Methodological Issues in the Surveillance of Poisoning, Illicit Drug Overdose, and Heroin Overdose Deaths in New Mexico

Michael G. Landen1, Stuart Castle1, Kurt B. Nolte2, Mary Gonzales3, Luis G. Escobedo4, Barbara F. Chatterjee1, Karen Johnson1, and C. Mack Sewell1

1 Office of Epidemiology, New Mexico Department of Health, Santa Fe, NM.
2 Office of the Medical Investigator, University of New Mexico School of Medicine, Albuquerque, NM.
3 Office of Vital Records and Health Statistics, New Mexico Department of Health, Santa Fe, NM.
4 Public Health Division, District III, New Mexico Department of Health, Las Cruces, NM.

Received for publication February 12, 2002; accepted for publication August 28, 2002.

New Mexico leads the nation in poisoning mortality, which has increased during the 1990s in New Mexico and the United States. Most of this increase has been due to unintentional deaths from illicit drug overdoses. Medical examiner and/or vital statistics data have been used to track poisoning deaths. In this study, the authors linked medical examiner and vital statistics records on underlying cause of death, coded using the International Classification of Diseases, Ninth Revision, to assess the extent to which these data sources agreed with respect to poisoning deaths. The authors used multiple-cause files, which are files with several causes listed for each death, to further assess poisoning deaths involving more than one drug. Using vital statistics or medical examiner records, 94.7% of poisoning deaths were captured by each source alone. For unintentional illicit drug and heroin overdose deaths, each data source alone captured smaller percentages of deaths. Deaths coded as E858.8 (unintentional poisoning due to other drugs) require linkage with medical examiner or multiple-cause records, because this code identifies a significant percentage of illicit drug overdose deaths but obscures the specific drug(s) involved. Surveillance of poisoning death should include the use of medical examiner records and underlying- and multiple-cause vital statistics records.

cause of death; coroners and medical examiners; heroin; mortality; overdose; poisoning; population surveillance; vital statistics

Abbreviations: ICD, International Classification of Diseases; NCHS, National Center for Health Statistics; OMI, Office of the Medical Investigator.

In 1998, New Mexico had the highest rate of poisoning mortality in the United States. While it was noted as a problem during the 1980s (1), poisoning mortality has dramatically increased since 1989, overtaking firearm injury death as the second major cause of injury death in New Mexico. Additionally, poisoning is one of the few categories of injury death in New Mexico, the United States, and other developed countries (2) that showed a notable rate increase during the 1990s.

Several different data sources are available for surveillance of poisoning mortality. A review of US poisoning deaths using National Center for Health Statistics (NCHS) mortality records from 1985–1995 showed that poisoning mortality had increased 25 percent during that time period, with over 18,000 such deaths in 1995 (3). Approximately three fourths of these deaths were poisonings caused by illicit drugs. Multiple-cause-of-death records were used and showed that rates of death from opiates and cocaine doubled from 1990 to 1995 among males aged 35–54 years. More recently, heroin overdose deaths in Multnomah County, Oregon, during 1993–1999 and unintentional opiate overdose deaths in King County, Washington, during 1990–1999 were assessed using medical examiner records (4, 5). The number of deaths in each county doubled during the respective time periods. While the national NCHS study and the two local medical examiner studies used different data

Correspondence to Michael G. Landen, Office of Epidemiology, New Mexico Department of Health, 1190 St. Francis Drive, N 1350, P.O. Box 26110, Santa Fe, NM 87502-6110 (e-mail: michaell@doh.state.nm.us).
sources, their conclusions regarding the prominence of poisonings caused by illicit drugs were similar. Poison control center reports, another source of poisoning data, capture only 5 percent of poisoning deaths and thus are not considered critical to surveillance of poisoning mortality (6).

Because poisoning is not a homogeneous category and involves agents as diverse as carbon monoxide, alcohol, prescription drugs, and drugs of abuse such as heroin and cocaine, surveillance of specific subcategories of poisoning mortality, such as illicit drug overdose, is also needed. The ideal approach to poisoning mortality surveillance has not been determined, and it may depend on the quality and availability of databases (7, 8). While several studies have suggested that medical examiner records do not capture an adequate percentage of poisoning and injury deaths (9, 10), the centralized medical examiner system in New Mexico has captured most injury deaths in prior studies (11). New Mexico’s centralized medical examiner system probably captures a greater percentage of injury deaths than noncentralized medical examiner or coroner-based systems. To determine the benefits of using vital statistics records and/or medical examiner records to describe and enumerate poisoning deaths, including important subcategories, we linked and analyzed poisoning deaths from both data sources for the state of New Mexico.

MATERIALS AND METHODS

Data sources

Vital statistics mortality records. New Mexico’s Certificate of Death includes the two-part cause-of-death section recommended by the World Health Organization, as well as information on manner of death and when, where, and how an injury occurred. These items are also included on the US Standard Certificate of Death, as defined by the NCHS. In part I of the Certificate of Death, the cause-of-death sequence is listed, beginning with the immediate cause and ending with the underlying cause. In part II, other significant medical conditions contributing to death are listed. New Mexico’s Office of Vital Records and Health Statistics employs nosologists trained by the NCHS to code the underlying cause of death. The methodology for assigning the underlying-cause code is based on the World Health Organization’s International Classification of Diseases (ICD). Between 1979 and 1998, the United States used the Ninth Revision of the ICD (ICD-9) to assign cause-of-death codes.

Medical examiner records. Records of the New Mexico Office of the Medical Investigator (OMI) were also used to identify poisoning deaths. The OMI is authorized to investigate all deaths in New Mexico that are sudden, unexplained, suspicious, violent, or unattended, with the exception of those that occur within certain tribal and federal jurisdictions (i.e., Indian reservations and military installations). However, the OMI is frequently invited to investigate those deaths as well. For all deaths suspected of being due to the effect of drugs, toxins, or poisons, a full autopsy and toxicologic evaluation is carried out. Toxicologic support for the OMI is provided by the Toxicology Bureau of the New Mexico Scientific Laboratory Division. OMI pathologists consult with the toxicologists of the Scientific Laboratory Division in case evaluations. All toxic substances identified through screening tests receive confirmatory testing (e.g., gas chromatography or mass spectrometry). When individuals die from toxic substances after a period of hospitalization, the OMI procures antemortem specimens from the health care facility for toxicologic testing.

Definitions

The following definitions were used in this report for the three categories of poisoning death involving New Mexico residents found in the vital statistics mortality files: Poisoning deaths were those with an underlying-cause ICD-9 classification of 305, E850–E869, E950–E952, E962, or E980–E982; unintentional illicit drug overdose deaths were those with an underlying-cause ICD-9 classification of E850.0, E854.2, E855.2, and/or E858.8; and unintentional heroin overdose deaths were those with an underlying-cause ICD-9 classification of E850.0 and/or E858.8. The two poisoning subcategories were chosen because they make up a major portion of poisoning deaths.

Specific poisoning deaths were coded in the following manner based on the ICD-9 classification. The underlying cause of death was coded as nondependent abuse of drugs, 305, if the descriptive words “use” or “abuse” were listed on the death certificate. The underlying cause of death was coded with an external-cause code (E-code) if the descriptive words “overdose,” “intoxication,” “toxicity,” or “poisoning” were reported.

When a poisoning death due to multiple drugs was reported, the following rules applied. If a single drug was reported in part I of the death certificate with a combination of drugs reported in part II, the underlying cause of death was coded as the drug reported in part I. If multiple drugs were reported in part I but all of the drugs were of the same type, the underlying cause was coded as the specific drug type (e.g., codeine, heroin, and morphine, which are all opiates, were coded as “poisoning by opiates and other related narcotics,” with these specific codes based on intent: accident, E850.0; suicide, E950.0; homicide, E962.0; or undetermined, E980.0). If multiple drugs were reported in part I but the drugs were of different types (e.g., opiates and barbiturates), the underlying cause of death was coded as “poisoning by exposure to other drugs” (accident, E858.8; suicide, E980.4 and E950.5; homicide, E962.0; or undetermined, E980.4 and E980.5), because a single type of drug could not be identified as the type causing the death.

If a combination of drug(s) and alcohol was reported, alcohol was not assumed to be the underlying cause of death; the underlying cause of death was coded according to the drug(s), following the selection rules listed above. Poisoning death was attributed to alcohol if alcohol was the only substance mentioned in part I. When a natural condition was reported in part I (immediate cause) and a drug was reported in part II (other significant conditions), the natural condition was coded as the underlying cause unless the natural condition in part I was a direct sequel of use of the drug.
Poisoning deaths were retrieved from the computerized OMI database using Manner of Death codes for three categories of poisoning death: poisoning, unintentional illicit drug overdose, and unintentional heroin overdose. These codes were developed by the OMI to facilitate data retrieval and are assigned by investigators while entering death certificate information developed by pathologists. For each unnatural manner of death (homicide, suicide, accident), these codes depict the array of potential circumstances resulting in death (e.g., A30 = ingested and/or injected illicit drugs).

**Surveillance data linkage**

All poisoning deaths occurring during 1995–1998 that were listed in the vital statistics mortality files, including out-of-state deaths of New Mexico residents, were linked manually in a deterministic manner to all poisoning deaths in the OMI database. For each decedent, date of death was matched first, then age, sex, race/ethnicity, and name. After exact matches were completed, additional matches were made allowing for a difference in date of death of 1 day, for a difference in age of 1 year, and for slight differences in spellings of the decedent’s name. For poisoning deaths in the vital statistics mortality file that were not matched with an OMI poisoning death, the entire OMI database was searched in a manner similar to that described above to find a match with a nonpoisoning death. For poisoning deaths in the OMI database that were not matched with a vital statistics poisoning death, the entire vital statistics mortality file was searched in a manner similar to that described above to find a match with a nonpoisoning death. This resulting linked database included all poisoning-to-poisoning matched records, poisoning-to-nonpoisoning matched records, and unmatched poisoning records from both the vital statistics mortality file and the OMI database. Thus, this database permitted assessment of the extent to which OMI and vital statistics data agreed with respect to poisoning deaths.

**Statistical methods**

Using vital statistics mortality files, we first analyzed deaths of New Mexico residents for overall poisoning and for two important subcategories: unintentional illicit drug overdose death and unintentional heroin overdose death. Rates for each category of death for 1989–1998 for New Mexico were determined and compared with US rates. Deaths were further characterized for the period 1995–1998 by age group, sex, race/ethnicity, and intent for the overall poisoning category. Sex- and race/ethnicity-specific death rates, as well as the rates used for New Mexico and US trends, were age-adjusted to the 1940 US standard population. Denominators for calculation of rates were intercensal estimates or census data from the corresponding single- or multiple-year time period for a particular population.

From the linked database, we utilized four approaches to define poisoning, unintentional illicit drug overdose, and unintentional heroin overdose deaths. These four approaches used 1) deaths from vital statistics mortality records only, 2) deaths from OMI database records only, 3) deaths included in both vital statistics poisoning records and OMI poisoning records, or 4) deaths included in either vital statistics poisoning records or OMI poisoning records. Resulting characteristics and numbers of deaths determined by each of these four approaches for the overall category and the two subcategories of poisoning death were compared.

The state of New Mexico does not currently maintain mortality files with multiple-cause-of-death coding. Therefore, record axis multiple-cause codes from NCHS multiple-cause mortality files for 1995–1998, the codes that are the basis for NCHS core multiple-cause tabulations, were used for New Mexico and the United States to further examine vital statistics coding for code E858.8 (poisoning by exposure to other drugs), since this code captures unintentional poisoning deaths attributed to more than one drug. Record axis multiple-cause codes are the set of codes that best describe the overall medical certification portion of the death certificate. For those deaths coded with an underlying cause of E858.8, subsequent codes in the multiple-cause records were reviewed to determine whether these deaths were also assigned any of the following codes: 965.0 (poisoning by opiates and related narcotics), 968.5 (surface and infiltration anesthetics, including cocaine), or 969.7 (psychostimulants, including amphetamines).

**RESULTS**

New Mexico mortality rates for poisoning, unintentional illicit drug overdose, and unintentional heroin overdose were all substantially higher than the US poisoning mortality rate after 1993 (figure 1). The highest age-specific rate of poisoning mortality for New Mexico during 1995–1998 was in the age group 35–44 years (33.5 deaths/100,000 person-years), followed by the age group 25–34 years (28.1 deaths/100,000 person-years). White Hispanics had the highest death rates for poisoning (20.8 deaths/100,000 person-years), followed by White non-Hispanics (12.5 deaths/100,000 person-years). Native Americans had the lowest rate (8.1 deaths/100,000 person-years). Male death rates (22.2 deaths/100,000 person-years) were nearly three times higher than female death rates (7.8 deaths/100,000 person-years). With respect to intent, 78.3 percent of poisoning deaths were unintentional, 21.2 percent of poisoning deaths were suicides, 0.3 percent were homicides, and 0.2 percent were undetermined.

Of the four approaches, using records from either vital statistics or OMI databases captured the most poisoning deaths and captured 5.4 percent more poisoning deaths than using records from either database alone (table 1). Compared with using poisoning deaths from either source, using vital statistics mortality files alone or using OMI files alone each included most deaths (94.7 percent for each). Poisoning deaths increased according to all four approaches each year from 1996 to 1998. One of the major differences between databases was that vital statistics mortality records, unlike the medical examiner records, captured New Mexico residents who died in another state—24 deaths over a 4-year period.

For determination of unintentional illicit drug overdose deaths, large differences were found when the code E858.8 (unintentional poisoning by other drugs) was included as
opposed to excluded (table 2). When code E858.8 was included in the definition, vital statistics files captured 95.2 percent of the unintentional illicit drug overdose deaths captured by either database, while the OMI database captured 82.2 percent. When the E858.8 code was excluded, the vital statistics files captured 70.6 percent of unintentional illicit drug overdose deaths captured by either database. Seventy-two percent of vital statistics mortality file deaths with an underlying cause of E858.8 were matched to a death in the OMI database with a specific drug code for morphine, cocaine, and/or methamphetamine.

For determination of unintentional heroin overdose deaths, large differences were found when the E858.8 code was included versus excluded (table 3). Of vital statistics mortality file deaths with an underlying-cause code of E858.8, 55.6 percent were matched to a death in the OMI database with a Manner of Death code for an illicit drug overdose death and a drug code for morphine.

Many poisoning deaths found in the vital statistics mortality file were not classified as poisoning deaths in the OMI database. Twenty-four of these deaths occurred out-of-state and were not further reviewed. Of the remaining 35 deaths, 13 (37.1 percent) were not reported to the OMI. Fifteen deaths (42.8 percent) were coded in the OMI database as natural deaths due to diseases such as cirrhosis, sepsis, and heart disease but were attributed to nondependent abuse of drugs (ICD-9 code 305) in the vital statistics files. Two deaths were mistakenly coded as nonpoisoning deaths in the OMI database. Of the remaining deaths, three poisoning deaths of undetermined manner in vital statistics files were not classified as poisonings of undetermined manner in the medical examiner files, and two poisoning deaths were classified as unintentional injury deaths of unspecified cause in the OMI database.

Of 59 deaths classified as poisoning deaths in the OMI database and not classified as poisoning deaths in the vital statistics mortality files, four (6.8 percent) were not found in the vital statistics mortality files, one had a revised death certificate from the OMI that did not get recoded in vital statistics, 17 (28.8 percent) were coded as other injury deaths, and 37 (62.7 percent) were coded as natural deaths in the vital statistics mortality files. These 37 deaths typically had a specific reference to poisoning in part II of the death certificate but not in part I. Of those classified as other injury deaths, six were fire-related unintentional deaths and one was a fire-related suicide. Of the natural deaths, 16 (43.2 percent) were coded with ICD-9 codes of 420–429 (other diseases of the heart).

**TABLE 1.** Poisoning deaths among New Mexico residents according to vital statistics files, the database of the New Mexico Office of the Medical Investigator, both sources, and either source, New Mexico, 1995–1998

<table>
<thead>
<tr>
<th>Year</th>
<th>VS only</th>
<th>OMI only</th>
<th>VS and OMI</th>
<th>VS or OMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>243</td>
<td>237</td>
<td>225</td>
<td>255</td>
</tr>
<tr>
<td>1996</td>
<td>235</td>
<td>238</td>
<td>224</td>
<td>249</td>
</tr>
<tr>
<td>1997</td>
<td>271</td>
<td>272</td>
<td>254</td>
<td>289</td>
</tr>
<tr>
<td>1998</td>
<td>297</td>
<td>299</td>
<td>284</td>
<td>312</td>
</tr>
<tr>
<td>Total no.</td>
<td>1,046</td>
<td>1,046</td>
<td>987</td>
<td>1,105</td>
</tr>
<tr>
<td>Total %</td>
<td>94.7</td>
<td>94.7</td>
<td>89.3</td>
<td></td>
</tr>
</tbody>
</table>

* VS, vital statistics; OMI, Office of the Medical Investigator.

**FIGURE 1.** Rates of poisoning death in the United States and New Mexico, 1989–1998. Data were age-adjusted to the 1940 US population.

**Multiple-cause codes**

When multiple-cause codes were used in addition to the underlying cause, 90 percent of New Mexico resident deaths...
with an underlying-cause code of E858.8 (unintentional poisoning by other drugs) had an additional code of 965.0 (poisoning by opiates and related narcotics), 968.5 (surface and infiltration anesthetics, including cocaine), and/or 969.7 (psychostimulants, including amphetamines). Eighty-eight percent of US deaths with an underlying-cause code of E858.8 also had at least one of these three multiple-cause codes. Eighty-five percent of New Mexico resident deaths with an underlying cause of E858.8 had a record axis multiple-cause code of 965.0, while 83 percent of US deaths met the same condition.

**DISCUSSION**

Poisoning death is a broad category encompassing deaths caused by many different substances. There are several practical approaches to surveillance of poisoning deaths, including the use of medical examiner data, vital statistics underlying-cause data, and vital statistics multiple-cause data. Using New Mexico data, we were able to utilize all three of these types of data in determining the best approach to surveillance of poisoning deaths.

The ideal surveillance approach to poisoning death includes all three types of data. Centralized medical examiner systems, like the New Mexico OMI, provide timely reporting of in-state poisoning deaths (typically within 3 months of death in New Mexico) and specific descriptions of toxicology results. In New Mexico, 24 poisoning deaths among New Mexico residents occurred in another state; these deaths were only captured in vital statistics data. While underlying-cause vital statistics data in New Mexico provided less timely reporting of deaths (data were typically available within 1 year after the end of a given calendar year), classification was more consistent with explicit rules for coding different death certificate descriptions of a poisoning death. For New Mexico, public-use multiple-cause data are available from the NCHS approximately 2 years after the end of a given calendar year, and these data provide specific substance-related coding for those deaths coded with an underlying cause of E858.8. Because the percentage of deaths with an underlying-cause code of E858.8 that are poisonings due completely or partly to an illicit drug may vary from year to year, it is important to track this percentage. Ideally, all three of these types of data would be linked. In New Mexico, we were able to link medical examiner records with underlying-cause vital statistics data and vital statistics multiple-cause data. Because the multiple-cause data came from an NCHS file without identifiers, these records were not linked.

While vital statistics or medical examiner data in New Mexico captured the vast majority (94.7 percent) of poisoning deaths among New Mexico residents, each database alone did less well when enumerating unintentional illicit drug overdose or unintentional heroin overdose deaths. This deficit with respect to enumerating these two important

| TABLE 2. Unintentional illicit drug overdose deaths among New Mexico residents, with and without deaths coded E858.8, from vital statistics files, the database of the New Mexico Office of the Medical Investigator, both sources, and either source, New Mexico, 1995–1998 |
|---|---|---|---|---|
| | VS* only | OMI* only | VS and OMI | VS or OMI |
| 1995 | 131 | 120 | 113 | 138 |
| 1996 | 131 | 115 | 105 | 141 |
| 1997 | 144 | 118 | 110 | 151 |
| 1998 | 203 | 173 | 166 | 210 |
| Total no. | 609 | 526 | 494 | 640 |
| Total % | 95.2 | 82.2 | 77.2 |

* ICD-9, International Classification of Diseases, Ninth Revision; VS, vital statistics; OMI, Office of the Medical Investigator. Includes ICD-9* code E858.8 Excludes ICD-9 code E858.8

| TABLE 3. Unintentional heroin overdose deaths among New Mexico residents, with and without deaths coded E858.8, from vital statistics files, the database of the New Mexico Office of the Medical Investigator, both sources, and either source, New Mexico, 1995–1998 |
|---|---|---|---|---|
| | VS* only | OMI* only | VS and OMI | VS or OMI |
| 1995 | 120 | 91 | 86 | 120 |
| 1996 | 113 | 79 | 77 | 113 |
| 1997 | 118 | 75 | 73 | 118 |
| 1998 | 186 | 115 | 115 | 186 |
| Total no. | 537 | 360 | 351 | 537 |
| Total % | 100 | 67.0 | 65.4 |

* ICD-9, International Classification of Diseases, Ninth Revision; VS, vital statistics; OMI, Office of the Medical Investigator.
subcategories of poisoning is associated with the ICD-9 code E858.8 (unintentional poisoning and exposure to other unspecified drugs), under which unintentional poisoning deaths involving multiple substances are coded. The majority of these deaths in New Mexico and the United States involve illicit drugs (90 percent and 88 percent, respectively) and opiates (85 percent and 83 percent, respectively) when multiple causes are reviewed. However, a significant proportion of deaths coded with E858.8 (10–12 percent) are not due to illicit drugs.

Code E858.8 should be included in definitions of unintentional overdose deaths due to illicit drugs and heroin, since over 80 percent of these deaths were attributed to at least one illicit substance. The unintentional illicit drug overdose death category should be made up of codes E850.0 (opiates and related narcotics), E854.2 (psychostimulants—amphetamines and caffeine), E855.2 (local anesthetics—cocaine, lidocaine, procaine, and tetracaine), and E858.8.

This study had several limitations. Because NCHS files were used for multiple-cause-of-death analyses, we were unable to link the medical examiner–underlying-cause linked records to the multiple-cause records. In states that maintain their own multiple-cause data, this linkage would be accomplished almost automatically, since underlying-cause and multiple-cause data would probably be in the same record. Secondly, this study was completed using 1995–1998 data that relied on ICD-9 coding. The Tenth Revision of the ICD (ICD-10) is now being used, starting with 1999 mortality data, and a similar study evaluating the linkage of ICD-10 underlying-cause codes with medical examiner data will be necessary.

Surveillance of poisoning mortality is a complex endeavor that should utilize most available tools. This surveillance effort must be timely, complete, and consistent, which requires the use of medical examiner data, vital statistics underlying-cause data, and vital statistics multiple-cause data. The lack of more specific codes in both the ICD-9 and the ICD-10 precludes perfect correspondence between unintentional heroin overdose deaths and a specific code, yet unintentional heroin overdose death and illicit drug overdose death are major reasons why poisoning is one of the few categories of injury death with increasing rates in both New Mexico and the United States. Continued improvements in the surveillance of poisoning death, specifically unintentional poisoning due to illicit drugs and to heroin, are needed if this serious and complex health problem is to be adequately tracked.

REFERENCES