event phase, during the injury event phase, and for the postinjury event phase. Depending upon the research questions being asked, epidemiologic methods can be used to describe the injury within the population, identify potential risk factors for injury within the population, determine the etiology of the injury, or even predict who is likely to be injured. This information can then be used to develop intervention techniques aimed at preventing future occupational injuries.

Presented at the 41st Annual Meeting of the Academy of Forensic Sciences, Las Vegas, NV, 13-18 Feb. 1989. Received for publication 26 June 1989; accepted for publication 20 July 1989.

¹Epidemiologists, Division of Safety Research, National Institute for Occupational Safety and Health, Morgantown, WV.

An epidemiologic study is only as good as the data used in the study. Therefore, considerable effort should be undertaken during the design of an epidemiologic study to ensure that the data source providing the best (that is, most valid and comprehensive) data is used. Because injuries are multicausal events—that is, many factors interact to produce an injury—it is necessary to evaluate many different potential risk factors, which may involve using multiple data sources. Common sources are often records which were generated for purposes other than epidemiologic research. Because of this, there are usually limitations when using these sources. Examples of data sources include hospital records (prepared to document medical treatment and patient monitoring), police reports (existing to document liability), labor reports (to document work relatedness), and death certificates (used to document the occurrence of death).

Although medical examiner/coroner records have not been extensively used by epidemiologists, their usefulness is increasingly being realized [2–11]. These studies, however, are often limited to single research questions, such as the prevalence of alcohol or drugs at the time of death or only a single external cause of death.

However, because medical examiner/coroner records cover a defined geographic area, these studies are often population based and can provide information on all deaths (under the jurisdiction of a medical examiner) in that area. Some researchers have addressed the importance of medical examiner/coroner records in epidemiologic surveillance, especially for traumatic deaths [9]. Because medical examiner/coroner records do address all circumstances surrounding a person's death, they are potentially a very useful data source in occupational injury research.

The Division of Safety Research (DSR) of the National Institute for Occupational Safety and Health (NIOSH) has begun to utilize medical examiner/coroner records in its research program on work-related trauma because they contain information not available from other data sources. This paper will highlight some of the DSR uses of medical examiner/coroner reports, address their limitations, and present possible solutions for using these records for occupational injury epidemiologic studies. The primary uses of these records which will be discussed are the following:

- (a) for occupational injury surveillance,
- (b) for validity studies, and
- (c) as a data source.

Occupational Injury Surveillance

Surveillance is defined as the ongoing, systematic collection, analysis, and interpretation of health data needed to plan, implement, and evaluate public health programs [12]. In the context of occupational death surveillance, medical examiner/coroner records have been shown to be superior to death certificates in case ascertainment (identifying work-related deaths). Studies in two different states, Maryland [13] and Oklahoma [14] revealed that using medical examiner/coroner records alone identified 96 and 81%, respectively, of all externally caused occupational deaths identified by multiple sources. This ascertainment was better than death certificates (which identified only 67 to 68% of occupational deaths within the same states). In a separate study in a single county in Pennsylvania, it was found that death certificates only identified 57% of all occupational (including nontraumatic) deaths found by the county coroner during 1979 through 1982 [10]. However, death certificates are commonly used in injury epidemiologic studies and occupational fatality surveillance because they are available through a central state vital statistics agency.

One limitation to using medical examiner/coroner records for case ascertainment is that most states do not computerize their records and, therefore, it requires manual searching and reviewing of each record from different locations within the state to identify

those persons killed at work. However, using medical examiner/coroner records allows more rapid identification of these persons than by using vital statistics data, which often have a delay of two to three years before becoming available. Using medical examiners/coroners to identify deaths for investigation or follow-up can result in very rapid case identification (often immediately after death has occurred). If medical examiner/coroner records were routinely computerized and included a variable identifying whether the death was occupational, this would greatly increase the utility of using these records for occupational fatality surveillance.

When conducting epidemiologic research of occupational fatalities, it is necessary to be able to define the occupation for coding by standard methods (such as Bureau of Census Occupation coding). Some medical examiner/coroner records do not have occupation information, but this limitation can be overcome by matching medical examiner/coroner records to other sources of data, such as workers' compensation records. In a study based on Oklahoma deaths [14], it was noted that the combination of medical examiner/coroner records and workers' compensation records identified 96% of all externally caused occupational deaths, and the workers' compensation records usually contained the most complete and accurate occupation information.

Because the medical examiner or coroner may be the only state official responsible for investigating all work-related traumatic deaths, there may be underreporting of these deaths when using other sources with more limited jurisdiction. For example, a two-year study in a Pennsylvania county showed that only 60% of the deaths investigated by the county coroner were under Occupational Safety and Health Administration (OSHA) jurisdiction [8]. Therefore, using OSHA records to identify work-related deaths would have resulted in undercounting of all occupational deaths. This problem of underreporting when OSHA records are used has also been noted in other studies [13].

States with centralized medical examiner/coroner systems (Arkansas, Connecticut, Delaware, District of Columbia, Iowa, Kentucky, Maine, Maryland, Massachusetts, Mississippi, Montana, New Hampshire, New Jersey, New Mexico, North Carolina, Oklahoma, Oregon, Rhode Island, Tennessee, Utah, Vermont, Virginia, West Virginia)² have the greatest potential for occupational traumatic death surveillance using medical examiner/coroner records. In fact, some of these states (such as North Carolina and New Mexico) currently do have computerized databases containing information from the medical examiner/coroner records. However, even in these states, computer software and coding systems vary, making state comparisons difficult. Also, there is no way to link medical examiner/coroner records easily with other data sources (such as death certificates) because the death certificate number is not always included on the medical examiner/coroner record.

Most states require that all externally caused deaths be referred to the medical examiner/coroner for investigation. However, states which have laws specifying "industrial" or occupational deaths as medical examiner/coroner cases (Arizona, Arkansas, California, Connecticut, Delaware, District of Columbia, Florida, Kentucky, Massachusetts, New Jersey)³ have the greatest potential for comprehensive identification of all occupational deaths. However, without centralized systems, this case ascertainment can only be accomplished through intensive manual record review.

Medical examiner/coroner records are not limited to residents of the state but include all deaths (meeting the criteria for investigation) which occur within the state. This provides information on nonresidents dying within a particular state. However, if a person dies in a state he or she is not a resident of, his death would not be included in medical examiner/coroner records within his state of residence. This is especially important in

²Parrish, R. G. and Ing, R., "Medical Examiner and Coroner Jurisdictions in the United States," Public Health Service, 1988, unpublished document.

³See Footnote 2.

some occupations, such as tractor-trailer truck drivers, who may be killed outside their state of residence.

Medical examiner/coroner records may underestimate the true number of motor vehicle related occupational deaths. This limitation is true also for death certificates. This problem results from the lack of a standard definition for "work related." The death certifier, medical examiner, or coroner may not receive or request information that the decedent was driving during work or while performing work-related tasks. This problem may be resolved by increasing the awareness of medical examiners and coroners on the usefulness of this information and the need to document the occupational nature of motor vehicle related deaths. Furthermore, the forms used by medical examiners/coroners to investigate deaths should specifically record whether the death was work related and whether the decedent was driving as part of his work tasks at the time of death.

Also, although medical examiner/coroner records have been shown to have high sensitivity (identifying true work-related deaths) [11], the specificity (accurate identification of true nonoccupational deaths) of medical examiner/coroner records may not be as high since people who were killed at a work site may be identified as occupational deaths, even though they were not actually performing work-related tasks. One example is in agricultural production, where people are killed on farms while not actually engaged in work-related tasks.

Validity Studies

A second use of medical examiner/coroner records in epidemiologic research is to validate other sources of information. This can include validating case ascertainment as well as data elements. For example, in a DSR study (Fatal Accident Circumstances and Epidemiology Project)⁴ which conducts extensive field investigations of selected work-related deaths, the next-of-kin (usually the spouse) was asked whether the deceased worker drank alcohol or used any drugs prior to the incident. When the answers provided were compared with toxicologic results of the autopsy, there was sometimes disagreement. If the next-of-kin data were used, the proportion of deaths with positive drug or alcohol tests (at the time of death) would have been underestimated. In addition, medical examiner/coroner records often provide quantitative measurement of alcohol or drugs present in the deceased at the time of death, which can be used to determine the level of impairment. Pathologic evidence, such as fatty metamorphosis of the liver, can also be indicative of a history of alcohol use by the decedent.

Data Source

Medical examiner/coroner records may contain very detailed information describing a person's death. For example, a death certificate will list the causes of death and an injury description in short narrative phrases. However, a medical examiner/coroner record will usually explain, if it is known, how the person was injured (external cause) and the nature of injuries ultimately resulting in death. It is possible to describe and code all injuries observed in the investigative or autopsy reports contained in the medical examiner/coroner records. Because not all medical examiner/coroner cases are autopsied, it is important to interpret results from autopsied cases in comparison with nonautopsied cases cautiously because the nature of injuries noted may vary by autopsy status.

Another use of medical examiner/coroner records is to obtain information on alcohol and drug use at the time of death. As previously mentioned, quantitative toxicologic

⁴"Fatal Accident Circumstances and Epidemiology Project," Division of Safety Research, National Institute for Occupational Safety and Health, 1988, unpublished research protocol.

information is typically not available from other data sources. In an unpublished DSR study, 182 medical examiner/coroner cases (45% of all work-related deaths during 1978 through 1982) were tested for alcohol in either blood or vitreous fluid. Only 6% of those tested positive, and only 1% had levels greater than the legal definition of intoxication for the state. This finding that alcohol use was not a contributing factor in the deaths of most of the persons tested could not have been reached by using death certificates.

Because the body rapidly metabolizes alcohol, it is important to know when the injury occurred and the interval between time of injury and time of death. This information is often recorded in medical examiner/coroner records and may be useful in interpreting the results of an alcohol test. Techniques such as testing blood from a hematoma may also be used to determine more accurately the level of blood alcohol at the time of injury, especially if the person survives more than 6 h after injury [15]. This is useful in determining whether alcohol may have contributed to the fatal injury.

Occupational deaths that are delayed and result from the complications of an injury may be missed by the medical examiner or coroner. When there is a lag period between an injury at work and death (for example, in the hospital) the person may not be identified as an occupational death or as a medical examiner/coroner case. Therefore, there may be a bias when using medical examiner/coroner records to evaluate the length of survival after work-related injury.

Medical examiner/coroner records also often identify the county of injury as well as the county of death. This is useful when examining geographic patterns of injury and death. Using only the county of death (which is available from death certificates) may provide misleading results because clusters of deaths in a single county may occur as a result of the location of a trauma center in the county, while the person was actually injured elsewhere. Before identifying high-risk industries within geographic areas, one must know not only where the death occurred but also where the injury occurred.

The occupation and type of industry of the deceased worker should be determined for epidemiologic studies evaluating work-related deaths. One of the primary advantages to using medical examiner/coroner defined occupation is that it reflects what the person was doing at the time of his death. Death certificates only report usual occupation and this may misclassify the decedent's occupation at the time of death [16-18]. For purposes of occupational traumatic fatality surveillance and occupational injury epidemiologic studies, it is important to know the current occupation of the person at the time of death. Furthermore, the medical examiner/coroner record may also describe exactly what the worker was doing when he was injured. This provides more information than simply the occupational title of the person and is especially relevant for persons with more than one job or place of employment.

Conclusion

Medical examiner/coroner records are useful for supporting occupational injury epidemiologic studies. Their usefulness could be further increased by using a standardized investigation form which would collect specific information on whether the injury was work related, the industry and the occupation of the deceased worker, and the work activities resulting in death. Computerizing the records and identifying through a defined variable those deaths which are work related would also increase the usefulness of these records. This may become more common in medical examiner/coroner offices across the country because several database systems are now available commercially. As a result, more epidemiologists will be able to collaborate with medical examiners and coroners and more medical examiner/coroner records will be available to support occupational epidemiologic injury studies. Through the collaboration of professionals from these different disciplines, it will be possible to understand better the etiology of work-related

deaths, predict who is likely to be injured at work, and progress toward preventing occupational traumatic deaths.

References

- [1] Haddon, W. "A Logical Framework for Categorizing Highway Safety Phenomena and Activity." *Journal of Trauma*, Vol. 12, 1972, p. 193.
- [2] Berkelman, R. L., Herndon, J. L., Calloway, J. L., Stivers, R., Howard, L. B., et al., "Fatal Injuries and Alcohol." *American Journal of Preventative Medicine*, Vol. 1, 1985, pp. 21-28.
- [3] Mason, J. P. and McBay, A. J., "Ethanol, Marijuana, and Other Drug Use in 600 Drivers Killed in Single Vehicle Crashes in North Carolina 1978-81," *Journal of Forensic Sciences*, Vol. 29, No. 4, Oct. 1984, pp. 987-1026.
- [4] Blaser, M. J., Jason, J. M., Weninger, B. G., Elsea, W. R., Finton, R. J., et al., "Epidemiologic Analysis of a Cluster of Homicides of Children in Atlanta," *Journal of the American Medical Association*, Vol. 251, 1984, pp. 3255-3258.
- [5] Goodman, R. A., Mercy, J. A., Loya, F., et al., "Alcohol Use and Interpersonal Violence: Alcohol Detected in Homicide Victims." *American Journal of Public Health*, Vol. 76, 1986, pp. 144-149.
- [6] Atkinson, M. W., Kessel, N., and Dalgaard, J. B., "The Comparability of Suicide Rates," *British Journal of Psychiatry*, Vol. 127, 1975, pp. 247-256.
- [7] Copeland, A. R., "Non-Vehicular Accidents Among Teenagers—The 5-year Metro Dade County Experience From 1979 to 1983," *Forensic Science International*, Vol. 27, 1985, pp. 221-227.
- [8] Parkinson, D. K., Gauss, W. F., Perper, J. A., and Elliott, S. A., "Traumatic Workplace Deaths in Allegheny County, Pennsylvania, 1983 and 1984," *Journal of Occupational Medicine*, Vol. 28, 1986, pp. 100-102.
- [9] Graitcer, P. L., Williams, W. W., Finton, R. J., Goodman, R. A., Thackes, S. B., et al., "An Evaluation of the Use of Medical Examiner Data for Epidemiologic Surveillance," *American Journal of Public Health*, Vol. 77, 1987, pp. 1212-1214.
- [10] Robinson, C. C., Kuller, L. H., and Perper, J., "An Epidemiologic Study of Sudden Death at Work in an Industrial County 1979-1982," *American Journal of Epidemiology*, Vol. 128, 1988, pp. 806-820.
- [11] Davis, H., Honchar, P. A., and Suarez, L., "Fatal Occupational Injuries of Women, Texas 1975-1984," *American Journal of Public Health*, Vol. 77, 1987, pp. 1524-1527.
- [12] Graitcer, P. L., "The Development of State and Local Injury Surveillance Systems," *Journal of Safety Research*, Vol. 18, 1987, pp. 191-198.
- [13] Baker, S. P., Samkoff, J. S., Fisher, R. S., and Van Buren, C. B., "Fatal Occupational Injuries," *Journal of the American Medical Association*, Vol. 248, 1982, pp. 692-697.
- [14] Russell, J. C., "Comparison of Four Sources of Occupational Mortality Data," Ph.D. dissertation, University of Oklahoma, Oklahoma City, OK, 1989.
- [15] Spitz, W. U. and Fisher, R. S., *Medicolegal Investigation of Death—Guidelines for the Application of Pathology to Crime Investigation*, Charles C Thomas, Springfield, IL, 1977.
- [16] Kraus, J. F., "Homicide While at Work: Persons, Industries, and Occupations at High Risk," *American Journal of Public Health*, Vol. 77, 1987, pp. 1285-1289.
- [17] Steenland, K. and Beaumont, J., "The Accuracy of Occupation and Industry Data on Death Certificates," *Journal of Occupational Medicine*, Vol. 26, 1985, pp. 288-296.
- [18] Illis, W. R., Swanson, M., Satariano, E. R., and Schwartz, A. G., "Summary Measures of Occupational History: A Comparison of Latest Occupation and Industry with Usual Occupation and Industry," *American Journal of Public Health*, Vol. 77, 1987, pp. 1532-1534.

Address requests for reprints or additional information to
 Dr. Carol Conroy
 Division of Safety Research
 National Institute for Occupational Safety and Health
 944 Chestnut Ridge Road
 Morgantown, WV 26505