

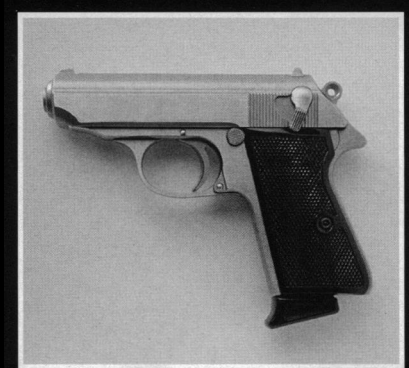
Public Health Quiz

HOW MUCH DO YOU KNOW?

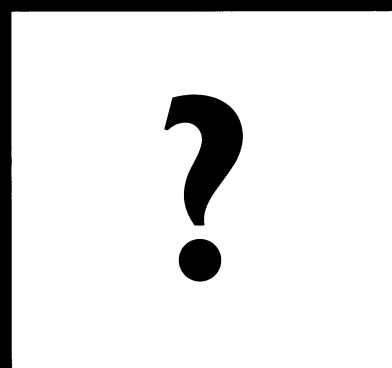
What is the third leading cause of injury mortality?



1



2



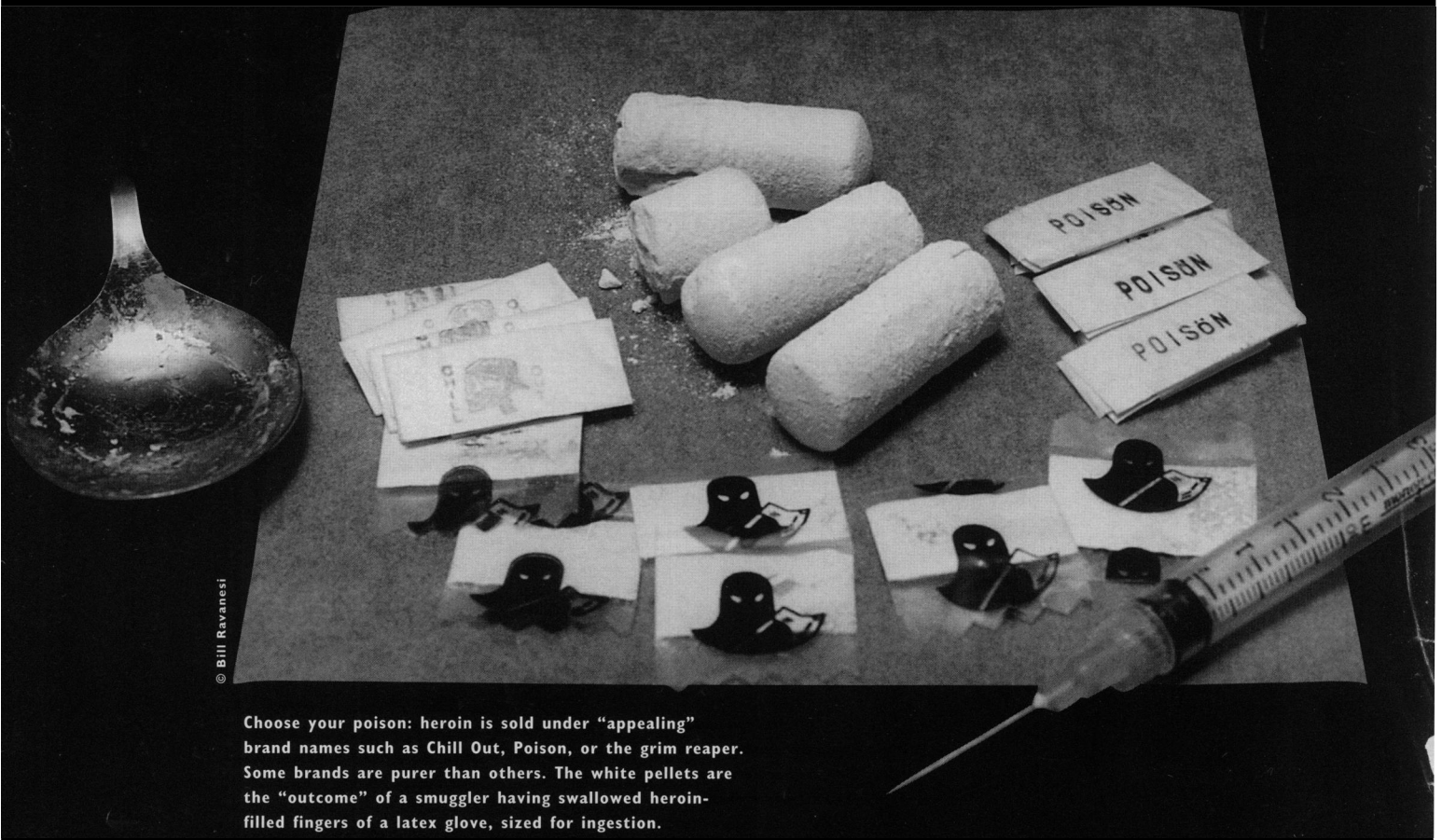
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HINT: As many as 18,549 died from this underlying cause of death in 1995, and it was the leading cause of injury death for people ages 35 to 44.

ANSWER: Turn the page.

POISONING

MORTALITY



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Choose your poison: heroin is sold under "appealing" brand names such as Chill Out, Poison, or the grim reaper. Some brands are purer than others. The white pellets are the "outcome" of a smuggler having swallowed heroin-filled fingers of a latex glove, sized for ingestion.

Lois A. Fingerhut, MA
Christine S. Cox, MA

1985–1995

WHILE THE TOLL taken by motor vehicle and firearm injuries—the two leading causes of injury mortality¹—has been reported extensively in the literature, the third leading cause—poisoning—often goes unnoted. Mortality from this third cause has increased 25% in the last decade, and it claimed the lives of as many as 18,549 people in 1995 (Figure 1).

A detailed analysis of poisoning mortality data from the National Center for Health Statistics (NCHS), the public health agency responsible for collecting and tabulating national vital statistics, reveals that poisoning deaths most often resulted from drugs and somewhat less often from the inhalation of toxic fumes or alcohol binge drinking. In most cases, poisoning deaths were unintentional, although a substantial number were suicides. About three-fourths of poisoning deaths in 1995 were attributable to drugs—including opiates and cocaine. Among men, the age-adjusted drug-related poisoning death rate increased from 3.7 per 100,000 in 1985 to 7.2 per 100,000 in 1995.

In this paper, we report on our analysis of poisoning mortality in the United States in 1995 and trends in poisoning mortality over the decade from the mid-1980s to the mid-1990s. We will (a) explain how we have defined poisoning deaths, (b) summarize age-, sex-, cause-specific, and geographic patterns of deaths for which poisoning was reported as the underlying cause, (c) report trends in poisoning mortality for 1985–1995, and (d) discuss why a thorough understanding of the causes of poisoning mortality must take account of more than the underlying causes of poisoning deaths.

Several articles dealing with aspects of poisoning mortality have been published in the scientific literature; none, however, offers a comprehensive pic-

SYNOPSIS

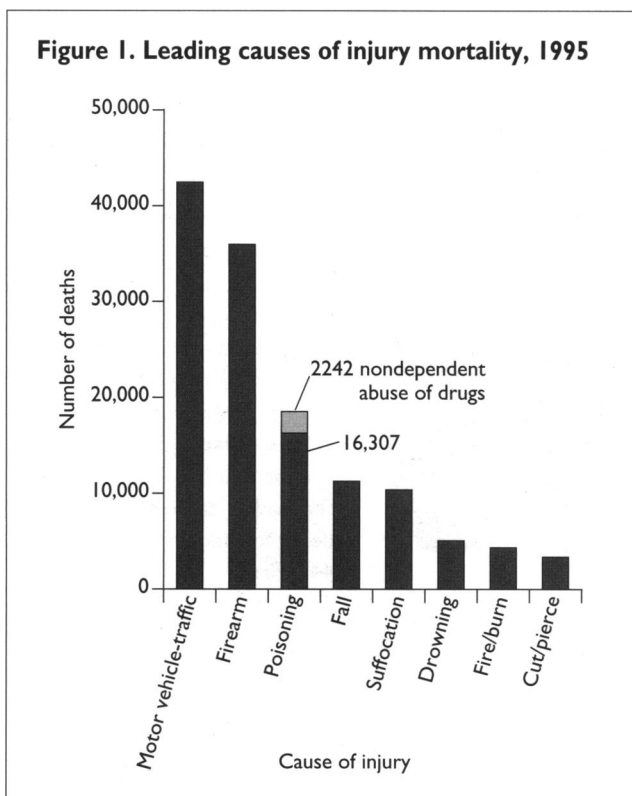
POISONING WAS REPORTED as the underlying cause of death for 18,549 people in the United States in 1995 and was ranked as the third leading cause of injury mortality, following deaths from motor vehicle traffic injuries and firearm injuries. Poisoning was the leading cause of injury death for people ages 35 to 44 years.

Poisoning death rates were higher in 1995 than in any previous year since at least 1979. From 1990 to 1995, the age-adjusted rate of death from poisoning increased 25%; all of the increase was associated with drugs.

About three-fourths of poisoning deaths (77%) in 1995 were caused by drugs. The age-adjusted rate of drug-related poisoning deaths for males (7.2 per 100,000) in 1995 was more than twice that for females (3.0 per 100,000).

From 1985 to 1995, poisoning death rates for males ages 35–54 years nearly doubled to 20.4 per 100,000, and the drug-related poisoning death rate for males ages 35–54 years nearly tripled, reaching 16.1 per 100,000. From 1990 to 1995, death rates associated with opiates and cocaine more than doubled among males ages 35–54 years. The numbers of opiate and cocaine poisoning deaths for 1995 more than doubled when all multiple cause of death codes were examined instead of only the underlying cause of death codes.

Figure 1. Leading causes of injury mortality, 1995



ture. For example, Annest and Pollock examined unintentional poisoning in detail for 1980–1986;² Olson et al. looked at poisoning mortality in New Mexico, focusing on “racial” and ethnic differences in childhood poisoning deaths;³ Wysowski et al. analyzed mortality associated with the misuse of psychoactive drugs;⁴ and Moolenaar et al. analyzed trends in unintentional carbon monoxide poisoning in New Mexico.⁵

In accord with the recommendations of the new framework for presenting injury mortality data,⁶ this paper presents the first analysis focusing on all poisonings, including all categories of cause and intent, in order to highlight how significant a public health problem poisoning mortality has become.

CODING AND CLASSIFICATION OF DEATH BY POISONING

Death certificates are the source of information on causes of death in the United States. Causes of death are reported on death certificates by physicians, medical examiners, or coroners. Information contained on death certificates filed in the 50 states and the District of Columbia is forwarded to the National Center for Health Statistics (NCHS).⁷

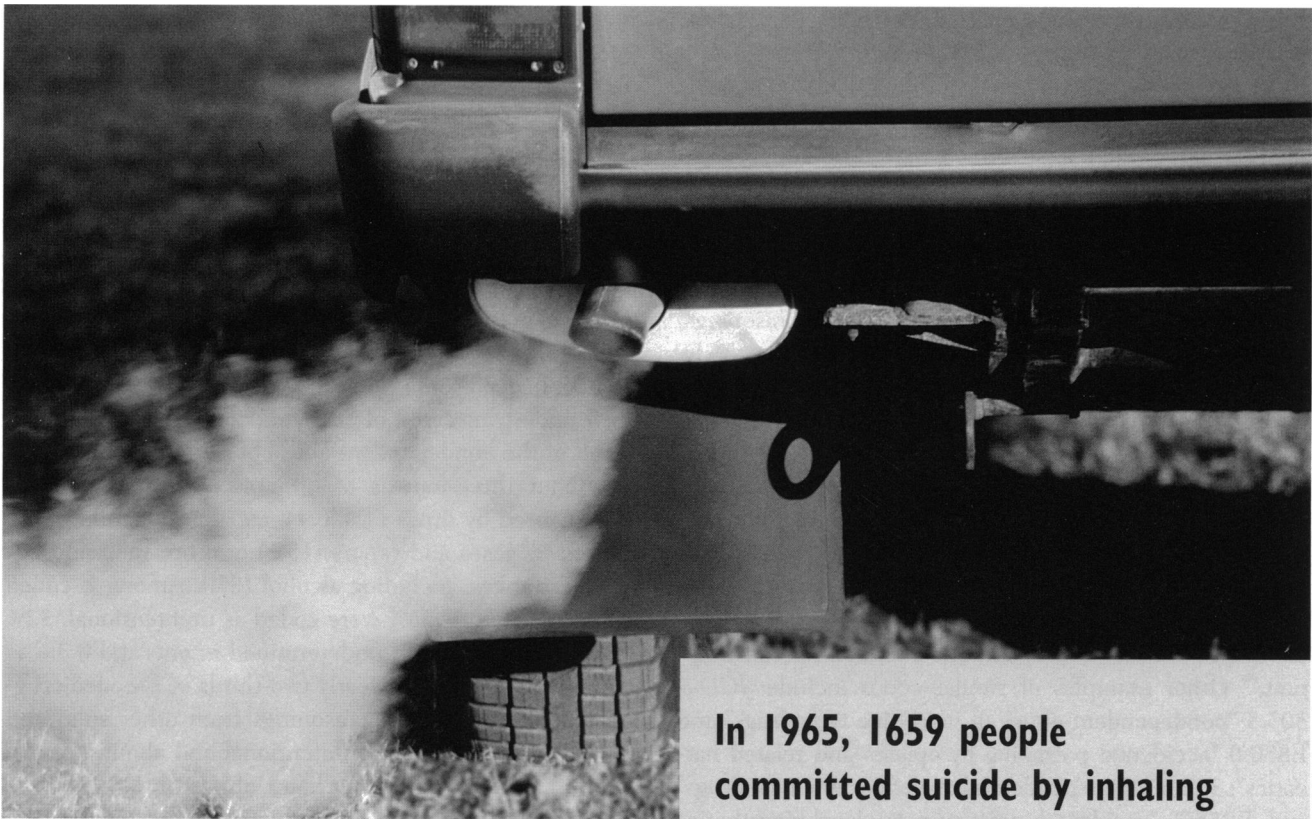
The cause of death information is coded and classified according to the rules of the *International Classification of Diseases (ICD)*. The ninth revision of the *ICD (ICD-9)*⁸ has been used since 1979; the tenth revision will be implemented in 1999.

Up to 20 causes of death, if reported, can be coded from a single death certificate. Taken together, the codes listed on a death certificate are known as the multiple cause of death codes. The multiple cause of death codes have been shown to be an important epidemiologic tool in injury research because they provide information on both the external cause of the injury and the associated medical diagnosis or diagnoses.^{9,10} External cause of death codes and diagnosis codes can only be found on the NCHS multiple cause of death data tapes.¹¹

The categorization of poisoning and other injury deaths in *ICD-9* is unique—different from the categorization of other causes of death—in that there are two sets of codes for classifying poisoning deaths: the external cause of death codes (E-codes) and the diagnosis codes. The codes for external causes of poisoning death are found in the *ICD-9* chapter on “Supplemental Classification of External Causes of Injury and Poisoning.” These are the codes used to identify the *underlying cause of death*, which is defined as “the disease or injury [which includes poisoning] which initiated the train of events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury.”^{8,12} For most poisoning deaths, the E-code specifies both the intent and the agent that caused the poisoning (for example, “accidental poisoning by alcoholic beverages,” E860.0). For causes of injury mortality other than poisoning, the E-code refers to the event or circumstance that caused the injury to happen (for example, a fall), and the diagnosis code is for the trauma itself (for example, a skull fracture). E-codes can be three or four digits depending on level of specificity. For example, the three-digit code E850 refers to poisoning “by analgesics, antipyretics, and antirheumatics,” while the fourth digits in E850.0 through E850.9 are for the specific drugs.

The diagnosis codes found in Chapter 17, “Injury and Poisoning,” which also specify the agent or substance responsible for the poisoning (for example, “toxic effect of ethyl alcohol,” 980.0) are never used to code the underlying cause of death. Instead, in the case of poisoning, the diagnosis codes are used to add specificity to the underlying cause. The *ICD-9* chapter on “Injury and Poisoning” includes codes 960–979 for “poisoning by drugs, medicines and biological substances,” and codes 980–989 for the “toxic effects of substances, chiefly nonmedicinal.”

The injury data framework developed by the injury control community recommends shifting the focus of analysis of injury mortality from intent to mechanism (or agent in the case of poisoning).⁶ Using this framework, poisoning deaths are defined by the following E-codes: E850–E869, E950–E952, E962, E972, and E980–E982. Prior to the release of the framework poisoning deaths were usually identified only with codes E850–E859. The injury mortality framework does not address diagnosis codes, but the poisoning diagnosis codes can be used to



In 1965, 1659 people committed suicide by inhaling motor vehicle exhaust gas, making it the second leading underlying cause of poisoning death in the United States.

add detail to the poisonings identified by the E-codes. Below, we show how the added specificity that results from analyses of diagnosis codes can be used to refine the picture of poisoning mortality.

In *ICD-9*, a total of 114 individual E-codes provide precise information on the agent or substance that caused an unintentional poisoning (E850.0–E869.9). In contrast, for suicide by poisoning (E950.0–E952.9) and for poisoning deaths of undetermined intent (E980.0–E982.9), E-codes are fewer in number and less specific: only 17 E-codes distinguish the substances associated with the poisoning for each of these intent categories. There are only four E-codes for homicide (E962.0–.9) and one for death by legal intervention (E972).

In addition to the chapters of poisoning codes, the *ICD* includes a Table of Drugs and Chemicals that gives code numbers for specific drugs and chemical substances as causes of poisoning.⁸ For example, poisoning by opiates and related narcotics, diagnosis code 965.0, is used in association with the following external cause codes: E850.0, E950.0, and E980.0; similarly, poisoning by surface and infiltration anesthetics (which includes cocaine), diagnosis code 968.5, is associated with the following external cause codes: E855.2, E950.4 and E980.4. The E-code categories for opiates are more specific than the E-code categories for cocaine. E950.0 and E980.0 are codes for suicide poisoning and poisoning of undetermined intent “by analgesics, antipyretics, and antirheumatics,” which specifically

includes opiates. On the other hand, there are no specific cause of death codes for poisoning suicide or poisoning deaths of undetermined intent by cocaine. These cocaine-related deaths are combined into E950.4 and E980.4, which refer to “other specified drugs.” For example, a poisoning suicide by other specified drug or medicine (E950.4) could be further defined, depending on the specific substance involved, by the diagnosis codes for poisoning by opiates and related narcotics (965.0), poisoning by antidepressants (969.0), or excessive blood level of alcohol (790.3).

In addition to the E-codes used to define poisoning as the underlying cause of death, another group of codes in *ICD-9* capture poisoning deaths; these codes are used for deaths caused by drug and alcohol abuse that are not reported on death certificates as injury deaths. In this paper, we extend the definition of a poisoning death beyond the traditional classification by E-codes to include deaths for which the underlying cause of death was the nondependent abuse of drugs, *ICD-9* codes 305.0–305.9 (found within the section “Neurotic disorders, personality

disorders and other nonpsychotic mental disorders” in the “Mental Disorders” chapter). We refer to these ICD-9 codes for “nondependent abuse of drugs” as NDAD codes. According to ICD-9, these diagnosis codes are defined to “include cases where a person, for whom no other diagnosis is possible, has come under medical care because of the maladaptive effect of a drug on which he is not dependent and that he has taken on his own initiative to the detriment of his health or social functioning.”⁸ While these codes are not traditionally classified with poisonings, they describe events similar to those represented by the E-codes for poisoning. For example, code 305.0 includes deaths due to alcohol abuse in people not known to be chronic alcohol users; these include “cases of acute intoxication or ‘hangover’ effects including drunkenness not otherwise specified, excessive drinking of alcohol not otherwise specified, inebriety not otherwise specified.”⁸ Paralleling code 305.0 is code E860.0, defined as “accidental poisoning by alcoholic beverages, not elsewhere classified—alcohol in preparations intended for consumption.”⁸ Other examples of similar codes include: ICD-9 305.5 “nondependent abuse of morphine type drugs” and E850.0 “accidental poisoning by opiates and related narcotics”; 305.6 “nondependent abuse of cocaine type drugs” and E855.2 “accidental poisoning by local anesthetics [which includes cocaine].”

The wording on the death certificate determines whether the underlying cause of death is coded as a poisoning with an E-code or as a death from the nondependent abuse of drugs. If the death certificate contains any of the following key words: “poisoning,” “toxicity,” or “overdose,” then the cause of death is coded with an E-code. On the other hand, if the cause is described as “drug abuse” without mention of “poisoning,” “toxicity,” or “overdose,” then the death will be coded as 305. These deaths may, on close scrutiny, be the same with regard to the agent and circumstances of death. While code 305 is specifically for nondependent abuse, some of these deaths will include dependent abusers, whose deaths should have been assigned code 304 but the fact of the dependency was either unknown to or suppressed by the certifier (Personal communication, Harry M. Rosenberg, PhD, Chief, Mortality Statistics Branch, Office of Vital and Health Statistics, NCHS, January 1998). In 1995, 2242 deaths were coded to diagnosis code 305, and a total of 306 deaths were coded to 304. In characterizing poisoning deaths, we do not include dependent users, as their risk profile is likely very different from that of a nondependent user.

Therefore, in describing the complete picture of poisoning as an underlying cause of death in the United States, we believe the following codes should be used: E850–E869, E950–E952, E962, E972, E980–E982, and diagnosis code 305; we have used these codes to describe poisoning deaths in the analyses that follow. If intent is the

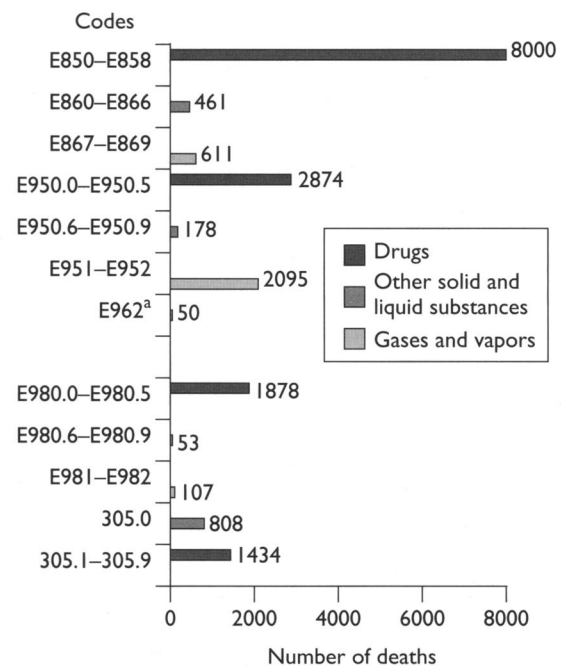
focus of an analysis, then only the E-codes should be used because the NDAD diagnosis codes (305.0–305.9) are not classified by intent. NDAD codes are subdivided in the analyses reported below into NDAD-alcohol (305.0) and NDAD-other drugs (305.1–305.9).

POISONING DEATHS IN THE UNITED STATES IN 1995

In 1995, poisoning was the underlying cause of death for 18,549 people in the United States. Of these people, 16,307 had poisoning (as defined by E-codes) listed as their underlying cause of death and 2242 people died as a result of the nondependent abuse of drugs.

About three-fourths of all poisoning deaths (77%) were caused by drugs (Table 1), and the remaining were caused by gases and vapors (15%) or other solid and liquid substances, including alcohol (8%). Among E-coded poisoning deaths, 56% were coded as unintentional, 32% as suicides, 12% as of undetermined intent, and 0.3% as homicides (Figure 2). Nearly two-thirds of E-coded drug-related poisonings and poisonings from other solid and liquid substances were unintentional and about a fourth were suicides. On the other hand, almost three of four E-coded poisoning deaths involving gases and vapors were suicides and about a fifth were unintentional.

Figure 2. Number of poisoning deaths, by ICD-9 codes, including E-codes and NDAD codes, 1995



^a27/50 caused by drugs
 ICD-9 = International Classification of Diseases, Ninth Revision
 NDAD = nondependent abuse of drugs

Table 1. Poisoning deaths by cause and ICD-9 code, including E-codes and NDAD codes, 1995

ICD-9 code	Deaths	Percent of all poisoning deaths
DRUGS	14,213	76.6
E850-E858—Unintentional poisoning by drugs, medicaments and biologicals.....	8000	43.1
E850 Analgesics, antipyretics, and antirheumatics.....	2508	13.5
E850.0 Opiates and related narcotics.....	2118	11.4
E850.1 Salicylates (includes aspirin).....	38	0.2
E850.2 Aromatic analgesics, not elsewhere classified (includes acetaminophen).....	81	0.4
E850.5 Other nonnarcotic analgesics.....	86	0.5
E850.8 Other.....	179	1
E851 Barbiturates.....	10	0.1
E852 Other sedatives and hypnotics.....	12	0.1
E853 Tranquilizers.....	72	0.4
E853.2 Benzodiazepine-based.....	46	0.2
E854 Other psychotropic agents.....	373	2
E854.0 Antidepressants.....	150	0.8
E854.2 Psychostimulants (amphetamines, caffeine).....	219	1.2
E855 Drugs acting on central and autonomic nervous system.....	1156	6.2
E855.1 Other central nervous system depressants.....	20	0.1
E855.2 Local anaesthetics (cocaine, lidocaine, procaine, and tetracaine).....	1088	5.9
E856 Antibiotics.....	26	0.1
E857 Anti-infectives.....	8	0
E858 Other drugs.....	3835	20.7
E858.1 Primarily systemic agents.....	41	0.2
E858.2 Agents primarily affecting blood constituents.....	26	0.1
E858.3 Agents primarily affecting cardiovascular system.....	226	1.2
E858.5 Water, mineral, and uric acid metabolism drugs.....	43	0.2
E858.8 Other.....	1986	10.7
E858.9 Unspecified.....	1478	8
E950.0-E950.5—Suicide by drugs.....	2874	15.5
E950.0 Analgesics, antipyretics, and antirheumatics.....	417	2.2
E950.1 Barbiturates.....	102	0.5
E950.2 Other sedatives and hypnotics.....	28	0.2
E950.3 Tranquilizers and other psychotropic agents.....	757	4.1
E950.4 Other specified drugs and medicaments.....	852	4.6
E950.5 Unspecified drug or medicament.....	718	3.9
E962.0—Homicide by drugs and medicaments.....	27	0.1
E980.0-E980.5—Undetermined intent-poisoning by drug.....	1878	10.1
E980.0 Analgesics, antipyretics, and antirheumatics.....	750	4
E980.3 Tranquilizers and other psychotropic agents.....	161	0.9
E980.4 Other specified drugs and medicaments.....	669	3.6
E980.5 Unspecified drug or medicament.....	281	1.5
305.1-305.9—Nondependent abuse of drugs.....	1434	7.7
305.1 Tobacco.....	310	1.7
305.2 Cannabis.....	0	0
305.3 Hallucinogens.....	4	0
305.4 Barbiturates and tranquilizers.....	4	0
305.5 Morphine type.....	148	0.8
305.6 Cocaine type.....	300	1.6
305.7 Amphetamine type.....	20	0.1
305.8 Antidepressants.....	2	0
305.9 Other, mixed or unspecified.....	646	3.5

(cont.)

Table I. (continued)

ICD-9 code	Deaths	Percent of all poisoning deaths
OTHER SOLID AND LIQUID SUBSTANCES	1505	8.1
E860-E866—Unintentional poisoning by other solid and liquid substances	461	2.5
E860 Alcohol, not elsewhere classified	318	1.7
E860.0 Alcoholic beverages	20	0.1
E860.1 Other and unspecified ethyl alcohol and its products	143	0.8
E860.9 Unspecified	124	0.7
E861 Cleansing and polishing agents, disinfectants, paints and varnishes	10	0.1
E862 Petroleum products, other solvents and their vapours, not elsewhere classified	57	0.3
E862.4 Other solvents	44	0.2
E863 Agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers	9	0.0
E864 Corrosives and caustics, not elsewhere classified	10	0.1
E865 Foodstuffs and poisonous plants	7	0.0
E866 Other and unspecified solid and liquid substances	50	0.3
E866.4 Other metals and compounds and fumes	21	0.1
E950.6-E950.9—Suicide by other solid/liquid substances	178	1.0
E950.6 Agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers	21	0.1
E950.7 Corrosive and caustic substances	31	0.2
E950.9 Other and unspecified solid and liquid substances	124	0.7
E962.1—Homicide by other solid/liquid substances ^a	5	0.0
E980.6-E980.9—Undetermined intent-poisoning by other solids and liquids	53	0.3
E980.9 Other and unspecified solid and liquid substances	45	0.2
305.0—Nondependent abuse of alcohol	808	4.4
GASES AND VAPORS	2831	15.3
E867-E869—Unintentional poisoning by gases and vapors	611	3.3
E867 Gas distributed by pipeline	27	0.1
E868 Other utility gas and other carbon monoxide	506	2.7
E868.0 Liquefied petroleum gas distributed in mobile containers	57	0.3
E868.2 Motor vehicle exhaust gas	234	1.3
E868.3 Carbon monoxide from incomplete combustion of other domestic fuels	44	0.2
E868.8 Carbon monoxide other sources	18	0.1
E868.9 Unspecified carbon monoxide	140	0.8
E869 Other gases and vapours	78	0.4
E869.8 Other specified gases and vapors	60	0.3
E951-E952—Suicide by gases in domestic use and other gases and vapors	2095	11.3
E951 Gases in domestic use	21	0.1
E952 Other gases and vapors	2074	11.2
E952.0 Motor vehicle exhaust gas	1659	8.9
E952.1 Other carbon monoxide	391	2.1
E962.2—Homicide by gases and vapors	18	0.1
E982—Undetermined intent-poisoning by other gases	107	0.6
E982.0 Motor vehicle exhaust gas	67	0.4
E982.1 Other carbon monoxide	28	0.2

NOTE: A fourth digit code is included here only when at least 20 deaths fall into the category it specifies.

^aIncludes one death due to unspecified causes.

ICD-9 = International Classification of Diseases, Ninth Revision

NDAD = nondependent abuse of drugs

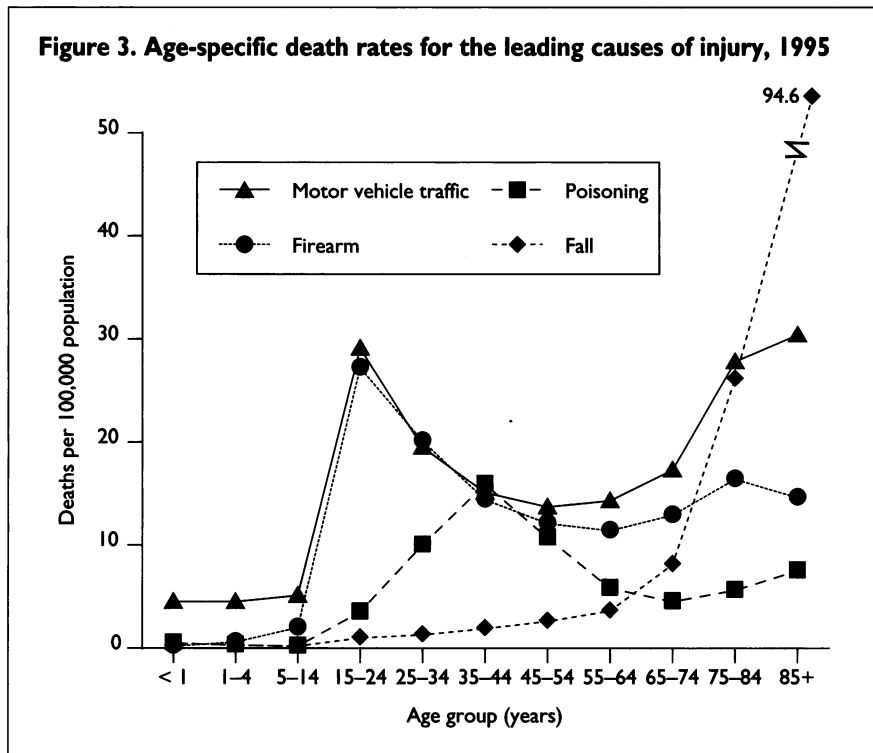
Adding the *NDAD* deaths to the E-coded poisoning deaths resulted in an additional 1434 drug-related poisoning deaths and an additional 808 poisoning deaths due to other solid or liquid substances (more than doubling the number of E-coded deaths in the other solid or liquid substance category).

Over a third of the *NDAD* poisoning deaths were attributed to abuse of alcohol, and the remainder to other drugs, which, according to *ICD-9* includes tobacco (see Figure 2 and Table 1). (It is interesting to note that tobacco poisoning can result from ingestion of cigarettes¹³ or from dermal exposure to dissolved nicotine from wet tobacco leaves.¹⁴)

The most detailed level of *ICD-9*, the fourth digit, allows the number of poisoning deaths to be refined: unintentional poisoning by opiates and related narcotics (which includes heroin), E850.0, was recorded as the underlying cause of death for 2118 people, accounting for 11% of all poisoning deaths in 1995. Combining the parallel *NDAD* deaths for opiates (code 305.5) increases the number of people who died in 1995 to 2266. The second-ranked underlying cause of poisoning deaths was suicide by inhalation of motor vehicle exhaust gas, E952.0 (1659 deaths), accounting for 9% of all poisoning deaths. Unintentional poisoning by local anesthetics (including cocaine), E855.2, accounting for 6% of all poisoning deaths, was the third-ranked cause of poisoning mortality (Table 1). As we did for opiates, we added in the parallel *NDAD* code for cocaine (305.6), increasing the number of cocaine deaths from 1088 to 1388.

By sex and age. In general, age-specific poisoning death rates for males were about two to three times the respective rates for females. (Poisoning death rates in these analyses are based on both E-codes and *NDAD* codes.) The age-adjusted poisoning death rate in 1995 was 6.6 per 100,000—9.6 per 100,000 for males and 3.6 per 100,000 for females. Drugs were the cause of most poisoning deaths (75% of poisoning deaths among males and 82% among females). The age-adjusted drug-related poisoning death rate for males (7.2 per 100,000) was 2.4 times that for females (3.0 per 100,000). The age-adjusted death rate for poisoning by gases and vapors was 1.0 per 100,000 and was also significantly higher for males (1.6 per 100,000) than for females (0.4 per 100,000). The death rate for other solid/liquid poisoning

Figure 3. Age-specific death rates for the leading causes of injury, 1995



among males (0.9 per 100,000) was likewise higher than for females (0.2 per 100,000).

Poisoning death rates were low among children under 15 years (less than 0.5 per 100,000), and even at 15–24 years the rate was considerably lower than the death rates for motor vehicle traffic injury or for firearm injury

Figure 4. Age-specific death rates for people ages 25–54 years for leading causes of injury, by sex, 1995

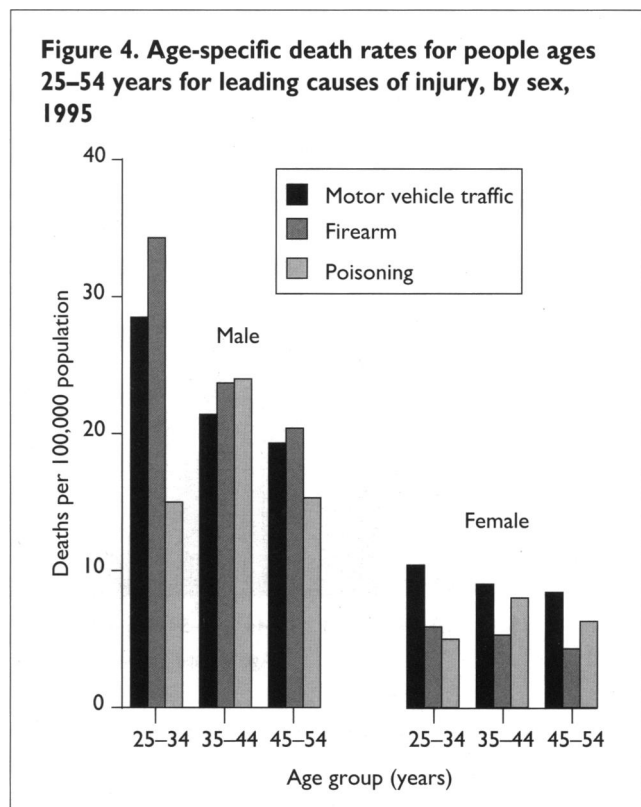
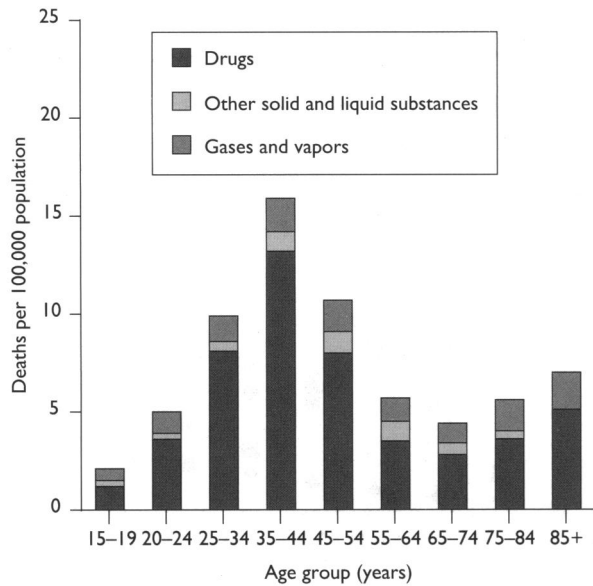


Figure 5. Age-specific death rates for poisoning, by cause, 1995



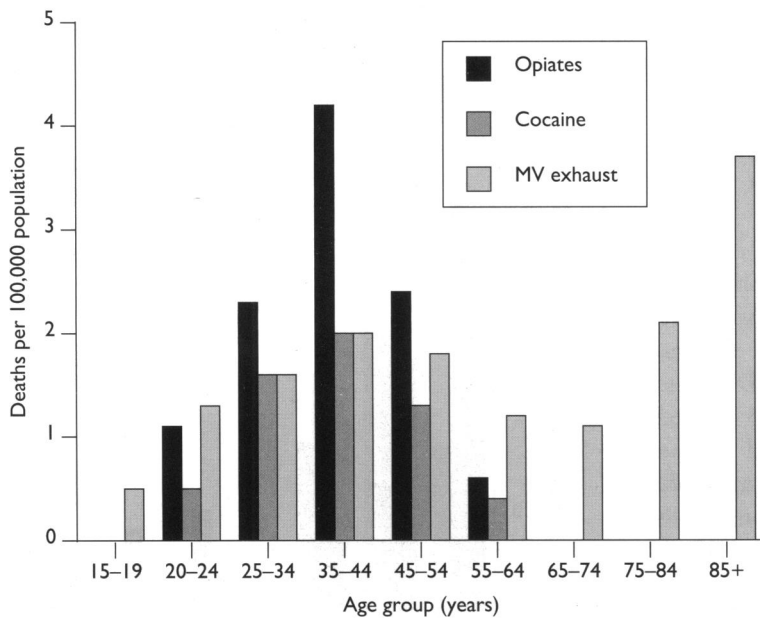
NOTE: Codes for drugs and other solid/liquid substances include E-codes as well as NDAD codes.
NDAD = nondependent abuse of drugs

(the two leading causes of death at that age) (Figure 3). Poisoning death rates peaked at 35–44 years of age, at 15.9 deaths per 100,000 population, and this rate was about 1.5 times the rates at each of the adjacent age groups. By ages 55–64, 65–74, and 75–84 years, the poisoning death rates were similar to rates for people in their early 20s, and the rate for people ages 85 years and older was 1.3 times the rate for those ages 75–84 years.

In the 35–44 age category, poisoning was the leading cause of injury mortality; the death rate for poisoning was 5% higher than the death rate for motor vehicle traffic injury, which, in turn, was 5% higher than the firearm injury death rate. For males ages 35–44 years, firearm injuries and poisoning were the two leading causes of injury death (Figure 4).

The shape of the age distribution of poisoning mortality is driven by the rates for drug-related poisoning (Figure 5). For people falling into the age categories between 25 and 54 years of age, 75% to 83% of all mortality from poisoning was caused by drugs. Even at younger and older ages, the proportion did not fall below 50%. Age-specific death rates for poisoning caused by gases and vapors and by other solid/liquid substances average about 1 per 100,000 to 2 per 100,000 across the age distribution, with higher death rates for gases and vapors among people ages 35–54 years and people 75 years and older than for others.

Figure 6. Death rates among males for opiates, cocaine, and motor vehicle exhaust gas poisoning by age, 1995



NOTE: Includes codes for nondependent abuse of morphine-type and cocaine-type drugs (305.5 and 305.6)

As highlighted above, opiates, motor vehicle exhaust gas, and cocaine were the leading specified underlying causes of poisoning deaths in 1995. Death rates for opiates (unintentional poisoning and NDAD) peaked at 35–44 years, and the rate for males (4.2 per 100,000) was about six times the rate for females (0.7 per 100,000) (Figure 6). Death rates for cocaine (unintentional poisoning and NDAD) also peaked at 35–44 years, but the rate for males was about half that for opiates. The cocaine death rate for males (2.0 per 100,000) was nearly three times the rate for females (0.7 per 100,000). Age-specific death rates for poisoning by motor vehicle exhaust gas, unlike those for other causes of poisoning, were about as high for people ages 65 years and older as for people in their 20s. Most (80% to 85%) of the poisoning deaths associated with motor vehicle exhaust gas, regardless of sex or age, were classified as suicides.

Geographic patterns. In 1994–1995, age-adjusted poisoning death rates ranged from lows of 3 per 100,000 to 4 per 100,000 in six states to highs of 10.0 per 100,000 in New Jersey, 11.4 per 100,000 in Nevada, and 13.7 per 100,000 in New Mexico (Table 2). New Mexico was one of six states with disproportionately high percentages of poisoning deaths attributed to opiates (22% in New Mexico, compared with a national average of 11%). Despite the fact that the poisoning death rate was significantly lower in Georgia than in the United States as a whole, Georgia had a relatively high proportion of poisoning deaths associated with cocaine, 21% compared with 8% for the United States. In addition to New Mexico, 16 states, primarily concentrated in the West and Northeast,

had age-adjusted poisoning death rates significantly higher than the U.S. average. The states with the lowest rates were generally the states with lower proportions of poisoning deaths attributed to drugs.

TRENDS IN POISONING MORTALITY, 1985–1995

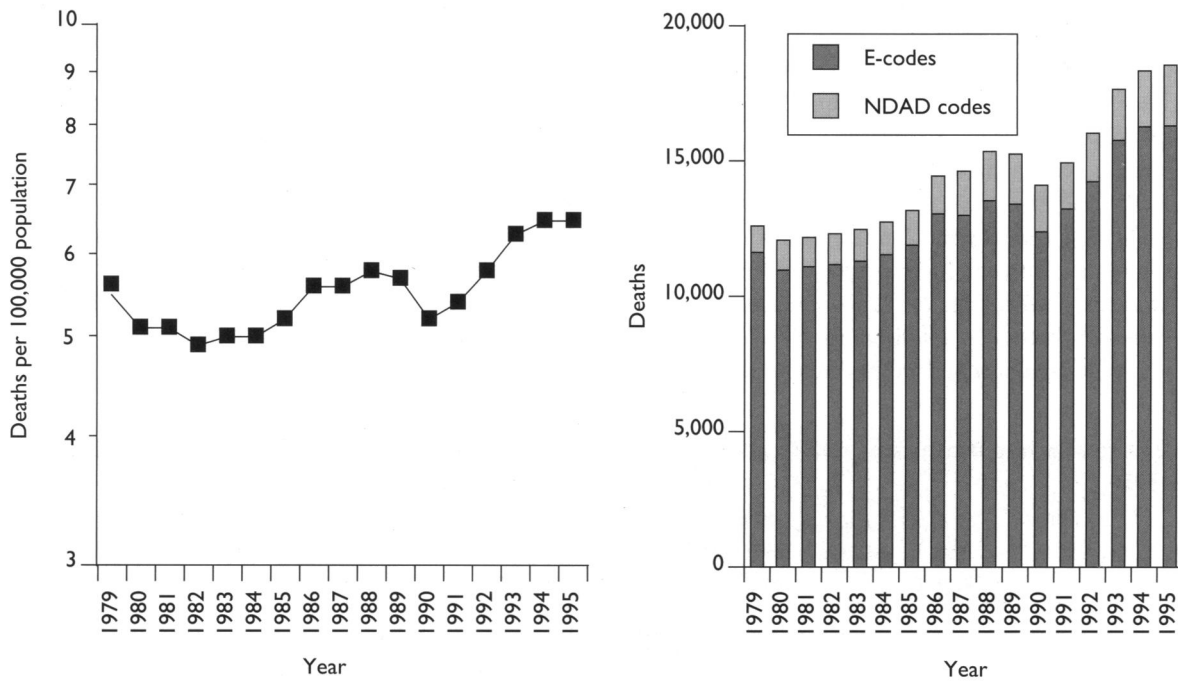
The number and the rate of poisoning deaths were higher in 1994 and 1995 than in any year since at least 1979, when ICD-9 was first implemented (Figure 7). We looked in detail at trends over the decade from 1985 to 1995 and found that while in 1985, 13,174 people died as a result of a poisoning, 10 years later the number was 18,549. From

Table 2. Age-adjusted death rates due to poisoning and proportions due to opiates and cocaine, by state, 1994–1995

State	All poisoning	Age-adjusted rate	Proportion of all poisoning due to:		State (cont.)	All poisoning	Age-adjusted rate	Proportion of all poisoning due to:	
			Opiates	Cocaine				Opiates	Cocaine
All states	36,888	6.6	11.0	8.0	Maryland	1111	9.8	0.8	1.2
Connecticut	584	8.2	22.3	8.0	North Carolina	858	5.5	9.7	10.3
Maine	125	4.6	3.2	1.6	South Carolina	431	5.5	5.8	10.0
Massachusetts	1059	8.1	1.5	0.8	Virginia	731	5.0	14.1	6.4
New Hampshire	117	4.7	1.7	0.0	West Virginia	168	4.1	0.33	3.5
Rhode Island	171	7.9	0.6	0.0	Alabama	327	3.6	3.4	7.0
Vermont	65	4.9	1.5	6.2	Kentucky	394	4.7	4.8	3.8
New Jersey	1693	10.0	14.9	10.6	Mississippi	191	3.5	2.1	9.4
New York	2812	7.2	16.7	14.7	Tennessee	599	5.3	2.3	8.3
Pennsylvania	2202	8.7	6.4	4.4	Arkansas	239	4.8	0.4	2.9
Illinois	1676	6.7	18.2	13.8	Louisiana	457	5.1	2.8	12.7
Indiana	547	4.4	1.5	5.7	Oklahoma	369	5.3	5.1	5.7
Michigan	1207	5.9	5.9	8.5	Texas	2106	5.4	6.8	13.5
Ohio	1066	4.3	8.7	6.6	Arizona	851	9.7	19.7	6.3
Wisconsin	545	5.0	2.8	9.5	Colorado	794	9.7	10.2	6.0
Iowa	278	4.6	2.5	2.2	Idaho	148	6.2	6.1	0.7
Kansas	193	3.5	3.1	6.2	Montana	125	6.8	6.4	2.4
Minnesota	490	4.9	4.3	1.8	Nevada	380	11.4	8.7	2.1
Missouri	621	5.5	6.0	6.6	New Mexico	464	13.7	22.2	6.9
Nebraska	151	4.2	1.3	0.7	Utah	310	8.6	2.9	1.6
North Dakota	63	4.8	0.0	0.0	Wyoming	68	6.8	1.5	4.4
South Dakota	51	3.2	0.0	2.0	Alaska	113	8.6	6.2	8.8
Delaware	130	8.4	14.6	16.9	California	5550	8.3	19.3	5.9
Florida	1714	5.6	6.8	11.1	Hawaii	176	6.8	16.5	13.6
Georgia	686	4.5	3.8	21.0	Oregon	578	8.5	26.3	0.0
					Washington	1061	8.9	18.9	5.9

NOTE: ICD-9 codes for poisoning include E-codes and NDAD codes. ICD-9 codes for opiates include E850.0 and 305.5, and codes for cocaine include E855.2 and 305.6.
 ICD-9 = International Classification of Diseases, Ninth Revision
 NDAD = nondependent abuse of drugs

Figure 7. Age-adjusted death rates and numbers of deaths for poisoning, by type of code, 1979–1995



NDAD = nondependent abuse of drugs

1991 to 1995, the number of poisoning deaths increased annually. The age-adjusted death rate for poisoning in 1995 was 25% higher than both the 1985 and 1990 rates. Between 1985 and 1990, the age-adjusted death rate rose and then fell again. From 1990 to 1994 the rate increased annually; in 1995 the rate remained at the previous year's level. The rate for males was 33% higher in 1995 than in 1985, and the rate for females was relatively unchanged over the period.

Drug-related poisoning deaths among males are responsible for the increase in the overall poisoning death rate (Figure 8). From 1985 to 1995, the age-adjusted drug poisoning death rate among males nearly doubled from 3.7 per 100,000 to 7.2 per 100,000, with increases occurring nearly every year; the rate for females increased more slowly, from 2.4 per 100,000 to 3.0 per 100,000. The death rate for poisoning by gases or vapors, on the other hand, declined over the decade for both males (33%) and females (56%) while the rate for other solid/liquid substances remained relatively unchanged.

Separating the large increase noted for males into its components reveals large increases in (a) the unintentional injury death rate for poisoning by drugs (the age-adjusted rate more than doubled from 2.1 per 100,000 to 4.5 per 100,000), (b) the rate for drug-related poisonings of undetermined intent (the rate also more than doubled, increasing from 0.4 per 100,000 to 1.0 per 100,000), and (c) the rates for NDAD associated with drugs other than alcohol (more than doubling from 0.3 per 100,000 to 0.7 per 100,000).

The rate of drug-related poisoning suicides did not increase (Figure 9).

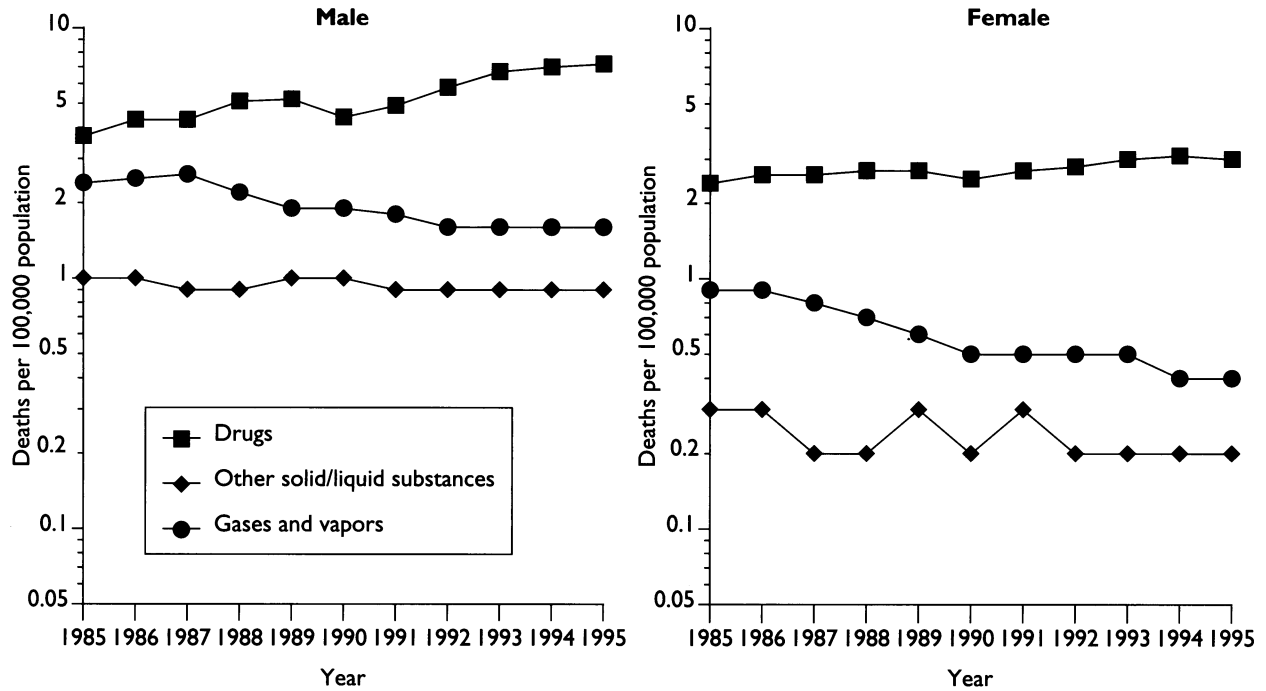
The largest increases in poisoning mortality were among males ages 35–54; from 1985 to 1995 death rates for males ages 35–44 years nearly doubled, increasing to 24.0 per 100,000, as did the rate for males ages 45–54, which increased to 15.3 per 100,000 (with most of the change taking place since 1990). Age-specific rates for females ages 35–44 years increased 50% to 8.0 per 100,000, while the rates for females in adjacent age groups remained practically unchanged (Figure 10).

Virtually all of these increases are associated with poisoning by drugs. The poisoning by drugs death rate for males ages 35–54 years nearly tripled, increasing from 5.5 per 100,000 to 16.1 per 100,000, and the rate for females ages 35–54 years increased 60% to 6.0 per 100,000 (Figure 11). From 1985 to 1995, the male death rate associated with opiates (E850.0 and 305.5) increased from 1.1 per 100,000 to 3.5 per 100,000, and the rate associated with cocaine use (E855.2 and 305.6) increased from 0.3 per 100,000 to 1.7 per 100,000 for males ages 35–54 years. Rates for females, while much lower than for males, nevertheless increased over the decade.

MULTIPLE CAUSE OF DEATH DATA

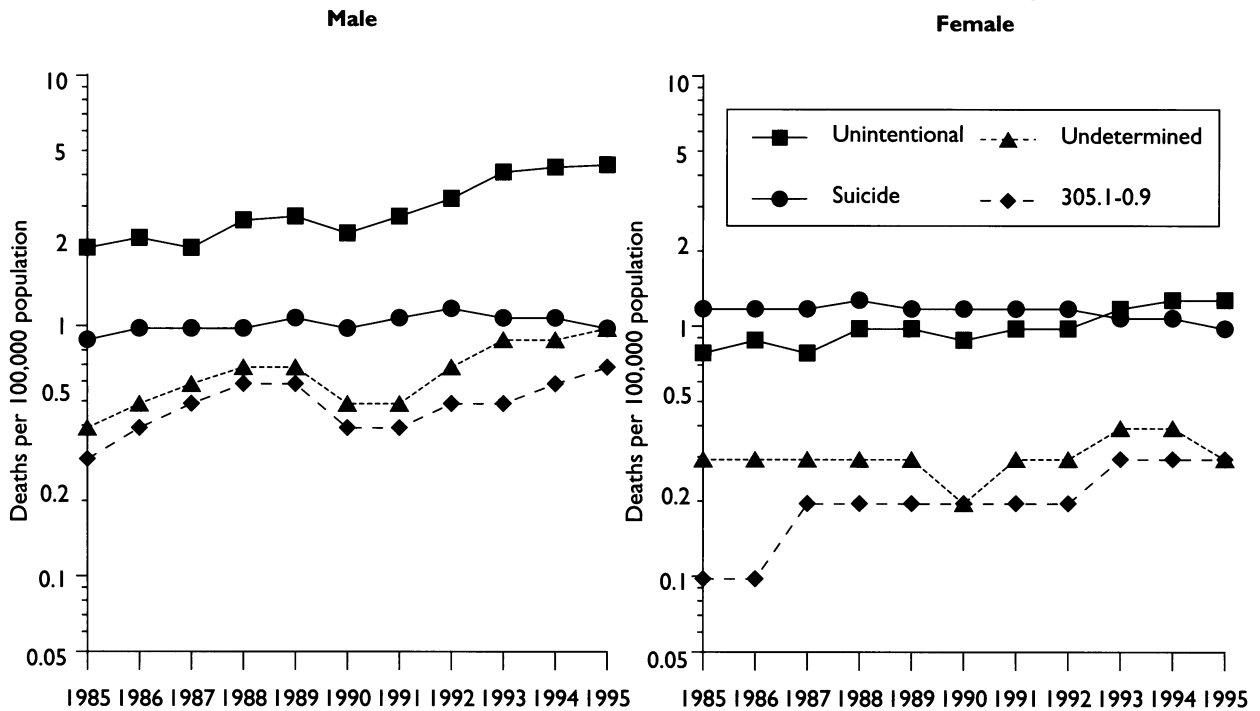
The above analyses of poisoning as an underlying cause of death represent one perspective on the poisoning mortality picture in the United States. As described above, two sets

Figure 8. Age-adjusted death rates due to poisoning, by cause and sex, 1985-1995



NOTE: ICD-9 codes for drugs and other solid and liquid substances include both E-codes and NDAD codes.
 ICD-9 = International Classification of Diseases, Ninth Revision
 NDAD = nondependent abuse of drugs

Figure 9. Age-adjusted death rates due to drug-related poisoning by intent and for NDAD by sex, 1985-1995



NDAD = nondependent abuse of drugs

Figure 10. Age-specific death rates due to poisoning among males and females, 1985-1995

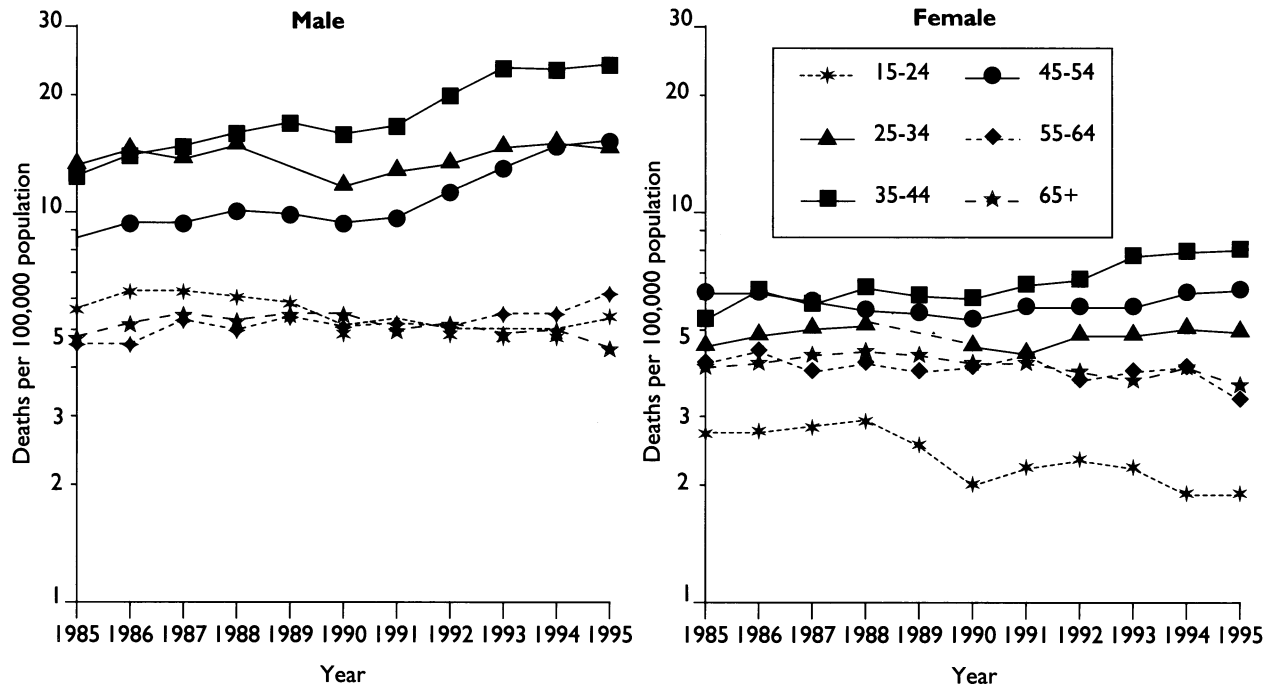
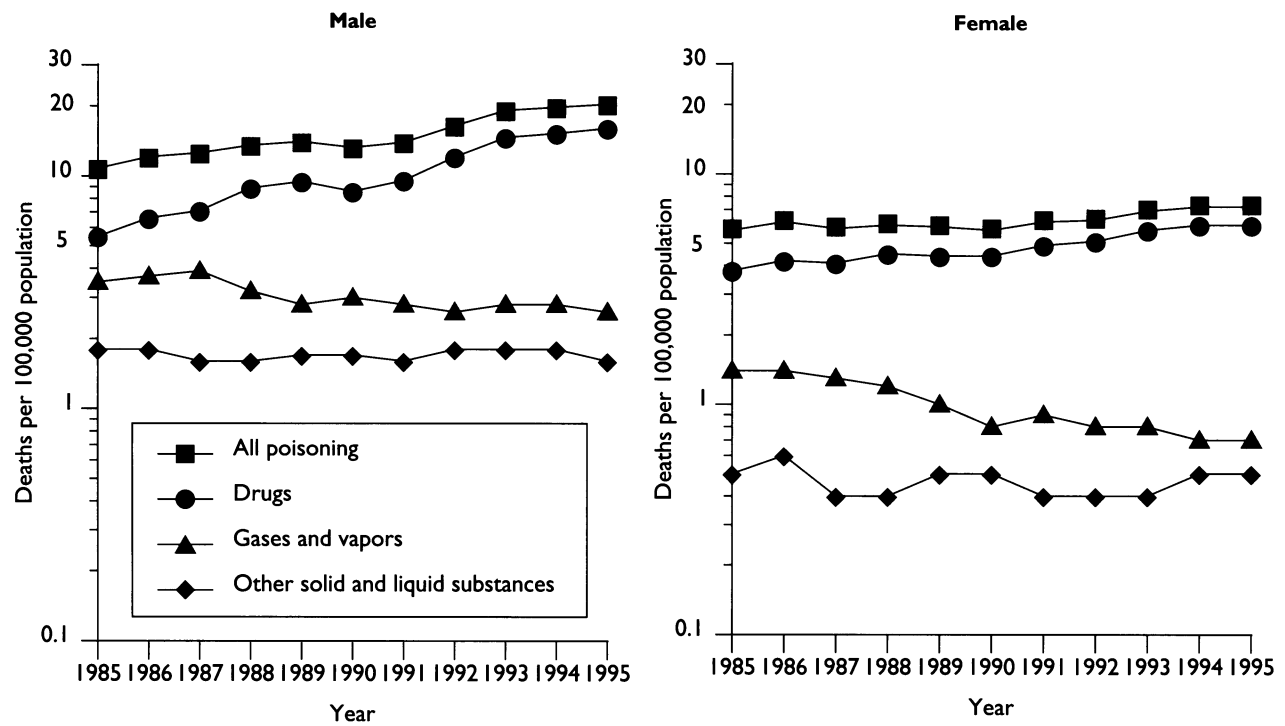


Figure 11. Poisoning death rates for males and females ages 35-54 years, 1985-1995



NOTE: ICD-9 codes for drugs and other solid and liquid substances include both E-codes and NDAD codes.
 ICD-9 = International Classification of Diseases, Ninth Revision
 NDAD = nondependent abuse of drugs

Table 3. Opiate and cocaine deaths, 1995

Category	Opiate		Cocaine	
	ICD-9 code	Number	ICD-9 code	Number
Unintentional	E850.0	2118	E855.2	1088
	E858.8	1641	E858.8	1328
Nondependent abuse of drugs	305.5	148	305.6	300
Suicide	E950.0	144	—	—
	E950.4	123	E950.4	74
Undetermined	E980.0	369	—	—
	E980.4	249	E980.4	448
Included among other poisoning deaths	—	129	—	83
Total	—	4921	—	3321

NOTES: An opiate-related death is defined as a death with the underlying cause of death coded as follows: E850.0; 305.5; or E858.8, E950.0, E950.4, E980.0, E980.4, or any "other poisoning" death with at least one contributing cause of death coded as 965.0.
 A cocaine-related death is defined as a death with the underlying cause of death coded as follows: E855.2; 305.6; or E858.8, E950.4, E980.4, or any "other poisoning" death with at least one contributing cause of death coded as 968.5.
 An "other poisoning death" is defined as a death with the underlying cause of death coded as follows: E850.0–E869.9 (excluding E850.0 and E858.8), E950.0–E952.9 (excluding E950.0 and E950.4), E962.0–E962.9, E972, E980.0–E982.9 (excluding E980.0 and E980.4), or 305.0–305.9 (excluding 305.5 and 305.6).
 ICD-9 = International Classification of Diseases, Ninth Revision

of codes are used to code and classify poisoning deaths. The diagnosis codes give much greater detail regarding the type of poisoning agent than the E-codes, particularly for poisoning suicides and poisoning deaths of undetermined intent (for which so many fewer specific E-codes are available than for unintentional poisoning mortality). In addition, in the case of poisoning, other causes of death in addition to the underlying cause provide details on the substances causing the poisoning. The underlying cause and the other contributing causes recorded on a death certificate comprise the *multiple causes of death*.

In 1995, 417 people committed suicide by poisoning themselves with analgesics, antipyretics, or antirheumatics (E950.0). However, the diagnosis code for opiates, 965.0, further specifies that 35% of the E950.0 suicides were due to poisoning by opiates and related narcotics (Table 3). Of the 750 deaths for which poisoning by analgesics, antipyretics, or antirheumatics of undetermined intent (E980.0) was listed as the underlying cause of death, 49% were due to opiate and related narcotic poisoning (code 965.0). In addition, for all ages, 123 suicides and 249 deaths of undermined intent involving other specified drugs (E950.4 and E980.4) were due to opiates and related narcotics. Thus, to understand the extent to which opiates are involved in poisoning deaths, it is critical to include analysis of all multiple cause of death codes.

Similarly, examination of the diagnosis codes associated with suicide by other specified drugs (E950.4) reveals that only 9% (of 852 deaths) were due to poisoning by surface and infiltration anesthetics (cocaine), code 968.5.

Two-thirds of the 669 deaths of undetermined intent by other specified drugs (E980.4) were due to cocaine.

Multiple cause data are also useful for specifying the substances involved in "other unintentional drug deaths" (that is, E858.8). Of the 1986 deaths falling into this category in 1995, 1641 also had a diagnosis code of 965.0 (poisoning by opiates and related narcotics), 1328 had a diagnosis code of 968.5 (poisoning by surface and infiltration anesthetics including cocaine), and 244 had a diagnosis code of 980.0 indicating the toxic effects of ethyl alcohol. Because more than one contributing cause of death can be recorded on the death certificate, poisoning deaths may be attributable to more than one poisoning agent; therefore these totals are not additive.

With a higher level of detail regarding the poisoning agent available for a large portion of these previously "other specified" poisoning deaths, these deaths can be combined with their appropriate E-code counterparts to obtain more accurate estimates of the deaths associated with specific substances or classes of substances. Above, the total number of opiate and cocaine-related poisoning deaths was reported as the total number of deaths coded as E850.0 and as 305.5 for opiates (2266) and E855.2 and 305.6 for cocaine (1388). However, as shown in Table 3, the greater level of detail available in the multiple cause of death coding shows that a large portion of opiate-related poisoning deaths have thus far gone uncounted. When we add the deaths identified through diagnosis codes for opiates (965.0) and cocaine (968.5), the number of opiate-related poisoning deaths more than doubles and the num-



In 1995, 3321 people died as a result of poisoning by cocaine; the death rate was highest for 35–44 year olds; and the rate for males was nearly three times that for females.

ber of cocaine-related poisoning deaths is almost two and a half times the number of cocaine-related deaths based on E-codes and NDAD codes alone. Thus, we can now state with more certainty that in 1995, at least 4921 deaths were attributable to opiate poisoning and 3321 to cocaine poisoning (among drug users not reported to be chronic abusers). Missing from these counts are deaths for which poisoning was not the underlying cause of death. For example, if opiate or cocaine poisoning were reported as a diagnosis associated with a fall or in a suicide by hanging, then these drug-related deaths are not counted here. Therefore, the numbers of deaths in which opiates or cocaine are likely to have played a part are even higher than the numbers reported here.

Similarly, both diagnosis and E-codes exist for the toxic effect of carbon monoxide. As noted earlier, self-inflicted inhalation of motor vehicle exhaust gas (E952.0) was among the leading causes of poisoning death. These represent nearly two-thirds of all deaths for which carbon monoxide was the underlying cause of death (1659/2581 deaths in 1995). Adding in unintentional deaths (E868.2) and deaths of undetermined intent by inhalation of motor vehicle exhaust gas (E982.0) raises the proportion of carbon monoxide deaths caused by motor vehicle exhaust to about 75%. The toxic effect of carbon monoxide, diagnosis code 986, was reported as a cause of death for an additional 104 poisoning deaths for which the underlying cause of death was not coded as a carbon monoxide poi-

soning. As was the case for opiate and cocaine poisoning mortality, deaths from the toxic effects of carbon monoxide can also be found across other causes of death not identified specifically as poisoning deaths.

Thus, to thoroughly address poisoning mortality, not only should the underlying cause of death codes for all categories of intent be included, but so should the diagnosis codes. These diagnosis codes are only available from the NCHS multiple cause of death tapes and are a unique feature of U.S. mortality statistics.

DISCUSSION

In 1995, poisoning was the third leading cause of injury mortality in the United States. The number of poisoning deaths was higher than in any previous year since at least 1979. Understanding the epidemiology of poisoning is more difficult than understanding the epidemiology of most other causes of injury because of the placement of codes in several chapters of ICD-9 and because poisoning, like deaths from firearm injury or from suffocation, cuts across the categories of intent. ICD-10, due to be implemented for mortality data in 1999, has much the same format as ICD-9 in terms of poisoning codes being located in several different chapters.¹⁵

Until quite recently, the generally accepted definition of poisoning was in terms of its E-codes, that is, E850–E869. For example, if a data user called NCHS and asked how many poisoning deaths occurred in 1995, the answer would have been 9072 (the total of all unintentional poisoning deaths as coded with E-codes). However, with the release of the framework for presenting injury mortality data⁶ and the *Injury Chartbook*,¹ the preferred definition now encompasses poisoning-specific E-codes for suicide, homicide, and deaths of undetermined intent, which brings the number of poisoning deaths in 1995 to 16,307. In this paper, we have advocated for adding in NDAD deaths (code 305), thereby raising the number to

18,549 deaths. Where we have not yet gone in terms of defining poisoning deaths is to look for other (non-poisoning) deaths for which poisoning was also a cause. For example, analyses could be done to determine the number of motor vehicle traffic or fall-related deaths for which the toxic effects of alcohol is reported as a contributing cause of death.

This analysis also points to the level of detail *missing* in the external cause of poisoning death codes for suicides and deaths of undetermined intent but *found* in the diagnosis codes for poisoning that are useful in further specifying drugs and for greater insight into the extent to which poisoning deaths relate to, for example, opiates and cocaine. By using the diagnosis codes, we more than doubled the numbers of poisoning deaths due to opiates and cocaine.

This paper demonstrates, moreover, the critical importance of the wording used by the certifier in completing the death certificate. Certifiers may willfully suppress or disguise the true circumstances of the event to protect the survivors of the decedent. If this happens, it could mean that the numbers of deaths due to dependent abuse and due to external causes could be higher and the number coded to nondependent abuse could be lower. Especially in the area of injury epidemiology, it is important to recognize that classification is dependent on the wording used on the death certificate.

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References

1. Fingerhut LA, Warner M. Injury chartbook. Health, United States, 1996-97. Hyattsville (MD): National Center for Health Statistics (US); 1997.
2. Unintentional poisoning mortality—United States, 1980-86. *MMWR Morb Mortal Wkly Rep* 1989;38:153-7.
3. Olson LM, Troutman WG, Wiggins CL, Becker TM. Fatal poisoning among American Indian, Hispanic, and non-Hispanic white children in New Mexico, 1958 to 1982. *Ethn Dis* 1991;1:257-62.
4. Wysowski DK, Schober SE, Wise RP, Kopstein A. Mortality attributed to misuses of psychoactive drugs, 1979-88. *Public Health Rep* 1993;108:565-70.
5. Moolenaar RL, Etzel RA, Parrish RG. Unintentional deaths from carbon monoxide poisoning in New Mexico, 1980 to 1988—a comparison of medical examiner and national mortality data. *West J Med* 1995;163:431-4.
6. Recommended framework for presenting injury mortality data. *MMWR Morb Mortal Wkly Rep* 1997;46(RR-14):26.
7. Anderson R, Kochanek K, Murphy S. Report of final mortality statistics, 1995. *Monthly Vital Statistics Report Vol. 45, No. 11, Suppl. 2*. Hyattsville (MD): National Center for Health Statistics; 1997.
8. World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, based on the recommendations of the Ninth Revision Conference, 1975*. Geneva: World Health Organization; 1977.
9. National Center for Health Statistics (US). Multiple causes of death in the United States. *Monthly Vital Statistics Report. Vol. 32, No. 10, Suppl. 2*. Hyattsville (MD): National Center for Health Statistics; 1984.
10. Israel RA, Rosenberg HM, Curtin LR. Analytical potential for multiple cause-of-death data. *Am J Epidemiol* 1986;124:161-79.
11. National Center for Health Statistics (US). National Vital Statistics System: multiple cause of death for ICD-9 1995 data. Hyattsville (MD): NCHS; 1997.
12. National Center for Health Statistics (US). *Vital statistics: instructions for classifying the underlying cause of death*. NCHS Instruction Manual. Part 2b. Hyattsville (MD): Public Health Service; 1995.
13. Ingestion of cigarettes and cigarette butts by children—Rhode Island, January 1994-July 1996. *MMWR Morb Mortal Wkly Rep* 1997; 46:125-8.
14. Castorena JL, Garriott JC, Barnhardt FE, Shaw RF. A fatal poisoning from *Nicotiana glauca*. *J Toxicol Clin Toxicol* 1987;25:429-35.
15. World Health Organization. *Manual of the International Statistical Classification of Diseases and Related Health Problems, based on the recommendations of the International Conference for the Tenth Revision of the International Classification of Diseases, 1989*. Vol. 1. Geneva: World Health Organization; 1992. ■

TECHNICAL NOTES

Mortality data may be affected by random variation in the number of deaths, especially if the number of deaths is small. Infrequent events such as these are assumed to follow a Poisson probability distribution. For this distribution, the standard error of the number of deaths is estimated as $(1/\sqrt{D}) \cdot D$ where D = number of deaths, and the standard error of a crude death rate is estimated as $(1/\sqrt{D}) \cdot R$ where R = death rate per 100,000.¹ Additional information on random variation can be found in the Technical Notes of the *Report of Final Mortality Statistics, 1995*.⁷

Age adjustment, using the direct method, is the application of age-specific rates in a population of interest to a standardized age distribution in order to eliminate differences in observed rates that result from age differences in population composition. This adjustment is usually done when comparing two or more populations at one point in time or one population at two or more points in time.¹

In the figures that accompany the trend section of this analysis, the death rates are plotted on a logarithmic rather than on a linear scale. For a given rate change, for example, from 2 per 100,000 to 3 per 100,000 or 20 to 30 per 100,000, the log scale emphasizes that the relative change is the same—50%.

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