1. PUBLIC HEALTH STATEMENT FOR 2,4-D

This Public Health Statement summarizes the Agency for Toxic Substances and Disease Registry’s (ATSDR) findings on 2,4-dichlorophenoxyacetic acid (2,4-D), including chemical characteristics, exposure risks, possible health effects from exposure, and ways to limit exposure.

The U.S. 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 sites targeted for long-term federal clean-up activities. The EPA has found 2,4-D in at least 46 of the 1,832 current or former NPL sites. The total number of NPL sites evaluated for 2,4-D is not known. But the possibility remains that as more sites are evaluated, the sites where 2,4-D is found may increase. This information is important because these future sites may be sources of exposure, and exposure to 2,4-D may be harmful.

If you are exposed to 2,4-D, many factors determine whether you’ll be harmed. These include how much you are exposed to (dose), how long you are exposed (duration), how often you are exposed (frequency), and how you are exposed (route of exposure). You must also consider the other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

WHAT IS 2,4-D?

2,4-Dichlorophenoxyacetic acid (2,4-D) does not occur naturally in the environment. 2,4-D is the active ingredient in many products used in the United States and throughout the world as an herbicide to kill weeds on land and in the water. There are nine forms of 2,4-D that can be used as an herbicide and it is typically sold as a powder or in a liquid form.

WHAT HAPPENS TO 2,4-D WHEN IT ENTERS THE ENVIRONMENT?

2,4-D can be released into the air when it is being applied to weeds and can be released when it is being made. 2,4-D in the air can be broken down by other chemicals or can settle to the ground. It takes about 19 hours to break down half of the 2,4-D in the air. 2,4-D is not persistent in most soils. Its half-life in soils is about 6 days under aerobic conditions (environments where oxygen is present) but longer under anaerobic (environments where there is limited oxygen) conditions. Although some of the 2,4-D in soil can go through the soil and enter the groundwater, it is rarely detected in groundwater. 2,4-D can enter rivers, lakes, and ponds when 2,4-D is sprayed on nearby plants, from runoff and soil erosion, or when it
is used on water plants. It breaks down more slowly in water than it does in the air or in soil. It takes about 15 days to break down half of the 2,4-D in water under aerobic conditions and about 41–333 days under anaerobic conditions. 2,4-D is not likely to concentrate in fish.

**HOW MIGHT I BE EXPOSED TO 2,4-D?**

Many herbicidal products contain 2,4-D. You may be exposed to 2,4-D when applying these products if you breathe it in or get it on your skin, especially if you eat afterwards without washing your hands or smoke during applications. You may also be exposed to 2,4-D while walking or playing on very recently treated lawns, gardens, golf courses, parks, or other grassy areas. People and pets may transport 2,4-D into homes by walking across recently treated lawns. You may also be exposed to 2,4-D in soils of treated lawns. Swimming in areas that use 2,4-D to control weeds is another way that you may come in contact with it. When workers make 2,4-D or apply it to weeds, they may have higher exposures. You are unlikely to be exposed to high levels of 2,4-D in food, water, or soil. It was detected at low levels (levels near the detection limits of the measurement) in roughly 20% of the food samples tested by the FDA and when it is found in drinking waters, it is usually well below the acceptable levels that EPA considers safe.

**HOW CAN 2,4-D ENTER AND LEAVE MY BODY?**

2,4-D can enter your body when you drink water or eat food containing 2,4-D. Almost all of the 2,4-D can be taken up (absorbed) from the gastrointestinal tract and enter the bloodstream within a few hours. A small amount of 2,4-D can enter your body through your skin. It has not been determined how much can enter through your lungs. The 2,4-D that is absorbed will enter the blood and move throughout your body. 2,4-D is found in most organs in your body. Your body does not break down or change 2,4-D. It may leave your body in the urine around 24 hours after a single initial exposure and if exposure is no longer occurring. 2,4-D does not accumulate in the body.

Additional information regarding how 2,4-D can enter and leave the body can be found in Section 3.4.

**HOW CAN 2,4-D AFFECT MY HEALTH?**

If you follow the manufacturer’s instructions, you are not likely to experience the harmful effects of 2,4-D. It does not appear that contact with small amounts of 2,4-D will cause harmful effects in humans.
based on currently available scientific evidence. Studies in laboratory animals have found a number of effects:

- Decreases in the amount of breast milk mothers produced
- Alterations in blood
- Liver effects
- Kidney effects
- Alterations in thyroid hormone levels

In general, effects were seen when the animals were given 2,4-D doses that were much higher than people would come in contact with in the environment.

Harmful effects have been seen in people who purposely or accidentally swallowed large amounts of 2,4-D; much larger amounts than found in the environment. These serious effects, which include fast breathing and heart rate, vomiting, confusion, coma, and paralysis, are not likely to occur at the levels of 2,4-D that are generally found in the environment. It should be mentioned that commercial herbicides that contain 2,4-D may have other substances in them. Some of these effects may be due to exposure to these other substances.

A few studies of farmers or professional applicators of herbicides containing 2,4-D have found that use or exposure to 2,4-D was linked with harmful health effects, particularly some cancers of the lymph system (i.e., bone marrow, thymus gland, lymph nodes, tonsils, spleen). These studies were in workers who are exposed to higher amounts of 2,4-D than most people. Some studies found increases in Non-Hodgkin’s lymphoma (NHL), which is a type of cancer. However, most human studies did not find strong proof that exposure to just 2,4-D increased the risk of developing NHL; there was not strong proof for links between 2,4-D exposure and other types of cancer. Long-term oral exposure of rats, mice, or dogs to 2,4-D did not produce cancer in any of these animal species.

The EPA has determined that 2,4-D is not classifiable as to human carcinogenicity (Group D). This means that there was not adequate data either to support or refute human carcinogenicity. The International Agency for Research on Cancer (IARC) recently classified 2,4-D as possibly carcinogenic to humans (Group 2B) based on “inadequate evidence” in humans and “limited evidence” in experimental animals.

Additional information regarding 2,4-D and health effects can be found in Section 3.2.
HOW CAN 2,4-D AFFECT CHILDREN?

This section discusses potential health effects of 2,4-D exposure in humans from when they’re first conceived to 18 years of age.

Studies of children living in farming areas did not find meaningful links between exposure to 2,4-D and harmful health effects. These studies included looking into birth weight and how often birth defects and cancer occurred in children exposed to 2,4-D. A study did find that the male children of mothers exposed to 2,4-D during pregnancy had an increased risk of hay fever or allergies when they were aged 12 years or older. Because all of these studies suffer limitations that may have influenced the results into finding positive or negative links, no firm conclusions can be drawn from them.

Studies in animals have shown that 2,4-D can be transferred to the fetus across the placenta and to newborn animals through maternal milk. Although this has not been directly shown in humans, it seems sensible to believe that it could happen.

Some studies in animals have shown that exposure to 2,4-D during and after pregnancy can reduce the weight of the fetuses and young animals during the first weeks of life. It also can cause minor tissue abnormalities without meaningful lasting effects. In one study, pups from rats exposed to 2,4-D during and after pregnancy showed changes in some behaviors such as spontaneous movement and grooming. This occurred when the rats were given 2,4-D doses that were much higher than people would come in contact with in the environment. 2,4-D did not cause birth defects in animals.

Additional information regarding 2,4-D and health effects in children can be found in Section 3.7.

HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO 2,4-D?

If your doctor finds that you have been exposed to significant amounts of 2,4-D, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate. You may also contact the state or local health department with health concerns.

2,4-D and its different chemical forms are listed as an ingredient in about 600 farm and household products. We recommend that you follow the directions when using 2,4-D products. It is especially important to wait until the sprayed area is dry and do not walk barefoot in the area. Wear protective eye
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Gear and gloves when using 2,4-D-containing products in order to reduce exposure. Getting 2,4-D on the skin is the main way that you can be exposed. Wear protective clothing to lessen skin contact. Do not stand in spray drift when 2,4-D containing herbicides are applied. Do not smoke while applying or in areas recently treated with 2,4-D. Amounts remaining on the skin after contact can easily be transferred to the mouth, other body parts, or other surfaces. This could result in "second-hand" exposures, which may be especially important for children. Washing after using 2,4-D products will lessen exposure to it and reduce unintentional hand to mouth ingestion. 2,4-D has been detected in the urine of dogs that have played on treated lawns. Prevent children and pets from playing on lawns treated recently with 2,4-D.

ARE THERE MEDICAL TESTS TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO 2,4-D?

There are tests to measure 2,4-D in blood, urine, and tissues of the body. Urine is easy to collect, so measuring 2,4-D in urine is the favored test to use. Finding 2,4-D in your body does not always mean that you will have harmful health effects. Most of the 2,4-D in the body does not breakdown. It does not build up in the body. 2,4-D leaves the body in the urine around 24 hours after a single exposure. Get tests for 2,4-D done quickly after exposure. Doctor’s offices do not normally do these types of tests. Specialized laboratories will test the samples.

More information about ways to measure 2,4-D in the body can be found in Chapter 7.

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

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but are not enforceable 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 as “not-to-exceed” levels; that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value usually based on levels that affect animals; levels are then adjusted to help protect humans. Sometimes these not-to-exceed levels differ
among federal organizations. Different organizations use different exposure times (e.g., an 8-hour workday or a 24-hour day), different animal studies, or emphasize some factors over others, depending on their mission.

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that issued the regulation or recommendation.

EPA has made recommendations on the acceptable levels of 2,4-D in drinking water that would be safe for a child weighing 10 kilograms (10 kg or 22 pounds). The level that would be safe for a 1-day exposure is 1 milligram per liter (1 mg/L). The level that would be safe for a 10-day exposure is 0.3 mg/L.

OSHA established a legal limit of 10 milligrams per cubic meter (10 mg/m³) as an average for 2,4-D in workplace air during an 8-hour workday.

NIOSH recommends an exposure limit of 10 mg/m³ for 2,4-D in workplace air during a 10-hour workday. NIOSH also says that an air level of 100 mg 2,4-D/m³ is an immediate danger to life or health.

FDA set an allowable limit of no more than 0.07 mg 2,4-D/L in bottled drinking water.

WHERE CAN I GET MORE INFORMATION?

If you have any questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below. You may also contact your doctor if experiencing adverse health effects or for medical concerns or questions. ATSDR can also provide publicly available information regarding medical specialists with expertise and experience recognizing, evaluating, treating, and managing patients exposed to hazardous substances.

- Call the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636) or
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- Write to:
  Agency for Toxic Substances and Disease Registry
  Division of Toxicology and Human Health Sciences
  1600 Clifton Road NE
  Mailstop F-57
  Atlanta, GA 30329-4027

Toxicological profiles and other information are available on ATSDR’s web site: