

A photograph of laboratory glassware, including a graduated cylinder and Erlenmeyer flasks, containing a yellow liquid. The word "POISONING" is overlaid in large white letters.

POISONING

QUICK FACTS

While the majority of unintentional poisoning deaths in the United States are attributable to misuse and abuse of drugs, environmental substances, such as carbon monoxide and pesticides, also contribute to the poisoning illnesses and deaths occurring in the United States each year.^{1,2}

Carbon monoxide causes the most nondrug poisoning deaths (approximately 524 per year), especially among people over 65 years old and males.^{3,4}

The majority of pesticide poisoning exposures are unintentional and occur in children under 6 years old or in adults over 20 years old.⁵

Poisoning is a significant problem in the United States and is the leading cause of unintentional injury death, surpassing motor vehicle crashes. In 2010, fatalities from unintentional poisoning totaled 33,041.⁶ Approximately 2.3 million unintentional poisonings or poison exposures (predominately nonfatal) were reported to poison control centers in 2011.⁵

WHAT IS POISONING?

A poison is a substance that can cause illness, injury, or death. Poisons can be swallowed, inhaled, or absorbed through the skin. Some substances are toxic in small doses, but other usually harmless substances can be poisonous if encountered in large enough quantities. A poisoning can occur in almost any setting, from any substance, and in any form (liquid, solid, or gas).

WHAT ARE THE RISK FACTORS FOR POISONING?

Childhood exposures often occur as a result of exploratory behavior. In these cases, the amounts ingested are usually small and the health effects minimal. However, exposures to some medicines and household chemicals even in small amounts can result in serious illness or death.

Adult poisonings, on the other hand, are usually drug-related and result from

- Overdoses of illegal drugs and legal drugs taken for nonmedical reasons
- Poisoning from legal drugs taken in error or at the wrong dose
- Unanticipated effects from prescription drugs for medical or non-medical reasons

Overall, the majority of unintentional poisoning deaths in the United States are attributable to misuse and abuse of drugs. In recent years, deaths involving prescription narcotic painkillers (e.g., oxycodone, hydrocodone, methadone), have outnumbered the combined total of deaths involving the illegal drugs heroin and cocaine.⁵

Carbon monoxide (CO) causes the most nondrug poisoning deaths in the United States. Household products, such as cleaning agents, personal care and topical products, and pesticides, are among the top ten substances responsible for poisoning exposures annually. Occupational poisonings occur from exposures to a variety of chemicals.

This module reviews the overall trends in unintentional poisonings with a focus on environmental exposures to carbon monoxide and pesticides, because they are commonly encountered in our everyday environment and frequently appear in reports of poisonings. The illnesses and deaths produced by these two agents are preventable through simple human intervention.

HOW ARE WE TRACKING POISONINGS?

Information about unintentional poisonings comes primarily from the following four sources:

- Poison control centers
- Emergency department records
- Hospital admission and discharge records
- Death certificates



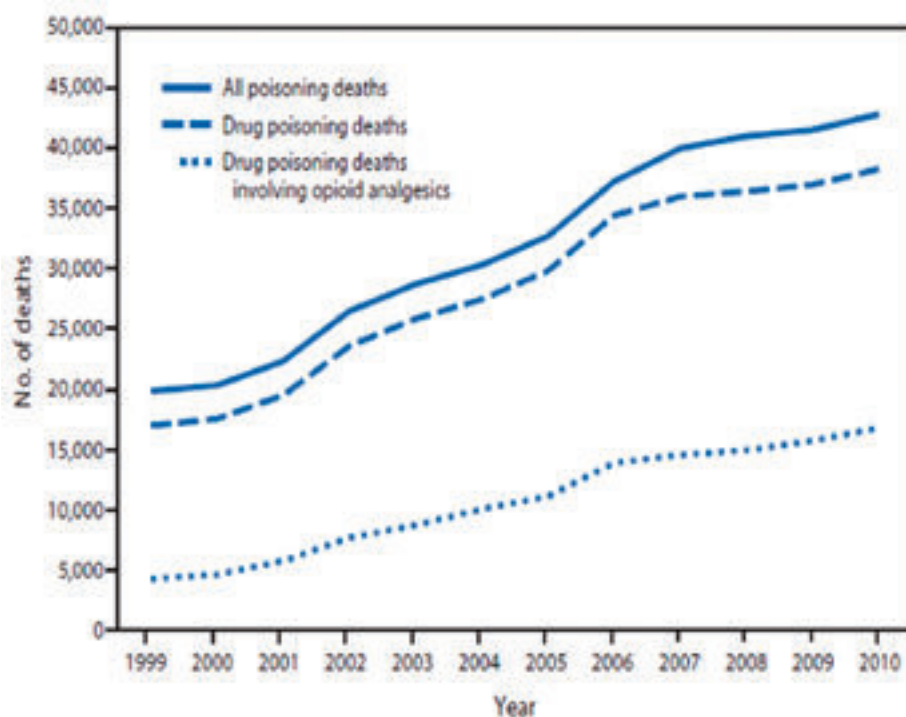


Figure 1. Number of deaths from poisoning, drug poisoning and drug poisoning deaths involving opioid analgesics in the United States, 1999-2010.⁸

None of these sources captures all unintentional poisonings, and even collectively, they do not tell the complete story. However, much has been learned from these data sources, and the emerging picture suggests that although drug poisonings are escalating rapidly, the number of poisonings from environmental agents has decreased over time and has leveled off since 2007 (Figure 1).

WHAT ARE THE STATUS AND TRENDS OF POISONINGS?

Poisonings are a significant problem in the United States and the leading cause of unintentional injury death. In 2010, deaths from unintentional poisoning totaled 33,041.⁶ Approximately 2.3 million unintentional poisonings or poison exposures (predominately nonfatal) were reported to poison control centers in 2011.⁵ Most poisoning deaths occur in adults. Deaths in children under 5 years old are uncommon but continue to occur and have not decreased significantly in the past 10 years.⁷

The rates of unintentional poisoning exposures and deaths are increasing rapidly in the United States primarily because of drug misuse and abuse (Figure 1).⁸ By 2004, overdose deaths from prescribed, controlled substances, primarily narcotic painkillers, numbered more than the total of deaths

involving the illegal drugs heroin and cocaine. It is now apparent that prescribed, controlled substances are driving the upward trend in drug poisoning deaths.¹ Nondrug poisoning fatalities, on the other hand, have decreased about 60% since 1979.² In this report, environmental poisonings are defined to include exposure to nonfire-related carbon monoxide and other gases, organic solvents and halogenated hydrocarbons, pesticides, and other unspecified chemicals.

Unintentional poisoning death rates are highest among adults 25 to 54 years of age, particularly males of non-Hispanic, white or of American Indian and Alaskan Native race or ethnicity.¹ Poisoning death rates for women are about half those for men.

In 2012, unintentional poisonings caused about 623,778 emergency department (ED) visits.⁹ Most patients receiving ED care for an unintentional poisoning are treated and released, but about one fourth are hospitalized. Older patients are more likely to be hospitalized than younger patients, especially patients older than about 70 years of age.

Children under 6 years old accounted for only 1.7% of unintentional poisoning deaths in 2011, yet this age group was responsible for 49% of unintentional poisoning exposures reported to poison control cen-

ters that year.⁵ The most common exposures in children under 6 years old are cosmetics and personal care products, followed by analgesic drugs.⁵

A decrease in unintentional carbon monoxide poisoning has been attributed to stricter automobile emission standards that began with the 1975 model year.¹⁰ Carbon monoxide is still concern. It is second only to alcohol (unrelated to automobile deaths) as the largest cause of nondrug poisoning deaths based on poison control center data.⁵ It is also the single largest environmental cause of death from accidental poisoning based on mortality data.¹¹

Pesticide poisonings are also of great concern. In 2011, pesticides were the tenth leading cause of poisoning exposure reported to poison control centers behind analgesics and other drugs; cosmetics and personal care products; household cleaning substances; and foreign bodies, toys, and miscellaneous.⁵ In addition, pesticide poisonings are likely underreported because of difficulty with diagnosis, incomplete reporting to surveillance systems,¹² symptoms not being recognized as a poisoning.^{13**} Furthermore, long-term, low-dose exposures, which

can be more typical of pesticides exposures, are not included in poisoning data. Additional details on carbon monoxide and pesticide poisoning are presented in the rest of this module.

WHAT IS CARBON MONOXIDE POISONING

Unintentional, nonfire-related carbon monoxide (CO) poisoning is one of the most common types of environmental poisoning in the United States. CO is a colorless, odorless, toxic gas that is generated by the incomplete combustion of hydrocarbons. Most of the CO in the environment is man-made (84%) and created outdoors with 59% coming from on-road vehicles and 25% from off-road equipment, such as lawn equipment, construction equipment, airplanes, boats, and trains.^{14,15} CO poisonings, on the other hand, predominately occur in the home (approximately 73%) from improperly maintained and vented sources in or near the home.^{16,17} These sources, based on the number of CO poisoning deaths, are shown in Figure 2.

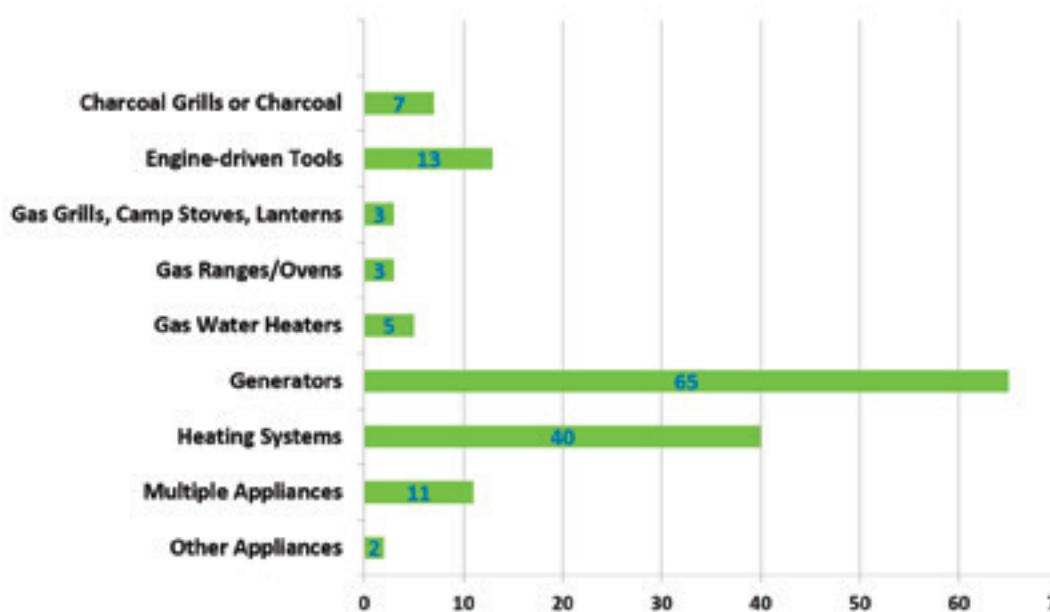
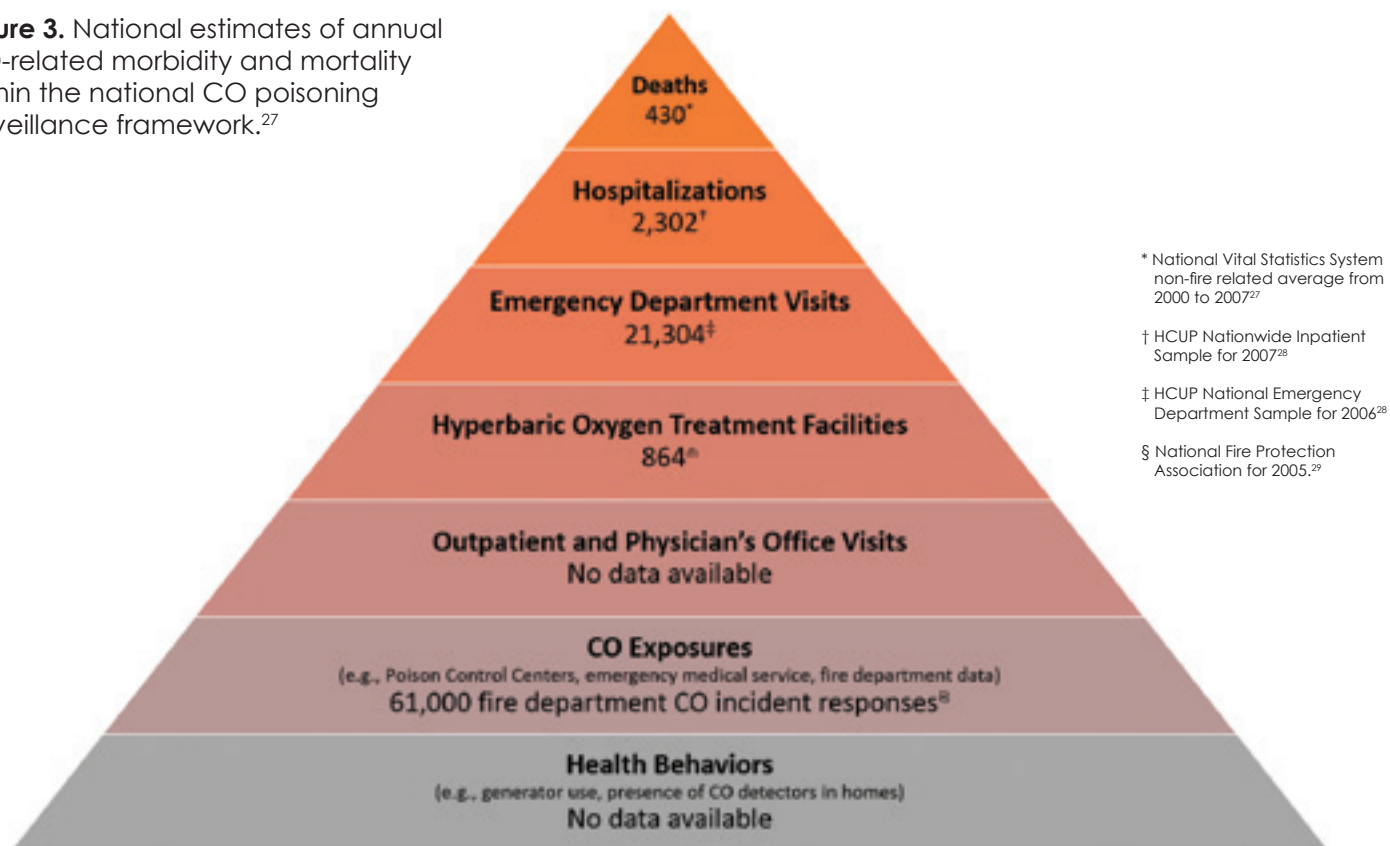


Figure 2. Estimated Unintentional Non-Fire Carbon Monoxide Poisoning Deaths by Associated Fuel-Burning Consumer Products in 2009^{18*}

* Heating systems include systems fueled by LP gas, natural gas, coal/wood, kerosene, and diesel. Generators are considered an engine-driven tool but are separated out because of its large contribution. Other engine-driven tools include garden tractors and lawn mowers, power washers/sprayers, water pumps, snow blowers, air compressors, ATVs, paint sprayers, and welders not used as a generator.

** Symptoms may include difficulty breathing, dizziness, excessive sweating, pinpoint pupils, runny nose, skin irritation or rash, tingling, and numbness, upset stomach watery eyes.

Figure 3. National estimates of annual CO-related morbidity and mortality within the national CO poisoning surveillance framework.²⁷



Motor vehicles are also a source of CO poisonings. Nontraffic, unintentional CO poisoning from vehicle exhaust averaged 147 deaths for 2003 and 2004 and averaged an estimated 2,000 injuries from 2003–2006.¹⁹ Outbreaks of CO poisoning often occur during winter and adverse weather events (e.g., hurricanes, snowstorms, blizzards) because of increased use of home heating systems and portable generators and because of motor vehicles left running during cold weather.^{20,21,22}

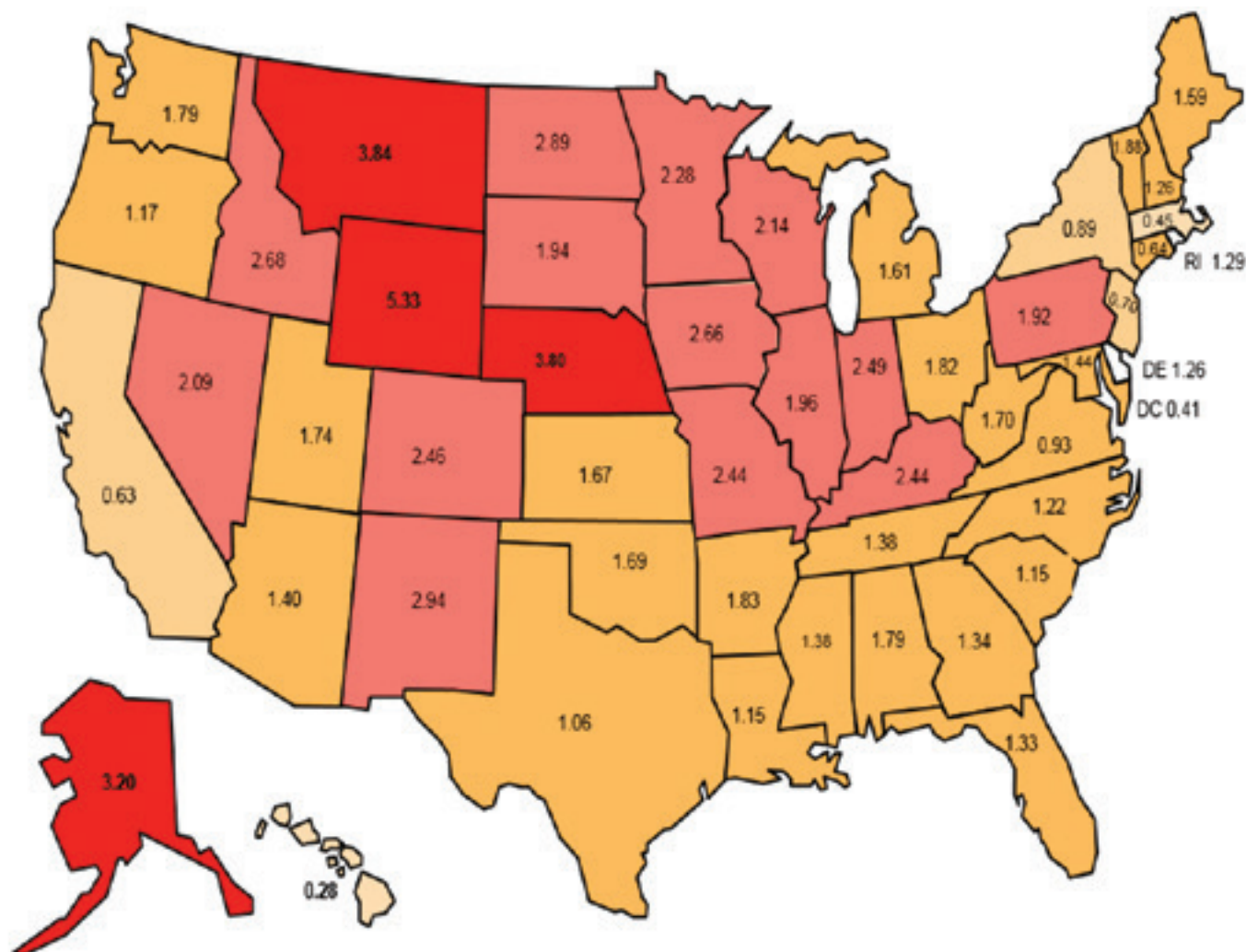
Low-level exposure to CO can cause fatigue and flu-like symptoms (dizziness, headache, nausea, and vomiting), and high levels of exposure can cause disorientation, collapse, coma, cardiorespiratory failure, and death. As many as 15%–49% of persons who survive a CO poisoning eventually develop secondary health effects, including impaired memory and higher-order cognitive processing which affects goal setting, planning, organization, adaptive responding, and self-monitoring.^{23–28}

WHAT ARE THE STATUS AND TRENDS FOR CARBON MONOXIDE POISONING

From 1979 to 1988, the number of unintentional CO poisonings decreased steadily from 1,513 in 1979 to 878 in 1988.²² Decreases since about 1980 coincide with the decrease in CO emissions from motor vehicles. From 1999 to 2010, National Vital Statistics System (NVSS) mortality records averaged 430 unintentional, nonfire-related CO poisoning deaths annually. Death rates were highest for adults over 65 years old, and death rates for males were nearly three times higher than those for females.³

In 2007, a total of 2,302 people were hospitalized for CO poisoning. Hospitalization rates were highest for older adults over 65 years old and for males. In contrast to the death rates, hospitalization rates for CO poisoning of males were only about 30% greater than rates for females in 2007.²⁹

Figure 4. Rates of unintentional, nonfire, carbon monoxide-related death, by state, United States, 1999–2010⁶



* Population age-adjusted to 2000 U.S. Census population

According to hospital ED visits data, there were 21,304 confirmed unintentional, nonfire-related and nonfatal CO exposures occurred in 2007. Individuals 18 to 44 years of age had the highest rate of CO-related ED visits among all age groups, and rates for children 0 to 17 years of age were almost as high. ED visit rates were lowest for persons 65 to 84 years of age. Females and males visited the ED at the same rate.²⁹

The total number of unintentional, nonfire-related CO exposures is difficult to determine, because many exposures are probably not reported, and no single database or collection of databases encompasses all types of unintentional, nonfire-related CO poisoning events (deaths, medically

treated exposures, and untreated, verified exposures).¹⁷ In 2005, municipal fire departments responded to an estimated 61,100 CO incidents across the United States, unrelated to fire. However, this number includes only those incidents that were reported to municipal fire departments and reflects only the number of CO incidents rather than the number of *people* affected by CO incidents. The majority of incidents occurs in homes and can involve multiple people.³⁰

Geographically, the highest rate of CO poisoning deaths occurs in the northern central states and Alaska (Figure 4). In these areas, the duration and severity of winter and the subsequent reliance on heating systems and generators during power outages likely increases the exposure risk to exhaust gases containing CO.¹⁶

WHAT IS PESTICIDE POISONING?

Based on poison control center surveillance, pesticides are among the top ten substances most frequently associated with poisoning exposures and among the top four when drug poisonings are excluded.⁵ Pesticides are used domestically and commercially to control weeds, insects and other organisms for improving human health, agriculture, and horticulture. The term pesticide includes many types of products and chemicals. More than 16,000 pesticide products exist, comprising about 600 active ingredients, and approximately one billion pounds are used annually in the United States. Pesticide products and chemicals are subdivided based on their target pest³² and application methods. They include insecticides, herbicides, fumigants, and fungicides, among others.

The active ingredients are grouped based on their chemistry. Four main classes of compounds include organophosphates, carbamates, pyrethrins and pyrethroids, and organochlorine compounds, among others. Table 1 provides additional details on these pesticide classes.

WHAT ARE THE STATUS AND TRENDS FOR PESTICIDE POISONING?

About 89,000 unintentional pesticide poisoning exposures were reported to the poison control centers in 2012. About 42% of the incidents involved children less than 6 years old.⁵ Researchers suspect that the actual number of poisonings is greater than 89,000, because symptoms of pesticide poisoning can be similar to symptoms of flu and other common illnesses.

Table 1. Details on Five Pesticide Classes

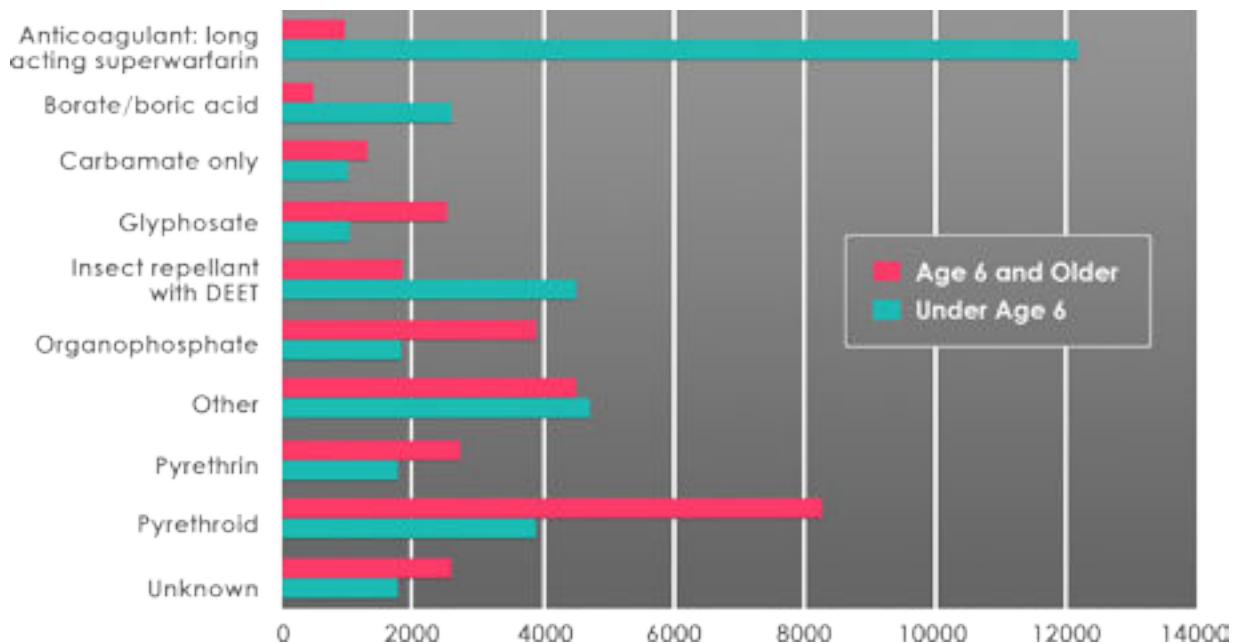
Pesticide Class	Example Compound	Use	Some Symptoms of Acute Pesticide Poisoning ³⁵	Function
Carbamates	carbofuran	Control of aphids, beetles and weevils in alfalfa and corn	Malaise, weakness, dizziness, sweating, headache, salivation, nausea, and vomiting.	Reversible inhibition of acetyl-cholinesterase affecting neuromuscular functions. ³⁴
Organochlorine compounds	chlordane	Formerly used for residential termite control. No longer approved for use in the United States.	Excitability, dizziness, headache, restlessness, tremors, and convulsions.	Interferes with the functioning of the nerve cell membranes. ³⁵
Organophosphates	chlorpyrifos	Formerly used for residential termite control. Currently used on a variety of food and feed crops to control spiders and mites.	Headache, dizziness, weakness, anxiety, excessive sweating, vomiting, diarrhea, and abdominal cramps,	Inhibits acetyl-cholinesterase which affects neuromuscular functions and is more difficult to reverse than carbamates ³⁶
Pyrethrins / Pyrethroids	Pyrethrum	Used to control insects and is present in veterinary flea powders for cats and dogs.	Allergic reactions, dermatitis, wheezing, seizures, coma, breathing difficulties, diarrhea, and abdominal pain	Interferes with the functioning of the nerve cell membrane. Pyrethroid is the manmade version of pyrethrin. Pyrethrin is made from the flowers of chrysanthemums. ³⁷

Only the American Association of Poison Control Centers (AAPCC) collects national data for unintentional pesticide poisonings that include nonoccupational exposures. Most pesticide poisoning exposures occur in children under 6 years old or in adults (over 20 years old), and less than 1 in 5 exposures is treated at a healthcare facility. The majority of unintentional pesticide poisoning exposures result in only minor health consequences. Deaths are rare.⁵

The most common pesticides and pesticide classes recorded by the AAPCC for unintentional pesticide poisonings in 2012 were pyrethroid insecticides, long-acting, anticoagulant rodenticides of the superwarfarin type, borate/boric acid type insecticides and pyrethrin insecticides.⁵

(Figure 5). From 2006 to 2012 pyrethroids increased from 21% to 28% unintentional pesticide poisonings reported to the AAPCC^{5,33}. Long-acting, anticoagulant rodenticides (superwarfarin) had decreased from 14% of poisonings during 1997-2006 to 11% of pesticide poisonings in 2012; and insect repellants with DEET had decreased from 9% of poisonings in 1997-2006 to 5% of pesticide poisonings in 2012.⁵ By 2012, children under 6 years old were most likely to be poisoned by superwarfarin type rodenticides, followed by pyrethroids.⁵

Figure 5. Total Exposures for Major Pesticide Categories, 2000-2006³¹



* The American Association of Poison Control Centers (AAPCC; <http://www.aapcc.org>) maintains the national database of information logged by the country's Poison Control Centers (PCCs). Case records in this database are from self-reported calls: they reflect only information provided when the public or healthcare professionals report an actual or potential exposure to a substance (e.g., an ingestion, an inhalation, or a topical exposure, etc.), or request information or educational materials or both. Exposures do not necessarily represent a poisoning or overdose. The AAPCC is not able to completely verify the accuracy of every report made to member centers. Additional exposures may go unreported to PCCs, and data referenced from the AAPCC should not be construed to represent the complete incidence of national exposures to any substance.

HOW CAN WE PREVENT POISONING?

Poisoning is almost always preventable. The following tips can help you, your family, and friends avoid unintentional poisonings.

- Keep chemical products in their original bottles or containers.
- Do not use food containers, such as cups, bottles, or jars, to store chemical products, such as cleaning solutions or beauty products.
- Keep all drugs in medicine cabinets or other child-proof cabinets that young children cannot reach.
- Never leave children alone with household products or drugs.
- Do not leave household products or drugs out after using them. Return the products to a childproof cabinet as soon as you are done with them.
- Read and follow directions for application and storage of all household products.

There are also specific steps you can take to prevent carbon monoxide poisoning.³⁸

- Have heating systems, water heaters, and all other gas-, oil-, or coal-burning appliances serviced by a qualified technician every late summer or early fall.
- Install battery-operated CO detectors in homes, and check or replace batteries when changing the time on clocks each spring and fall. If a detector sounds, leave the home immediately and call 911.
- Seek medical attention promptly if CO poisoning is suspected and if you feel dizzy, light-headed, or nauseated.
- Do not use a generator, charcoal grill, camp stove, or other gasoline- or charcoal-burning device inside the home, basement, garage, or outside the home near a window.
- Never leave a car or truck running inside a garage attached to a house, even if the garage door is left open.
- Do not use a stove or fireplace that is not vented to the outside.
- Do not use a gas cooking oven for heat.

ADDITIONAL RESOURCES

- CDC Poisoning Prevention: www.cdc.gov/ncipc/factsheets/poisonprevention.htm
- American Association of Poison Centers: www.aapcc.org
- CDC Air Pollution and Respiratory Health Branch (APRHB) Carbon Monoxide Poisoning Prevention: www.cdc.gov/co/guidelines.htm



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