

MU Guide

Pesticide Poisoning Symptoms and First Aid

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Pesticide poisoning is a commonly under-diagnosed illness. Health care providers generally receive a limited amount of training in occupational and environmental health, especially in pesticide-related illnesses. Clinical toxicology is a dynamic field of medicine; new treatment methods are developed regularly, and the effectiveness of old as well as new techniques is subject to constant review. *Prevention* of pesticide poisoning remains a much surer path to safety and health than reliance on treatment. Therefore, the most important rule when using pesticides is to **read and follow instructions and precautions on the label.**

The purpose of this guide is to describe the health hazards of pesticides currently in use and to present consensus recommendations for management of poisonings and injuries caused by them.

Common pesticide poisonings

Table 1 shows the pesticides most often implicated in poisonings, injuries and illnesses, according to 1996 data from the Toxic Exposure Surveillance System of the American Association of Poison Control Centers. The list is based on symptomatic cases classified as minor, moderate, major, or fatal outcome for unintentional cases involving a single product. Numbers of cases are reported for both children under six years of age and for adults and other children. Suicide/homicide (intentional) cases have been excluded. Cases listed as organophosphates (and the other categories as well) may also include other insecticides such as carbamates and organochlorines in a single product.

About 90 percent of symptomatic cases involve only minor symptoms that could typically be treated at home with dilution or just observation. However, seven of the top ten categories listed in Table 1 (organophosphates, pyrethrins/pyrethroids, hypochlorite disinfectants, carbamates, organochlorines, phenoxy herbicides and anticoagulant rodenticides) are much more likely to require medical attention.

The list is not representative of all symptomatic poisonings because it shows only cases reported to Poison Control Centers. However, it does give a sense

Table 1. Pesticides most often implicated in symptomatic illnesses, 1996.

Rank	Pesticide or pesticide class	Number of cases		
		Children less than 6 years old	Adults and older children	Total*
1	Organophosphates	700	3,274	4,002
2	Pyrethrins and pyrethroids**	1,100	2,850	3,950
3	Pine oil disinfectants	1,336	903	2,246
4	Hypochlorite disinfectants	808	1,291	2,109
5	Insect repellents	1,081	997	2,086
6	Phenol disinfectants	630	405	1,040
7	Carbamates	202	817	1,030
8	Organochlorines	229	454	685
9	Phenoxy herbicides	63	387	453
10	Anticoagulant rodenticides	176	33	209
	All other pesticides	954	3,604	4,623
	Total all pesticides and disinfectants	7,279	15,015	22,433

*Totals include a small number of cases with unknown age.

**Rough estimate: includes some veterinary products not classified by chemical type.

Source: American Association of Poison Control Centers, Toxic Exposure Surveillance System, 1996 data.

of the relative frequency and risk of poisoning from various agents or classes of agents. The relative frequency of cases generally reflects how widely a product is used in the environment. For example, a number of disinfectants occur in the top ten partly because they are far more commonly found in the home and work environment than other pesticides.

Poison Control Centers are best able to collect data on pesticide exposures that occur in residential settings; occupational exposures are not as well covered. In occupational exposures to pesticides, dermal and eye injuries are more common than systemic poisonings, although systemic poisonings are likely to be more severe.

Information sources for pesticide poisoning emergencies

Missouri Regional Poison Control Center	1-800-366-8888
Children's Mercy Hospital, Kansas City	(816) 234-3371
National Pesticide Safety Team Network	1-800-424-9300

Table 2. Typical precautionary statements on pesticide labeling.

Exposure	Highly toxic	Moderately toxic	Slightly toxic
Acute oral	"Fatal if swallowed," or "Can kill you if swallowed."	"Harmful or fatal if swallowed," or "May be fatal if swallowed."	"Harmful if swallowed," or "May be harmful if swallowed."
Acute inhalation	"Poisonous if inhaled," or "Can kill you if breathed," and "Do not breathe dusts, vapors, or spray mist."	"Harmful or fatal if inhaled," or "May be fatal if breathed," and a statement such as "Do not breathe dusts, vapors, or spray mist."	"Harmful if inhaled," or "May be harmful if breathed," and "Avoid breathing dusts, vapors, or spray mist."
Acute dermal	"Fatal if absorbed through the skin," or "Can kill you by skin contact," and "Do not get on skin or clothing."	"Harmful or fatal if absorbed through the skin," or "May be fatal by skin contact," and a statement such as "Do not get on skin or clothing."	"Harmful if absorbed through skin," or "May be harmful by skin contact," and "Avoid contact with skin or clothing."
Skin irritation	"Corrosive – causes severe skin burns," and "Do not get on skin."	"Causes skin irritation," or "Causes skin burns," followed by a statement such as "Do not get on skin."	"May irritate skin," and "Avoid contact with skin."
Eye irritation	"Corrosive – causes irreversible eye damage," or "Causes severe eye burns or blindness," and "Do not get in eyes."	"Causes eye irritation," or "Causes eye burns," and a statement such as "Do not get in eyes."	"May irritate eyes," and "Avoid contact with eyes."

First aid supplies

A well-stocked first aid kit will contain some of the supplies needed for treating pesticide exposure. When setting up a first aid station for pesticide emergencies, be sure to include the following items:

- Eyewash bottle
- Plenty of clean water
- Syrup of ipecac
- Activated charcoal powder
- Soap
- Disposable towels
- Clean change of clothes

Now is the time to make a list of emergency telephone numbers so they will be readily available if needed. The following list contains several sources of information regarding pesticide poisoning emergencies. You should also include the telephone numbers of your local emergency response provider (e.g., 911) and your local emergency medical facility.

Effects of pesticide exposure

Effects of exposure to pesticides generally fall into three categories: allergic, acute and delayed effects.

Allergic effects. Some people develop a reaction after being exposed to a certain pesticide, a process known as sensitization. Such effects include asthma, skin irritation and eye and nose irritation. Not all people develop allergies; however, certain people seem to be more sensitive than others to chemical irritants.

Acute effects. Acute effects appear immediately or within 24 hours of exposure. These are more accurately diagnosed than delayed effects because they tend to be more obvious. Often they are reversible if appropriate medical care is given promptly, but may be fatal if not treated. Acute effects of pesticides are classified accord-

ing to the site of the exposure: oral, inhalation, dermal and eye exposures. Table 2 shows typical precautionary statements used on pesticide labels to describe both allergic and acute effects.

Delayed effects. Sometimes, the term "chronic effects" is used to describe delayed effects, but this is only one type of delayed effect. *Delayed effects* also include *developmental*, *reproductive* and *systemic effects*. Chronic effects are illnesses or injuries that persist over long periods and may not appear until several years after exposure to a pesticide. Chronic effects include production of tumors, malignancy or cancer and changes in the genes or chromosomes. Developmental and reproductive effects occur to the fetus in the womb or by exposure to the reproductive system in men as well as women. These effects include birth defects, miscarriage or stillbirth, infertility or sterility in men or women and impotence in men. A delayed systemic effect is an illness or injury that does not appear within 24 hours of exposure. Such effects include blood disorders such as anemia or an inability to coagulate; nerve or brain disorders such as paralysis, tremor, behavioral changes and brain damage; skin disorders such as rash; lung and respiratory disorders such as emphysema and asthma; and liver and kidney disorders such as jaundice and kidney failure.

Principles for treating acute pesticide poisonings

Specific recommendations for managing acute pesticide poisoning vary among the different types of pesticide. For specific information on treatment, refer to individual pesticide labels or call the Poison Control Center. In an emergency, always take the pesticide label with you to the emergency medical facility and have it available when calling the Poison Control Center. The

following are guidelines for treatment of pesticide poisoning.

Skin decontamination. The hands and forearms account for the majority of skin exposures to pesticides. These exposures usually result from splashing or spilling of pesticides during the mixing operation. All contaminated clothing should be removed. Wash the exposed area with generous amounts of water and soap. If much of the body is exposed, shower the victim with soap and water, and use shampoo to remove chemicals from the scalp and hair. Also consider that pesticides may be held under fingernails and in skin folds. Persons attending the victim should avoid direct contact with heavily contaminated clothing and wear chemical-resistant gloves while washing the victim.

Respiratory exposure. Move the victim to fresh air immediately. Ensure that a clear airway exists. If the victim is convulsing, watch breathing and protect the person from falls and blows to the head. Pull the victim's chin forward so that the tongue does not block the air passage. If the victim appears neurologically impaired, it may be necessary to administer oxygen. There are several special considerations with regard to certain pesticides. If breathing has stopped, begin artificial respiration and continue until breathing resumes or until you reach the hospital.

Pesticides in the eye. It is important to wash the eye as quickly and as gently as possible; some pesticides can cause damage on contact. Hold eyelids open and wash eyes with a gentle stream of clean running water at body temperature if possible. Continue washing for 15 minutes or more. Do not use chemicals or drugs in wash water; they may increase the potential for injury. It is important to set up an eyewash station in the area where pesticides will be mixed or at least have ready access to an eyewash bottle in the first aid kit.

Chemical burns on the skin. Remove contaminated clothing. Wash the skin with large quantities of cold running water. Avoid using ointments, greases, powders and other drugs in first aid treatment of chemical burns.

Swallowed pesticide. Ingestion of a pesticide requires immediate medical attention.

- If pesticide is still in the mouth, wash it out with plenty of water. Quickly but carefully read the first aid section of the pesticide label again or contact the Poison Control Center to see if the swallowed pesticide should be diluted. The label or the Poison Control Center will specify what should be used to dilute the pesticide. Some pesticides should never be diluted; this information will be stated on the label or is available from the Poison Control Center.
- Check to see if vomiting should be induced. If so, move the victim to a kneeling position to prevent choking. You can use syrup of ipecac to induce vomiting, but if it is not available, put your finger in the victim's mouth and touch the back of the

victim's throat. Do not use salt water to induce vomiting or attempt to give liquids.

- Do not induce vomiting if the victim is unconscious, because the victim could choke.
- First aid for some swallowed pesticides includes giving activated charcoal after vomiting. This material adsorbs many chemicals and is available without a prescription. It is a powder mixed with water and given to the victim to drink. It should not be given at the same time as syrup of ipecac; the charcoal adsorbs the syrup, thus negating the beneficial effects of the syrup.
- Keep the victim calm and contact the local emergency response system, or take the victim to the nearest medical facility. Also take the product label and any Material Safety Data Sheets you have about the swallowed pesticide.

Herbicides

In general, many of the commonly used herbicides cause irritation to the skin, eyes and respiratory tract. Because herbicides kill weeds by impairing metabolic processes that are unique to plant life, their systemic toxicities in mammals are generally low. Nonetheless, some herbicides pose a significant risk of poisoning if handled carelessly, and all herbicides should be handled with full attention to safety measures that minimize personal contact. Some formulations contain adjuvants that may have significant irritating and toxic effects. Just because a herbicide is reported to have a high LD₅₀ (the dose that will produce death in 50 percent of test animals) does not justify neglecting good hygienic practice. In the event of exposure to one of these materials, follow general procedures for treating pesticide poisoning (as outlined above) before seeking professional medical assistance.

Insecticides

Organophosphates

The organophosphate insecticides are the most widely used class of insecticides today. More than 40 of them are currently registered for use, and all pose the risk of acute toxicity. Examples of commonly used organophosphates include chlorpyrifos, diazinon, malathion and methyl parathion. According to the American Association of Poison Control Centers, organophosphates are the most commonly implicated class of all pesticides in symptomatic illnesses (1996 data). All apparently share a common mechanism of cholinesterase inhibition and can cause similar symptoms. Because they share this mechanism, exposure to the same organophosphate by multiple routes or to multiple organophosphates by multiple routes can lead to serious additive toxicity. It is important to understand that there is a wide range of toxicity in these agents and wide variation in their absorption capacities. Exposure

by inhalation results in the fastest appearance of toxic symptoms, followed by the gastrointestinal route and finally the dermal route. The most commonly reported early symptoms include headache, nausea, dizziness, and increased secretions, such as sweating, salivation, tearing and respiratory secretions. Progressive symptoms include muscle twitching, weakness, tremor, incoordination, vomiting, abdominal cramps and diarrhea. Some victims may have altered vision, such as blurred or dark vision. Persons attending a victim should avoid direct contact with contaminated clothing and wear chemical-resistant gloves while washing the pesticide from the victim's skin and hair. Antidotes are available for treating organophosphate exposure, most notably atropine sulfate. In all cases, antidotes should be administered by a health professional.

Blood tests can be used to determine whether organophosphates have accumulated in a person's body. One such test uses cholinesterase, an enzyme that occurs naturally in the blood at levels that vary from one person to another. "Baseline" levels of cholinesterase for an individual can be determined at a time of the year when pesticide handling is minimal. The baseline helps determine the normal level of cholinesterase in the body. Other tests throughout the year indicate if there is a reduction in the baseline level. If a reduction has occurred, the individual should not apply organophosphate insecticides. The body normally produces new cholinesterase continuously, and levels return to normal after several weeks.

Carbamates

Carbamate insecticides are widely used in homes, gardens and agriculture. Common examples of carbamates include aldicarb, carbaryl and carbofuran. Like organophosphates, they inhibit cholinesterase enzymes and therefore share similar exposure symptoms, although carbamate poisonings tend to be of shorter duration.

As with the organophosphates, blood tests can determine whether carbamate insecticides are affecting cholinesterase levels.

Boric acid and borates

Boric acid is formulated as tablets and powder to kill larvae in livestock confinement areas and cockroaches, ants and other insects in structures. Because they are used in residences, boric acid powders and pellets scattered on floors do present a hazard to children. Boric acid dust is moderately irritating to skin. If inhaled, symptoms include nasal irritation, dryness of mucous membranes, cough, shortness of breath and chest tightness. If ingested, boric acid can cause nausea, persistent vomiting, abdominal pain and diarrhea. If a victim has ingested this type of pesticide and is treated within an hour of the accident, follow the guidelines for a swallowed pesticide (as outlined above). Because the

victim may be vomiting and have diarrhea, syrup of ipecac should not be given.

Pyrethroids

Pyrethroids are synthetic insecticides used in a variety of settings. Common examples include cyfluthrin, cypermethrin and permethrin. Systemic toxicity by inhalation and dermal absorption is low, and pyrethroids are promptly excreted by the kidney. If exposed to the skin, inflammatory reaction usually occurs within one to two hours. Pyrethroids are not cholinesterase inhibitors; some poisonings have been misdiagnosed as organophosphate exposure because of some of the same symptoms. If large amounts of pyrethroids have been ingested and the victim is seen soon after the accident, follow the guidelines for a swallowed pesticide (as outlined above).

Fungicides

Historically, some of the most tragic and large-scale occurrences of pesticide poisoning have been due to mistaken consumption of seed grain treated with organic mercury or hexachlorobenzene. Today, those products have been replaced with much safer materials; and, most fungicides currently in use are unlikely to cause frequent or severe systemic poisonings for several reasons. First, many have low inherent toxicity in mammals and are inefficiently absorbed. Second, many fungicides are formulated as suspensions of wettable powders or granules, from which rapid, efficient absorption is unlikely. And third, methods of application are such that relatively few individuals are intensively exposed. Apart from systemic poisonings, fungicides as a class are probably responsible for a disproportionate number of irritant injuries to the sinuses and skin.

Fumigants

Fumigants should be handled with great respect as they pose a dangerous risk. Fumigants diffuse rapidly, a property essential to their function. Some will readily penetrate rubber and neoprene personal protective equipment, as well as human skin. Even special adsorbents in respirator canisters may not provide complete protection when air concentrations of fumigants are high.

The most commonly used fumigants for treating stored products include methyl bromide and phosphine-producing materials. In structural fumigation, chloropicrin and sulfuryl fluoride are used. Following are brief descriptions of exposure symptoms for each of these fumigants.

Methyl bromide. Exposure to methyl bromide is severely irritating to the lower respiratory tract, sometimes causing fluid buildup in the lungs, hemorrhage or pneumonia. The onset of respiratory distress may be delayed 4 to 12 hours after exposure. Early symptoms

of acute poisoning include headache, dizziness, nausea, vomiting, tremor, slurred speech and unsteady movements. If liquid methyl bromide contacts the skin, severe burning, itching and blistering occur.

Phosphine. Like methyl bromide, phosphine is severely irritating to the respiratory tract. Most severe acute exposures have involved ingestion of solid aluminum phosphide, and mortality rates range from 50 to 90 percent. Onset symptoms of poisonings are fatigue, nausea, headache, dizziness, thirst, cough, shortness of breath, chest tightness and jaundice.

Chloropicrin. This fumigant is severely irritating to the upper respiratory tract, eyes and skin. Inhalation sometimes leads to vomiting. Ingestion could be expected to be corrosive to the gastrointestinal tract.

Sulfuryl fluoride. Death due to oxygen deficiency may follow when persons enter a structure too early after treatment. Early symptoms of exposure include nose, eye and throat irritation, weakness, nausea, vomiting, difficult breathing, cough, restlessness, muscle twitching and seizures.

To treat victims of fumigant exposure, remove them to fresh air immediately, keep them quiet and in a semi-reclining position. Anyone attempting to rescue a person suffering from fumigant exposure should be properly equipped with self-contained breathing apparatus. Minimum physical activity limits the likelihood of pulmonary edema, a medical emergency characterized by the accumulation of abnormally large amounts of fluid in the lungs. If skin is contaminated, flush with water for at least 15 minutes. Seek medical attention immediately.

Rodenticides

Rodenticides pose particular risks for accidental poisonings for several reasons. Since they are designed specifically to kill mammals, usually rodents, their toxicity would be similar for humans. Warfarin and other anticoagulant rodenticides were initially developed to overcome this problem by creating compounds that were highly toxic to rodents, but much less toxic to humans. Because rodents usually share human environments, use of rodenticides poses an inherent risk of exposure to humans, especially children. Finally, as rodents have developed resistance to existing rodenticides, there is a continuous need to develop new and potentially more toxic rodenticides. Any situation in which it is suspected that these pesticides have been ingested should be overseen by a medical health professional. Information about specific rodenticides is outlined below.

Warfarin and related compounds (*coumarins and indandiones*). These have been the most commonly ingested rodenticides in the United States according to 1996 data. Effects usually begin several days following ingestion because of their long half-lives. Nosebleeds, bleeding gums and blood in the urine are some obvious signs. Victims may also have symptoms of anemia, including fatigue. If poisoning is severe, the victim may progress to shock and death.

Zinc phosphide. Poisonings by ingested zinc phosphide are extremely difficult to manage. Control of the airway and convulsions must be established before considering gastrointestinal decontamination.

Strychnine. A lethal dose of this natural toxin is as little as 15 mg in children. Strychnine causes violent convulsions because of its direct action on the central nervous system, chiefly the spinal cord. The onset of symptoms begins usually within 15 to 20 minutes of ingestion.

Wood preservatives

Creosote. Creosote is used extensively as a wood preservative, usually by high-pressure impregnation of lumber. It is irritating to skin, eyes and mucous membranes. Systemic poisonings following dermal absorption have been rare; workers in contact with creosote sometimes develop skin irritation. It is most important to avoid contamination of skin or eyes and inhalation of vapor. If eye contamination occurs, wash with profuse amounts of water, and then seek medical attention promptly because corneal injury may be severe. Skin contamination should be promptly washed off with soap and water.

Pentachlorophenol (Penta). Penta is also used in pressure treatment of lumber. The most common effects include irritation of the nose, throat and eyes, producing a stuffy nose, scratchy throat and tearing. Dermal exposure may lead to irritation and dermatitis. Most occupational poisonings occur through dermal contact. If skin exposure occurs, follow decontamination procedures as listed above.

A final word

Remember that prevention is the key to safe handling of pesticides. Reading and following the pesticide label is the best way to prepare for handling pesticides. If there is any doubt about the seriousness of any poisoning or you are unsure about which procedures to take, contact the Poison Control Center.

For further information

- G 1914 *Laundering Pesticide-Contaminated Clothing*
- G 1916 *Pesticide Application Safety*
- G 1917 *Personal Protective Equipment for Working With Pesticides*
- G 1918 *Homeowner Chemical Safety*

Extension Publications

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