office has jurisdiction over all deaths thought to be drug-related, some drug-poisoning deaths might not have been properly reported and, therefore, might have been excluded from analysis. Second, BMI values for the decedents were based on measurements made by the ME. The measured body weight at postmortem examination might have been less than the decedent's usual body weight when alive. In addition, the denominator used for death rate calculations was based on self-reported data from a telephone survey in which respondents might underreport weight. The combined effects of these two potential biases are uncertain. Finally, whether being overweight or obese is a risk factor for fatal drug poisoning or the result of greater use of these drugs by overweight persons cannot be determined from the data.

The Drug Enforcement Administration collects information regarding the movement of controlled substances from manufacture through commercial distribution channels by using the Automation of Reports and Consolidated Orders System (ARCOS) (*5*). From 1997 to 2002, the amount of drugs distributed to Utah and the United States (in grams per 100,000 population) increased substantially for several of the prescription drugs described in this report, including methadone (Utah: from 269 g to 1,703 g; United States: 194 g to 954 g), oxycodone (Utah: 1,848 g to 9,804 g; United States: 1,668 g to 8,056 g), and hydrocodone (Utah: 4,754 g to 8,122 g; United States: 3,249 g to 6,777 g). The numbers of drug-poisoning deaths attributed to each of these drugs increased at a greater rate than the supplies of the drugs in Utah. In addition, from 1997 to 2002, the codeine supply declined (Utah: from 7,746 g to 5,179 g; United States: 9,396 g to 8,149 g), possibly suggesting a prescription preference for newer pain-relieving drugs.

The sixfold increase in the methadone supply in Utah and fivefold increase in the United States were not the result of expansion of addiction treatment programs; ARCOS does not track drugs distributed through such programs. Methadone is also used to control pain and can be prescribed by physicians for pain management. Review of ME investigations into methadone deaths during 1996–2000 revealed previous methadone prescriptions for 48% (17 of 35) of decedents. A valid methadone prescription at time of death was found for 40% (14 of 35) of decedents. Of those with a valid prescription, seven (50%) were taking methadone for the first time (range: zero to 17 previous prescriptions) when they died.

Sources of decedents' drugs cannot always be determined from ME data. The narcotics associated with a drug-poisoning death might have been prescribed for pain, acquired illegally, or (in the case of methadone) obtained from an addiction treatment program. Further research is needed to investigate the proportion of deaths that occurred among legitimate users of prescription medications, and to identify risk factors that might increase the likelihood of drug-poisoning deaths for patients using prescription medications. Other state health departments that track drug-poisoning deaths should conduct their own analyses of unintentional or undetermined drug-poisoning deaths caused by non-illicit drugs. Steps should be taken to ensure safe use of non-illicit, pain-relieving medications while more information regarding factors contributing to deaths is collected. Such steps should include increased education for both health-care providers and their patients.

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Unintentional Non–Fire-Related Carbon Monoxide Exposures — United States, 2001–2003

Carbon monoxide (CO) is a colorless, odorless, poisonous gas that results from incomplete combustion of fuels (e.g., natural or liquefied petroleum gas, oil, wood, coal, or other fuels). CO sources (e.g., furnaces, generators, gas heaters, and motor vehicles) are common in homes or work environments and can put persons at risk for CO exposure and poisoning. Most signs and symptoms of CO exposure are nonspecific (e.g., headache or nausea) and can be mistakenly attributed to other causes, such as viral illnesses. Undetected or unsuspected CO exposure can result in death (*1*). To examine fatal and nonfatal unintentional, non–fire-related CO exposures, CDC analyzed 2001–2003 data on emergency department (ED) visits from the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) and 2001–2002 death certificate data from the National Vital Statistics System (NVSS). During 2001–2003, an estimated 15,200 persons with confirmed or possible non–fire-related CO exposure were treated annually in hospital EDs. In addition, during 2001–2002, an average of 480 persons died annually from

non–fire-related CO poisoning. Although males and females were equally likely to visit an ED for CO exposure, males were 2.3 times more likely to die from CO poisoning. Most (64%) of the nonfatal CO exposures occurred in homes. Efforts are needed to educate the public about preventing CO exposure.

NEISS-AIP is operated by the U.S. Consumer Product Safety Commission and collects data regarding initial ED visits for all types and causes of injuries (*2*). Data are drawn from a nationally representative subsample of 66 of 100 NEISS hospitals that were selected as a stratified probability sample of hospitals in the United States and its territories. NEISS-AIP provides data on approximately 500,000 injury-related and consumer-product–related ED cases each year.

Nonfatal cases were defined as those recorded at an NEISS-AIP hospital as CO exposure or CO poisoning. An incident was identified as a case if 1) the intent of injury was unintentional or undetermined, 2) the principal diagnosis by a physician was "poisoning" or "anoxia," and 3) the consumer product indicated was "CO detector" or "CO poisoning (source unknown)" or a brief narrative abstracted from the medical record indicated either CO exposure or CO poisoning. Fire-related (i.e., burn and smoke inhalation) cases were excluded. In addition, because death data are not captured completely by NEISS-AIP, persons who were dead on arrival or who died in the ED also were excluded. Data for all cases were reviewed independently by two CDC epidemiologists to confirm they met the case criteria. Narratives were also reviewed to determine CO source, exposure status (on the basis of physician diagnosis), and symptoms reported.

Each case was assigned a sample weight on the basis of the inverse of the probability of selection; these weights were summed to provide national estimates of nonfatal CO exposures. Estimates were based on weighted data for 778 patients with confirmed or possible CO exposure treated at NEISS-AIP hospital EDs during 2001–2003. Three years of data were necessary to provide stable rates. Confidence intervals (CIs) were calculated by using a direct variance estimation procedure that accounted for the sample weights and complex sample design. Because CO source and symptoms were undetermined for a high percentage of cases, data on these factors were based on unweighted data for NEISS-AIP cases and thus are not nationally representative.

Death certificate data were obtained from NVSS (*3*). Using multiple-cause-of-death files from the National Center for Health Statistics (NCHS) (*3*), CO poisoning deaths were defined as those with any mention on the death certificate of *International Classification of Diseases, Tenth Revision* (ICD-10) code T58 ("Toxic effect of carbon monoxide") as a leading or contributing cause of death and an ICD-10 underlying-cause-of-death code of X47 ("Accidental poisoning by and exposure to other gases or vapors") or Y17 ("Poisoning by and exposure to other gases or vapors, undetermined intent"). NVSS is a complete census of all deaths and therefore is not subject to sampling error; however, CIs were calculated to account for random error (*3*). The case-fatality rate (CFR) was calculated as the number of CO deaths divided by the sum of CO deaths and nonfatal CO exposures multiplied by 100. Rates were calculated by using 2001–2003 U.S. census bridged-race population estimates from NCHS (*4*).

During 2001–2003, an estimated 15,200 persons were treated annually in EDs for nonfatal, unintentional, non–fire-related CO exposure, and, during 2001–2002, an average of 480 persons died each year from unintentional, non–fire-related CO exposure (Table 1). The nonfatal rate for CO exposure was highest for children aged ≤4 years (8.2 per 100,000 population), whereas the CO death rate was highest for adults aged ≥65 years (0.32). Adults aged ≥65 years accounted for 23.5% of CO poisoning deaths. The nonfatal rate was similar for males and females; in contrast, the death rate for males was 2.7 times that for females. The CFR increased with age, from 0.6% for children aged ≤4 years to 5.5% for adults aged 55–64 years; also, the CFR for males was 2.3 times that for females. The death rate was highest for non-Hispanic whites and blacks (0.17 per 100,000). Eleven percent of those treated in EDs were either hospitalized or transferred to another hospital for specialized care.

The annualized incidence of fatal and nonfatal CO exposures occurred more often during the fall and winter months, with the highest numbers occurring during December (56 fatal and 2,157 nonfatal exposures) and January (69 fatal and 2,511 nonfatal exposures). The annualized incidence was substantially lower during the summer months, with 21 fatal and 510 nonfatal exposures occurring during June and 22 fatal and 524 nonfatal exposures occurring during July.

The majority (64.3%) of nonfatal CO exposures were reported to occur in homes; 21.4% occurred in public facilities and areas. Narratives abstracted from the medical records of NEISS-AIP cases indicated that 18.5% of CO exposure incidents were associated with faulty furnaces (Table 2). An additional 9% were associated with motor vehicles. CO poisonings were diagnosed in approximately half of the NEISS-AIP cases, of which 73% had symptoms noted in the medical record (Table 2). The most common symptoms experienced were headache (37.5%), dizziness (18.0%), and nausea (17.3%). Severer symptoms were reported less often, including loss of consciousness (7.7%), shortness of breath (6.7%), and loss of muscle control (3.5%). According to medical records, 9.3% of patients in the NEISS-AIP sample reported

TABLE 1. Estimated annual number, percentage, and rate of persons with nonfatal and fatal unintentional non–fire-related carbon monoxide (CO) exposures, by selected characteristics — United States, 2001–2003

	Nonfatal (2001–03)*				Fatal (2001–02)†				
Characteristic	Average no. of exposures per year	(%)	Rate§	(95% CI¶)	Average no. of deaths per year	(%)	Rate§	(95% CI)	CFR**
Age group (yrs)									
0–4	1,596	(10.5)	8.15	(4.47–11.83)	9	(1.9)	0.05	(0.02–0.07)	0.56
5–14	2,352	(15.5)	5.73	(3.67–7.80)	19	(4.0)	0.05	(0.03–0.06)	0.80
15–24	2,478	(16.3)	6.11	(4.17–8.04)	58	(12.1)	0.14	(0.12–0.17)	2.29
25–34	2,750	(18.1)	6.90	(4.69–9.11)	57	(11.9)	0.14	(0.12–0.17)	2.03
35–44	2,358	(15.5)	5.26	(3.60–6.92)	92	(19.2)	0.20	(0.17–0.23)	3.76
45–54	1,669	(11.0)	4.17	(2.56–5.78)	79	(16.5)	0.20	(0.17–0.23)	4.52
55–64	918	(6.0)	3.45	(1.97–4.93)	53	(10.9)	0.20	(0.16–0.24)	5.46
≥65	1,079††	(7.1)††	—	—	113	(23.5)	0.32	(0.20–0.36)	—
Sex									
Male	7,874	(51.8)	5.56	(4.00–7.12)	344	(71.6)	0.24	(0.23–0.26)	4.19
Female	7,326	(48.2)	5.00	(3.40–6.59)	137	(28.4)	0.09	(0.08–0.10)	1.84
Race/Ethnicity§§									
White, non-Hispanic	7,171	(47.2)	—	—	346	(72.1)	0.17	(0.16–0.19)	—
Black	3,817	(25.1)	—	—	65	(13.5)	0.17	(0.14–0.20)	—
Hispanic	690	(4.5)	—	—	51	(10.6)	0.14	(0.11–0.17)	—
Other, non-Hispanic	135††	(0.9)††	—	—	18	(3.8)	0.12	(0.08–0.16)	—
Unknown	3,387	(22.3)	—	—	—	—	—	—	—
Disposition									
Treated and released	13,201	(86.8)	4.58	(3.35–5.81)	—	—	—	—	—
Hospitalized/Transferred	1,676	(11.0)	0.58	(0.27–0.90)	—	—	—	—	—
Other/Unknown	324††	(2.1)††	—	—	—	—	—	—	—
Total	**15,200**	**(100.0)**	**5.27**	**(3.83–6.72)**	**480**	**(100.0)**	**0.17**	**(0.16–0.18)**	**3.06**

* National estimate of persons with nonfatal CO exposure treated in hospital emergency departments, based on 778 cases reported by the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP).
† Based on actual number of persons reported in death certificate data from the National Vital Statistics System.
§ Per 100,000 population.
¶ Confidence interval.
** Case-fatality rate = annualized CO deaths / (annualized CO deaths + annualized nonfatal CO exposures) x 100.
†† Estimates might be unstable because the coefficient of variation is >30% or the number of nonfatal NEISS-AIP cases was <20.
§§ Nonfatal rates and CFR are not presented for racial/ethnic groups because race/ethnicity was unknown for a substantial percentage of persons with nonfatal exposures. "Black" includes Hispanic and non-Hispanic blacks; "Hispanic" excludes black Hispanics.

that they had a CO detector at home, and 100% of those indicated that the detector had alerted them to the presence of CO.

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Editorial Note: Data in this report indicate that, each year, approximately 15,000 U.S. residents visit EDs for unintentional, non–fire-related CO exposure and approximately 500 die from unintentional, non–fire-related CO poisoning. Primary CO sources were home appliances, and the majority of exposures occurred during the fall and winter months, when persons are more likely to use gas furnaces and heaters. During warmer months, boating activities might also be a source of exposure (*5*). This analysis also determined that males are more likely to die from CO poisoning than females, which is consistent with previous findings (*6–8*). Males might be exposed to higher CO levels during high-risk activities, such as working indoors or in enclosed garages with combustion-engine–driven tools (e.g., generators or power washers) (*7*). The CO poisoning death rate was highest among persons aged ≥65 years, likely attributable to their being at higher risk for undetected CO exposure because symptoms often resemble those associated with other health conditions common among older persons (*9*).

The findings in this report are subject to at least three limitations. First, data on sources of CO exposure and symptoms of persons with CO poisoning were missing for a substantial percentage of cases. Second, national estimates of nonfatal injuries are based solely on persons treated in EDs and do not include those treated in outpatient settings or not treated at all. Finally, although risks for CO exposure vary by state and locality (e.g., because of differences in winter weather conditions), NEISS-AIP provides only national estimates and not state or local estimates.

TABLE 2. Unweighted number* and percentage of nonfatal, unintentional, non–fire-related carbon monoxide (CO) exposures by source, exposure status, and symptom — United States, 2001–2003

Source/Exposure status/ Symptom	No.	(%)
CO source		
All sources	778	(100.0)
Furnace†	144	(18.5)
Motor vehicle§	71	(9.1)
Stove/Gas range	38	(4.9)
Gas line leak	38	(4.9)
Gas water heater	33	(4.2)
Generators	22	(2.8)
Space heater	15	(1.9)
Machinery¶	12	(1.5)
Other	72	(9.3)
Unknown	333	(42.8)
Exposure status		
All exposures	778	(100.0)
Possible exposure	47	(6.0)
CO exposure	326	(41.9)
CO poisoning	405	(52.1)
Symptom**		
Headache	152	(37.5)
Dizziness	73	(18.0)
Nausea	70	(17.3)
Weakness	39	(9.6)
Vomiting	31	(7.7)
Loss of consciousness	31	(7.7)
Shortness of breath	27	(6.7)
Light-headedness	20	(4.9)
Sleepiness	19	(4.7)
Loss of muscle control	14	(3.5)
Chest tightness	9	(2.2)
Confusion	4	(1.0)
Blurred vision	1	(0.3)
Other	38	(9.4)

* Based on 778 cases reported by the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP).
† Includes oil, gas, and unspecified furnaces.
§ Includes cars, vans, sport utility vehicles, and trucks.
¶ Includes tractors and forklifts.
** Symptoms reported for 297 of the 405 CO poisoning cases. No symptoms were reported for the remaining 108 cases. Multiple symptoms were often reported; therefore, categories are not mutually exclusive.

Primary prevention of residential CO exposure can be accomplished through simple precautions (Box). Although residential CO detectors are important for early detection of CO, they should be considered a secondary prevention method. High oil and gas prices and power outages during winter months can contribute to consumer use of improperly vented heating sources. Public education campaigns, especially during winter months, combined with provision of battery-operated CO detectors for low-income persons, might reduce CO poisonings (*10*). Previous studies also suggest a need for multilingual educational campaigns to reach non–English-speaking populations (*10*).

BOX. Guidelines to prevent carbon monoxide (CO) exposure

- Have your heating system, water heater, and any other gas-, oil-, or coal-burning appliances serviced by a qualified technician every year.
- Install a battery-operated CO detector in your home and check or replace the battery when you change the time on your clocks each spring and fall.
- If your CO detector sounds, evacuate your home immediately and telephone 911.
- Seek prompt medical attention if you suspect CO poisoning and are feeling dizzy, light-headed, or nauseated.
- Do not use a generator, charcoal grill, camp stove, or other gasoline- or charcoal-burning device inside your home, basement, or garage or near a window.
- Do not run a car or truck inside a garage attached to your house, even if you leave the door open.
- Do not burn anything in a stove or fireplace that is not vented.
- Do not heat your house with a gas oven.

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