

1. PUBLIC HEALTH STATEMENT

This public health statement tells you about dichlorvos and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal cleanup. Dichlorvos has been found in at least 3 of the 1,430 current or former NPL sites. However, it's unknown how many NPL sites have been evaluated for this substance. As more sites are evaluated, the sites with dichlorvos may increase. This is important because exposure to this substance may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact. If you are exposed to dichlorvos, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS DICHLORVOS?

Dichlorvos is a synthetic organic chemical used as an insecticide. Dichlorvos does not occur naturally in the environment, but is manufactured by industry. Dichlorvos is sold under many trade names including Vapona[®], Atgard[®], Nuvan[®], and Task[®]. Dichlorvos may also be called DDVP, which is an abbreviation for its full chemical name. Pure dichlorvos is a dense colorless liquid that evaporates easily into the air and dissolves slightly in water. Dichlorvos has a sweetish smell and readily reacts with water. The dichlorvos used in pest control is

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diluted with other liquids and used as a spray. It can also be incorporated into plastic that slowly releases the chemical. The dichlorvos present at hazardous waste sites will most likely be in a liquid solution or as solid plastic pellets or strips.

Dichlorvos is manufactured by a reaction between two other chemicals called chloral and trimethyl phosphite. It is also manufactured by heating a chemical called trichlorfon. In 1984, about 1 million pounds of dichlorvos was manufactured in the United States. The main uses of dichlorvos are for insect control in food storage areas, greenhouses, and barns, and for parasite control in livestock. Dichlorvos is generally not used on outdoor crops. It is sometimes used for insect control in workplaces and the home. Veterinarians also use it to control parasites in pets. Dichlorvos was the active ingredient in "No-Pest Strips," but is no longer used for this purpose. You will find further information on the physical properties and uses of dichlorvos in Chapters 3 and 4 of this profile.

1.2 WHAT HAPPENS TO DICHLORVOS WHEN IT ENTERS THE ENVIRONMENT?

Dichlorvos enters the air, water, and soil during its manufacture and use. Wastes containing dichlorvos that are generated during its manufacture and use are sometimes disposed of in landfills. It can enter the environment from these landfills. Dichlorvos also enters the environment from accidental spills during transport and leaks from storage containers.

Dichlorvos evaporates easily into the air, which is why it is usually used in enclosed areas. Once in the air, it can react with water vapor and be broken down. The higher the temperature and the humidity, the more rapidly dichlorvos is broken down. Experiments in greenhouses and food storage areas show that 90% of the applied dichlorvos disappeared in 3-6 hours. The products of this breakdown are two chemicals called dimethyl phosphate and dichloroacetaldehyde. These chemicals are less harmful than dichlorvos and are not believed to cause health effects in people.

If dichlorvos is spilled into a lake or river, it will dissolve in the water. Some dichlorvos will then evaporate into the air, but most of it will be broken down when it reacts with the water.

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The less acid the water is, the more rapidly dichlorvos is broken down. Bacteria and other microorganisms (microscopic plants and animals) in lakes and rivers can also break down dichlorvos. In an experiment where dichlorvos was applied to a pond, 50% of the chemical was broken down in 24-36 hours.

Dichlorvos does not seem to bind to soil. This means it can move through soil fairly rapidly. The breakdown in soil is less rapid than in air or water. Dichlorvos breakdown is most rapid in moist soils with low acidity. In a laboratory experiment with soil that contained 200 parts of dichlorvos per million parts of soil (200 ppm), 37% of the dichlorvos remained in the soil after 3 days. Dichlorvos remains for longer periods in dry, acidic soil. Certain bacteria and other microorganisms in the soil can also break down dichlorvos.

Dichlorvos is not stored, accumulated, or concentrated by plants, fish, animals, or people.

You will find further information about what happens to dichlorvos in the environment in Chapter 5 of this profile.

1.3 HOW MIGHT I BE EXPOSED TO DICHLORVOS?

The general population is not likely to be exposed to dichlorvos. It has not been found in drinking water in the United States and only very rarely in outdoor air. Dichlorvos has occasionally been found on raw foods (fruits, vegetables, grains), but washing and processing destroys the residue. Maximum limits (ranging from 0.02 to 2 ppm) have been established by the U.S. EPA. Dichlorvos has not been found in prepared foods.

People living near hazardous waste sites containing dichlorvos or near its manufacturing, processing, or storage facilities, could potentially be exposed. Because of the chemical properties, the most likely way a person would be exposed is by breathing in air contaminated with dichlorvos. Another possible route of exposure is skin contact with soil contaminated with dichlorvos.

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You are most likely to be exposed to dichlorvos if you are involved in manufacturing or using it. Chemical plant workers, transport workers, and pesticide applicators are the major occupational groups that might be exposed. People in these groups are mainly exposed by breathing air containing dichlorvos, but significant exposure through the skin can occur as well. An estimated 24,000 workers in the United States are exposed to dichlorvos because of their occupations. Measured air levels in factories and workplaces have ranged from 0.005 to 0.08 ppm dichlorvos.

You might also be exposed to dichlorvos in the home after pesticide application. You are most likely to be exposed by breathing air containing dichlorvos, but skin contact with contaminated surfaces, or eating food that has been left out during dichlorvos application can also result in exposure. Measured levels of dichlorvos in room air immediately after pesticide applications have ranged from 0.08 to 2.7 ppm. It has been recommended that people should not reenter a room or house treated with dichlorvos until after a 10-hour ventilation period.

You will find further information on the potential for exposure to dichlorvos in Chapter 5.

1.4 HOW CAN DICHLORVOS ENTER AND LEAVE MY BODY?

Dichlorvos can enter your body through your lungs if it is in the air you breathe. It can also enter your body through your stomach if it is in your drinking water or food. It can also enter through your skin. Dichlorvos is taken into your body very rapidly by any of these routes (lungs, stomach, or skin). How much dichlorvos enters your body depends on how long you are exposed and the amount to which you are exposed.

Once dichlorvos enters your body, it goes into your bloodstream and is carried to all the organs in your body. There are enzymes in your liver and blood that rapidly break it down. These breakdown products are less harmful than dichlorvos. Most of these breakdown products quickly leave the body in the urine. Some of these products are broken down further and leave your body in your breath. Dichlorvos and its breakdown products are not stored in your body.

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You will find further information on how dichlorvos enters and leaves your body in Chapter 2.

1.5 HOW CAN DICHLORVOS AFFECT MY HEALTH?

Dichlorvos is a member of a group of chemicals called organophosphorus compounds. Some of these chemicals are extremely harmful to insects and are widely used as insecticides. At higher doses than those used to kill insects, these chemicals can also be harmful to people. Dichlorvos can chemically react with an important enzyme in your brain and nerves called acetylcholinesterase and stop them from working properly. When this happens, signals sent between your nerve cells and to your muscles are disrupted. To understand the harmful effects of dichlorvos that might occur at levels of exposure that people are likely to experience, scientific studies have been done with people and laboratory animals. To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

We do not know how much dichlorvos is necessary to cause harmful effects in people. This is because few people have been exposed to enough dichlorvos to cause symptoms of poisoning. From the results of animal testing, we can estimate that if a person breathed in air containing more than 1 ppm dichlorvos for more than one hour, harmful effects might result. Accidentally drinking as little as 1 ounce or 30 milliliters (mL) of a pesticide containing 5% dichlorvos could also cause harmful effects. Spilling an ounce of the same strength dichlorvos solution on your skin and failing to wash it off promptly could also be harmful.

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If you have been poisoned by dichlorvos, you will suddenly feel nauseated, anxious, and restless. You may also have teary eyes and heavy sweating. If this happens, you should seek medical attention immediately. Emergency rooms have drugs that stop the harmful effects of dichlorvos. Further symptoms can include loss of bladder control, muscle tremors, and labored breathing. Severe poisoning (5 ounces or more of a 5% dichlorvos solution) can result in coma, inability to breathe, and death.

Most people who have survived poisoning by dichlorvos make a complete recovery, although this can sometimes take several months. Dichlorvos poisoning does not appear to cause permanent damage to the nerves (a condition called “delayed neuropathy”).

A few studies have been done on people who have been exposed to dichlorvos in the air in their workplaces. When dichlorvos is used properly, air levels of 0.01-0.03 ppm are achieved. This level kills most insects within one hour. In tests done with volunteers, exposure at about 20 times this level (0.23 ppm) for 2 hours a day for 4 days had no harmful effects. In a study in rats exposed to air with very high levels of dichlorvos (up to 34 ppm), all the animals died within 3 days. The rats showed similar signs of effects on the nervous system as in people that have been poisoned with dichlorvos. In general, harmful effects have not been seen in animals exposed to air levels of dichlorvos below 0.5 ppm. In a 2-year study in rats, breathing air every day with low-to-moderately high levels (0.006-0.6 ppm) of dichlorvos had no effect on how long the rats lived or on their general health.

In at least one case, a person who drank a pesticide containing dichlorvos died. The doctors who treated this patient were unable to tell exactly how much dichlorvos she had taken. Volunteers who ate 0.03 milligrams dichlorvos per kilogram body weight (0.03 mg/kg) for 21 days showed no harmful effects. In studies where animals (rats and mice) have been force-fed dichlorvos, about half the animals died when given approximately 100 mg/kg. Before the animals died, they showed signs of harmful effects to their nervous systems similar to those seen in human poisoning cases.

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Two pesticide workers died after spilling concentrated dichlorvos on their skin and failing to wash it off promptly. It is not known exactly how much dichlorvos they absorbed through their skin. Experiments in animals show that dichlorvos can be just as harmful when it is applied to the skin as when it is breathed in or swallowed. Monkeys that had dichlorvos put on their skin (50 mg each day) died after 10 doses.

It is not known if exposure to dichlorvos can affect fertility or development of the fetus in people. Experiments done in animals that were fed or breathed in dichlorvos did not show any effect on fertility or health of the offspring.

There is no evidence that exposure to dichlorvos increases the risk of cancer in people. Rats that breathed in air containing dichlorvos for 2 years had the same rate of cancer as rats that did not breathe in dichlorvos. However, a 2-year study in rats and mice force-fed dichlorvos showed an increase in certain forms of cancer. Rats had increased rates of cancer in the pancreas and also had more cases of leukemia than rats that had not been treated with dichlorvos. Female mice had a higher rate of a form of stomach cancer.

The U.S. Department of Health and Human Services (DHHS) has determined that dichlorvos may reasonably be anticipated to be a carcinogen (a substance that can cause cancer). The International Agency for Research on Cancer (IARC) has determined that dichlorvos is possibly carcinogenic to humans. The U.S. EPA has determined that dichlorvos is a probable human carcinogen.

The U.S. EPA has calculated that a lifetime of drinking water containing 0.1 micrograms of dichlorvos per liter ($\mu\text{g/L}$) would cause one extra case of cancer in every million people exposed to this level. Dichlorvos has not been found in drinking water in the United States.

You will find further information on how dichlorvos may affect your health in Chapter 2.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO DICHLORVOS?

Two blood tests exist that can determine whether you have been exposed to significant levels of dichlorvos. These tests can be performed by any hospital or clinical laboratory. These tests measure the activity of two enzymes (called serum cholinesterase and erythrocyte [red blood cell] acetylcholinesterase) that are affected by dichlorvos. Dichlorvos affects these enzymes at lower levels of exposure than necessary to produce harmful effects. This means that if these enzymes have been affected, you will not necessarily have effects on your health. Many other insecticides also affect these enzymes. To determine whether you have been specifically exposed to dichlorvos, a laboratory test must measure the breakdown products in your urine. Tests of this type are not routinely done in hospital laboratories and your doctor will have to send a sample to a specialized laboratory.

You will find further information on how you can be tested for exposure to dichlorvos in Chapter 2.

1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations may be enforced by law. Federal agencies that develop regulations for toxic substances include the EPA, the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals, then they are adjusted to help

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protect people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for dichlorvos include the following:

- The U.S. OSHA has set a permissible exposure limit (PEL) of 1 mg/m³ (0.11 ppm) of dichlorvos for workplace air over a 10-hour workday.
- The U.S. EPA requires reporting of any discharge of dichlorvos to the environment that exceeds 10 pounds. The EPA has also designated dichlorvos as a hazardous substance and specific regulations regarding its disposal are in effect.
- The U.S. EPA has established maximum permissible levels of dichlorvos in various food products ranging from 0.02 to 2 parts per million (ppm). Samples from the food supply are regularly tested for dichlorvos.

Further information on federal and state regulations and recommendations concerning dichlorvos is found in Chapter 7.

1.8 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department or

Agency for Toxic Substances and Disease Registry

Division of Toxicology

1600 Clifton Road NE, Mailstop E-29

Atlanta, GA 30333

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*** Information line and technical assistance**

Phone: (404) 639-6000

Fax: (404) 639-63 15 or 6324

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

*** To order toxicological profiles, contact**

National Technical Information Service

5285 Port Royal Road

Springfield, VA 22 16 1

Phone: (800) 553-6847 or (703) 487-4650