

Pesticides - Harmful Effects and Emergency Response

Most pesticides are designed to harm or kill pests. Because some pests have systems similar to the human system, some pesticides also can harm or kill humans. Fortunately, humans usually can avoid harmful effects by avoiding being exposed to pesticides.

Humans may be harmed by pesticides in two ways: they may be **poisoned** or **injured**. Pesticide **poisoning** is caused by pesticides that harm internal organs or other systems inside the body. Pesticide-related **injuries** usually are caused by pesticides that are external irritants.

Pesticides that are chemically similar to one another cause the same type of harmful effects to humans. These effects may be mild or severe, depending on the pesticide involved and the amount of overexposure. But the **pattern** of illness or injury caused by each chemical group is usually the same. Some pesticide chemical families can cause both external irritation injuries and internal poisoning illnesses.

Some pesticides are highly toxic to humans; only a few drops in the mouth or on the skin can cause extremely harmful effects. Other pesticides are less toxic, but too much exposure to them also will cause harmful effects. A good equation to remember is:

Hazard = Toxicity x Exposure

Hazard is the risk of harmful effects from pesticides. Hazard depends on both the **toxicity** of the pesticide and your **exposure**.

Exposure

When a pesticide contacts a surface or organism, that contact is called a pesticide exposure. For humans, a pesticide exposure means getting pesticides in or on the body. The toxic effect of a pesticide exposure depends on how much

pesticide is involved and how long it remains there.

Types of Exposures

Pesticides contact your body in four main ways:

Oral exposure (when you swallow a pesticide), Inhalation exposure (when you breathe in a pesticide), Ocular – (through the eyes), or Dermal (through the skin)

Avoiding Exposure

Avoiding and reducing exposures to pesticides will reduce the harmful effects from pesticides. You can avoid exposures by using safety systems, such as closed systems and enclosed cabs, and you can reduce exposures by wearing appropriate personal protective equipment (PPE), washing exposed areas often, and keeping your personal protective equipment clean and in good operating condition.

In most pesticide handling situations, the skin is the part of the body that is most likely to receive exposure.

About 97 percent of all body exposure that happens during pesticide spraying is through skin contact.

The only time inhalation is a greater hazard than skin contact is when you are working in a poorly ventilated enclosed space and are using a fumigant or other pesticide that is highly toxic by inhalation.

The amount of pesticide absorbed through your skin (and eyes) and into your body depends on -- the pesticide and the material used to dilute it.

ECs, oil-based liquid pesticides, and oil-based diluents (such as xylene) are, in general, absorbed most readily. Water-based pesticides and dilutions (such as WPs, SPs and DFs) usually are absorbed less readily than the oil-based liquid formulations but more readily than dry formulations. Dusts, granules, and other dry formulations are not absorbed as readily as liquids.

The area of the body exposed. The genital area tends to be the most absorptive. The scalp, ear canal, and forehead are also highly absorptive.

Cuts, abrasions, and skin rashes allow absorption more readily than intact skin. Hot, sweaty skin will absorb more pesticide than dry, cool skin.

Causes of Exposure

One of the best ways to avoid pesticide exposures is to avoid situations and practices where exposures commonly occur.

Oral exposures often are caused by: not washing hands before eating, drinking, smoking, or chewing, mistaking the pesticide for food or drink, accidentally applying pesticides to food, or splashing pesticide into the mouth through carelessness or accident.

Inhalation exposures often are caused by: prolonged contact with pesticides in closed or poorly ventilated spaces, breathing vapors from fumigants and other toxic pesticides, breathing vapors, dust, or mist while handling pesticides without appropriate protective equipment, inhaling vapors immediately after a pesticide is applied; for example, from drift or from reentering the area too soon, and using a respirator that fits poorly or using an old or inadequate filter, cartridge, or canister.

Dermal exposures often are caused by: not washing hands after handling pesticides or their containers, splashing or spraying pesticides on unprotected skin, wearing pesticide-contaminated clothing (including boots and gloves), applying pesticides in windy weather,

wearing inadequate personal protective equipment while handling pesticides, and touching pesticide-treated surfaces.

Eye exposures often are caused by splashing or spraying pesticides in eyes, applying pesticides in windy weather without eye protection, rubbing eyes or forehead with contaminated gloves or hands, and pouring dust, granule, or powder formulations without eye protection.

Toxicity

Toxicity is a measure of the ability of a chemical to cause harmful effects. It depends on the types and amounts of active ingredient(s), solvent(s), - - inert ingredient(s), and formulation.

The toxicity of a particular pesticide is measured by subjecting laboratory animals (usually rats, mice, rabbits, and dogs) or tissue cultures to different dosages of the active ingredient and of the formulated product over various times. These toxicity studies help to estimate the risk that the pesticide may cause harmful effects in humans.

However, some people react more severely or more mildly than estimated. Be alert to your body's reaction to the pesticides you are handling. Some people seem to be especially sensitive to individual pesticides or to groups of similar pesticides.

You may have a choice of pesticides for a particular pest problem. Consider how toxic each pesticide is to persons who will use it or be exposed to it.

Harmful Effects

Pesticides can cause three types of harmful effects: **acute**, **delayed**, and **allergic**.

Acute Effects

Acute effects are illnesses or injuries that may appear immediately after exposure to a pesticide (usually within 24 hours).

Studying a pesticide's relative ability to cause acute effects has been the main way to assess and compare how toxic pesticides are. Acute effects can be measured more accurately than delayed effects, and they are more easily diagnosed than effects that do not appear until long after the exposure. Acute effects usually are obvious and often are reversible if appropriate medical care is given promptly.

Pesticides cause four types of acute effects: ORAL, INHALATION, SKIN, and EYE.

Acute oral effects -- Your mouth, throat, and stomach can be burned severely by some pesticides. Other pesticides that you swallow will not burn your digestive system but will be absorbed and carried in your blood throughout your body and may cause harm in various ways.

For some pesticides, swallowing even a few drops from a splash or wiping your mouth with a contaminated glove can make you very ill or make it difficult to eat and drink.

Acute inhalation effects -- Your entire respiratory system can be burned by some pesticides, making it difficult to breathe. Other pesticides that you may inhale may not harm your respiratory system but are carried quickly in your blood throughout your whole body where they can harm you.

Acute dermal effects -- Contact with some pesticides will harm your skin. These pesticides may cause your skin to itch, blister, crack, or change color. Other pesticides can pass through your skin and eyes and get into your body. Once inside your body, these pesticides are carried throughout your system where they can harm you.

Acute eye effects -- Some pesticides that get into your eyes can cause temporary or permanent blindness or severe irritation. Other

pesticides may not irritate your eyes but pass through your eyes and into your body. These pesticides can travel throughout your body, harming you.

Delayed Effects

Delayed effects are illnesses or injuries that do not appear immediately (within 24 hours) after exposure to a pesticide or combination of pesticides. Often the term "chronic effects" is used to describe delayed effects, but this term is applicable only to certain types of delayed effects.

Delayed effects may be caused by: **repeated exposures** to a pesticide, a pesticide group, or a combination of pesticides over a long period of time, OR

a **single exposure** to a pesticide (or combination of pesticides) that causes a harmful reaction that does not become apparent until much later.

Sometimes repeated exposures to a pesticide or family of pesticides will result in a delayed effect but a larger exposure will cause an acute effect. A person who is repeatedly exposed to two or more specific chemicals may become ill even though any one of the chemicals alone would have had no harmful health impact.

In some cases, a **single exposure** to a pesticide (or combination of pesticides) could adversely affect the exposed person's health later. For example, large exposures to herbicide paraquat may cause severe or fatal lung injury that does not appear for 3 to 14 days after the initial exposure. After an exposure, paraquat slowly builds up in the lungs and destroys lung cells.

Some kinds of harmful effects may not occur unless a certain set of circumstances is present. These effects can occur after the first exposure, but the likelihood is small. Continuous or frequent exposures over a long period of time make it more likely that all the necessary factors will be present. Some genetic changes that result in the development of cancer or other delayed effects are in this category.

Types of delayed effects include: 1) chronic effects, 2) developmental and reproductive effects, and 3) systemic effects.

Chronic effects -- Chronic effects are illnesses or injuries that appear a long time, usually several years, after exposure to a pesticide. Some delayed effects that are suspected to result from pesticides' chronic toxicity include:

- production of tumors (oncogenic effect),
- production of malignancy or cancer (carcinogenic effect), or
- changes in the genes or chromosomes (mutagenic effect).

Determining delayed effects -- Because of the time delay between the exposure and the observable effect, and because many other types of exposures may have occurred during the delay, it is sometimes hard to identify the cause of a delayed effect. Although some pesticides may cause delayed effects in laboratory animals, further studies are needed to determine whether these pesticides will affect humans the same way.

When there is clear evidence that a pesticide may cause chronic, developmental, reproductive, or systemic effects in humans, the EPA will determine what steps are appropriate to reduce or eliminate the risk. Such actions include:

removing the pesticide from use,

requiring label warning statements about the possible effects,

requiring specific personal protective equipment or safety systems during handling of the pesticide,

requiring changes in dosages, method or frequency of application, and waiting times before entry or harvest/slaughter/grazing,

restricting the use to certified applicators.

Avoiding delayed effects -- Scientists, pesticide manufacturers, and the EPA cannot yet be sure what the delayed effects of too much exposure to individual pesticides or combinations of

pesticides may be. It may be years before there are clear answers on the effects of all the pesticides and combinations of pesticides used today. Meanwhile, it makes good sense to reduce your exposure to all pesticides as much as possible.

Allergic Effects

Allergic effects are harmful effects that some people develop in reaction to substances that do not cause the same reaction in most other people. Allergic reactions are not thought to occur during a person's first exposure to a substance. The first exposure causes the body to develop repelling response chemicals to that substance. Later exposures result in the allergic response. This process is called **sensitization**, and substances that cause people to become allergic to them are known as **sensitizers**.

Certain substances cause many people to develop an allergic reaction. Poison ivy, for example, causes a severe skin rash in many people. Other substances cause allergic reactions in only a few people. Turfgrass, for example, causes a severe skin rash in relatively few people.

Types of allergic effects -- Some people are sensitized to certain pesticides. After being exposed once or a few times without effect, they develop a severe allergy-like response upon later exposures. These allergic effects include:

systemic effects, such as asthma or even life-threatening shock,

skin irritation, such as rash, blisters, or open sores, and

eye and nose irritation, such as itchy, watery eyes and sneezing.

Unfortunately, there is no way to tell which people may develop allergies to which pesticides. However, certain people seem to be more chemically sensitive than others. They develop an allergic response to many types of chemicals in their environment. These persons

may be more likely to develop allergies to pesticides.

Typical precautionary statements on pesticide labeling include:

"This product may produce temporary allergic side effects characterized by redness of the eyes, mild bronchial irritation, and redness or rash on exposed skin areas. Persons having allergic reactions should contact a physician."

Avoiding allergic effects -- Depending on how severe the allergic reaction is, persons with allergies to certain pesticides may have to stop handling or working around those pesticides. They may be unable to tolerate even slight exposures. Sometimes persons with allergies to certain pesticides can continue to work in situations where those pesticides are present by reducing their exposure to them.

Know the Law

The **Hazard Communication Standard (HCS)**, a regulation under the Occupational Safety and Health Act (OSHA), requires employers to provide protections to workers who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies. The HCS, which is administered by the U.S. Department of Labor, requires employers to:

- 1) Make a list of the hazardous chemicals in the workplace,
 - 2) Obtain material safety data sheets (MSDS) for all hazardous substances on their list and keep them in a file that is available to all workers,
 - 3) ensure that all containers of hazardous materials are labeled at all times,
 - 4) train all workers about the hazardous materials in their workplace.
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Signs and Symptoms of Harmful Effects

Watch for two kinds of clues to pesticide-related illness or injury. Some clues are feelings that only the person who has been poisoned can notice, such as nausea or headache. These are **symptoms**. Other clues, like vomiting or fainting, can be noticed by someone else. These are **signs**.

You should know:

what your own symptoms might mean, and

what signs of poisoning to look for in your coworkers and others who may have been exposed.

Many of the signs and symptoms of pesticide poisoning are similar to signs and symptoms of other illnesses you might experience, such as the flu or even a hangover. If you have been working with pesticides and then develop suspicious signs and symptoms, call your physician or poison control center. Only a physician can diagnose pesticide poisoning injuries.

External irritants cause redness, blisters, rash, and/or burns on skin, and swelling, a stinging sensation, and/or burns in eyes, nose, mouth, and throat.

Pesticide poisoning may cause nausea, vomiting, diarrhea, and/or stomach cramps, headache, dizziness, weakness, and/or confusion, excessive sweating, chills, and/or thirst, chest pains, difficult breathing, cramps in your muscles or aches all over your body.

Telltale signs or symptoms -- Ask your physician or poison control center to obtain the latest edition of "Recognition and Management of Pesticide Poisonings" by Donald P. Morgan, M.D., Ph.D. It is available through the U.S. Environmental Protection Agency or from the U.S. Government Printing Office. Many physicians have not been trained to recognize and treat pesticide poisonings or injury and may rarely see such cases.

Be informed -- You should know the kinds of harmful effects most likely to be caused by the pesticides you use. The appendix, *Effects of Pesticides on the Human Body*, contains a guide to help you judge how the products you use might affect you. The chart lists the major groups of pesticides. For each group, it tells:

- the action of the poison on the human system,
- acute poisoning (systemic) effects, ▪ acute irritation effects, ▪ delayed or allergic effects, and ▪ type of pesticide.

Responding to a Poisoning Emergency

Get medical advice quickly if you or any of your fellow workers have unusual or unexplained symptoms starting at work or later the same day. Do not let yourself or anyone else get dangerously sick before calling your physician or going to a hospital. It is better to be too cautious than too late. Take the pesticide container (or the labeling) to the physician. Do not carry the pesticide container in the passenger space of a car or truck.

First Aid for Pesticide Poisoning

First aid is the initial effort to help a victim while medical help is on the way. If you are alone with the victim, make sure the victim is breathing and is not being further exposed to the pesticide before you call for emergency help. Apply artificial respiration if the victim is not breathing. Do not become exposed to the pesticide yourself while you are trying to help.

Look at the pesticide labeling. It gives specific first aid instructions. Follow those instructions carefully.

The best first aid in pesticide emergencies is to stop the source of pesticide exposure as quickly as possible.

Pesticide on skin:

Drench skin and clothing with plenty of water. Any source of relatively clean water will work. If possible, immerse the person in a pond, creek, or other body of water. Even water in ditches or irrigation systems will do, unless you think they may have pesticides in them.

Remove personal protective equipment and contaminated clothing.

Wash skin and hair thoroughly with a mild liquid detergent and water. If one is available, a shower is the best way to completely and thoroughly wash and rinse the entire body surface.

Dry victim and wrap in blanket or any clean clothing at hand. Do not allow to become chilled or overheated.

If skin is burned or otherwise injured, cover immediately with loose, clean, dry, soft cloth or bandage.

Do not apply ointments, greases, powders, or other drugs in first aid treatment of burns or injured skin.

Pesticide in eye:

Wash eye quickly but gently. Use an eyewash dispenser, if available. Otherwise, hold eyelid open and wash with a gentle drip of clean running water positioned so that it flows across the eye rather than directly into the eye.

Rinse eye for 15 minutes or more.

Do not use chemicals or drugs in the rinse water. They may increase the injury.

Inhaled pesticide:

Get victim to fresh air immediately.

If other people are in or near the area, warn them of the danger.

Loosen tight clothing on victim that would constrict breathing.

Apply artificial respiration if breathing has stopped or if the victim's skin is blue. If pesticide or vomit is on the victim's mouth or face, avoid direct contact and use a shaped airway tube, if available, for mouth-to-mouth resuscitation.

Pesticide in mouth or swallowed:

Rinse mouth with plenty of water.

Give victim large amounts (up to 1 quart) of milk or water to drink.

Induce vomiting only if instructions to do so are on the labeling.

Procedure for inducing vomiting:

Position victim face down or kneeling forward. Do not allow victim to lie on his back, because the vomit could enter the lungs and do additional damage.

Put finger or the blunt end of a spoon at the back of victim's throat or give syrup of ipecac. Do not use salt solutions to induce vomiting.

Do not induce vomiting:

If the victim is unconscious or is having convulsions.

If the victim has swallowed a corrosive poison. A corrosive poison is a strong acid or alkali. It will burn the throat and mouth as severely coming up as it did going down. It may get into the lungs and burn there also.

If the victim has swallowed an EC or oil solution. EC and oil solutions may cause death if inhaled during vomiting.

Know the Law

The Occupational Safety and Health Act (OSHA), administered by the U.S. Department of Labor, contains some requirements that could affect you if you or one of your employees is involved in a pesticide-related injury or illness.

Employers must keep records of all work-related deaths, injuries, and illnesses and make periodic reports. Minor injuries needing only first aid treatment need not be reported. You must keep records if the injury involved medical treatment, loss of consciousness, restriction of work or motion, or transfer to another job.

OSHA will investigate employee complaints related to exposure to hazardous materials, such as pesticides.

Heat Stress

Heat stress is the illness that occurs when your body is subjected to more heat than it can cope with. Heat stress is not caused by exposure to pesticides, but may affect pesticide handlers who are working in hot conditions. Personal protective equipment worn during pesticide handling activities can increase the risk of heat stress by limiting your body's ability to cool down. If you are under a physician's care, you should consult your physician before working in hot conditions.

Signs and Symptoms of Heat Stress

Mild forms of heat stress will make you feel ill and impair your ability to do a good job. You may get tired sooner, feel weak, be less alert, and be less able to use good judgment. Severe heat stress is a serious illness. Unless victims are cooled down quickly, they can die. Severe heat stress is fatal to more than 10 percent of its victims, even young, healthy adults. Many who survive suffer permanent damage. Sometimes the victims remain highly sensitive to heat for months and are unable to return to the same work.

Learn the signs and symptoms of heat stress and take immediate action to cool down if you suspect you may be suffering from even mild heat stress. Signs and symptoms may include:

fatigue (exhaustion, muscle weakness),
headache, nausea, and chills,
dizziness and fainting,
severe thirst and dry mouth,
clammy skin or hot, dry skin,
heavy sweating or complete lack of sweating,
altered behavior (confusion, slurred speech, quarrelsome or irrational attitude).

First Aid for Heat Stress

It is not always easy to tell the difference between heat stress illness and pesticide poisoning. The signs and symptoms are similar. Don't waste time trying to decide what is causing the illness. Get medical help.

First aid measures for heat stress victims are similar to those for persons who are overexposed to pesticides:

Get the victim into a shaded or cool area.

Cool victim as rapidly as possible by sponging or splashing skin, especially face, neck, hands, and forearms, with cool water or, when possible, immersing in cool water.

Carefully remove all personal protective equipment and any other clothing that may be making the victim too warm.

If the victim is conscious, have them drink as much cool water as possible.

Keep the victim quiet until help arrives.

Severe heat stress or heat stroke is a medical emergency! Brain damage and death may result if treatment is delayed.

Heat Cramps

Heat cramps can be quite painful. These muscle spasms in the legs, arms, or stomach are caused by loss of body salt through heavy sweating. To relieve cramps, have the victim drink lightly salted water or "sports drinks." Stretching or kneading the muscles may temporarily relieve the cramps. However, if you suspect that stomach cramps are being caused by pesticides rather than heavy sweating, get medical help right away.

Test Your Knowledge

Q-1. Explain the terms hazard, toxicity, and exposure, and tell how they relate to one another.

- **A.** *Hazard* is the risk of harmful effects from pesticides. *Toxicity* is a measure of the ability of a pesticide to cause harmful effects. *Exposure* is the total amount of pesticide that gets on or in the body.

Hazard = Toxicity x Exposure

Q-2. What are the four routes through which pesticides can contact your body and cause you to be exposed?

- **A.** 1. Oral exposure (when you swallow a pesticide) 2. Inhalation exposure (when you inhale a pesticide) 3. Ocular exposure (when you get a pesticide in your eyes) and 4. Dermal exposure (when you get a pesticide on your skin).

Q-3. Which route of exposure should you, as a pesticide handler, be most concerned about?

- **A.** About 97% of all body exposure that happens during pesticide spraying is through skin contact.

Q-4. What three factors determine how much pesticide will be absorbed through your skin and into your body?

- **A.** The amount of pesticide that is absorbed through your skin (and eyes) and into your body depends on: 1. The pesticide itself and the material used to dilute the pesticide. 2. Which area of the body is exposed. 3. The condition of the skin that is exposed.

Q-5. Explain delayed effects.

- **A.** Delayed effects are illnesses or injuries that do not appear immediately (within 24 hours) after exposure to a pesticide or combination of pesticides.

Q-6. How can you avoid harmful effects from pesticides?

- **A.** Avoiding and reducing exposures to pesticides will reduce the harmful effects from pesticides. You can reduce exposures by wearing appropriate personal protective equipment, washing exposed areas often, and keeping your personal protective equipment clean and in good operating condition.

Q-7. Name four signs or symptoms of pesticide poisoning and two signs or symptoms of irritation effects from pesticides.

- **A.** Pesticide poisoning may cause nausea, vomiting, diarrhea, and/or stomach cramps; headache, dizziness, weakness, and/or confusion; excessive sweating, chills, and/or thirst; chest pains; difficult breathing; cramps in your muscles or aches all over your body.

External irritants may cause redness, blisters, rash, and/or burns on skin, and swelling, a stinging sensation, and/or burns in eyes, nose, mouth, and throat.

Q-8. What is the first thing you should do when you or someone else is overexposed to pesticides?

- **A.** The best first aid in pesticide emergencies is to stop the source of pesticide exposure as quickly as possible. If pesticide is on the skin or in the eyes, flood with water; if the pesticide has been swallowed, drink large amounts of water; if the pesticide has been inhaled, get to fresh air.

Q-9. What is heat stress?

- **A.** Heat stress is the illness that occurs when your body is subjected to more heat than it can cope with.

Q-10. What are some common signs and symptoms of heat stress?

- **A.** Heat stress may cause fatigue (exhaustion, muscle weakness); headache, nausea, and chills; dizziness and fainting; severe thirst and dry mouth; clammy skin or hot, dry skin; heavy sweating or complete lack of sweating; altered behavior (confusion, slurred speech, and quarrelsome or irrational behavior).

Q-11. If you are not sure whether a person is suffering from heat stress or pesticide poisoning, what should you do?

- **A.** Because so many signs and symptoms could be from either heat stress or pesticide poisoning, do not waste time trying to diagnose the problem -- get medical help. In the meantime, get the person to a cooler place away from pesticides. Remove personal protective equipment or other clothing that could be contaminating the skin or making the person too warm, use water to clean and cool the skin, and give the person plenty of water to drink.