

1. PUBLIC HEALTH STATEMENT FOR TRICHLOROETHYLENE

This Public Health Statement summarizes the Agency for Toxic Substances and Disease Registry's (ATSDR) findings on trichloroethylene, 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 trichloroethylene in at least 1,051 of the 1,854 current or former NPL sites. The total number of NPL sites evaluated for trichloroethylene is not known. But the possibility remains that as more sites are evaluated, the sites where trichloroethylene is found may increase. This information is important because these future sites may be sources of exposure, and exposure to trichloroethylene may be harmful.

If you are exposed to trichloroethylene, 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 TRICHLOROETHYLENE?

Trichloroethylene is a colorless, volatile liquid. Liquid trichloroethylene evaporates quickly into the air. It is nonflammable and has a sweet odor.

The two major uses of trichloroethylene are as a solvent to remove grease from metal parts and as a chemical that is used to make other chemicals, especially the refrigerant, HFC-134a. Trichloroethylene has also been used as an extraction solvent for greases, oils, fats, waxes, and tars; by the textile processing industry to scour cotton, wool, and other fabrics; in dry cleaning operations; and as a component of adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners.

WHAT HAPPENS TO TRICHLOROETHYLENE WHEN IT ENTERS THE ENVIRONMENT?

Most of the trichloroethylene used in the United States is released into the atmosphere by evaporation, primarily from degreasing operations. Once in the atmosphere, the dominant trichloroethylene

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degradation process is reaction with hydroxyl radicals; the estimated half-life for this process is about 3–7 days. This relatively short half-life indicates that trichloroethylene is not a persistent atmospheric compound. Most trichloroethylene in surface waters or on soil surfaces evaporates into the atmosphere, although its high mobility in soil may result in it moving into groundwater below the soil surface. In these subsurface environments, trichloroethylene is only slowly degraded and may be relatively persistent. Trichloroethylene and other volatile organic chemicals may diffuse from contaminated groundwater and soil and migrate into air spaces beneath buildings to enter the indoor air, a process termed vapor intrusion.

HOW MIGHT I BE EXPOSED TO TRICHLOROETHYLENE?

You may be exposed to trichloroethylene from trichloroethylene-contaminated air, water, food, or soil, or direct skin contact. You are most likely to be exposed to trichloroethylene by drinking trichloroethylene-contaminated water; you may also be exposed by breathing trichloroethylene released to the air from trichloroethylene-contaminated water. If you work in the degreasing industry or another industry where trichloroethylene is produced or used, you may be exposed by breathing in trichloroethylene-contaminated air or by contacting the chemical with your skin. Some trichloroethylene is released to the air by its evaporation from products such as adhesives, paints, and coatings; and through its evaporation from trichloroethylene-contaminated soil at landfills.

You may also be exposed to trichloroethylene by consumption of trichloroethylene-contaminated foods, by contact with consumer products containing trichloroethylene, and by direct contact with trichloroethylene-contaminated soil.

HOW CAN TRICHLOROETHYLENE ENTER AND LEAVE MY BODY?

Trichloroethylene can enter your body from trichloroethylene-contaminated air, water, food, or soil.

Trichloroethylene in air can easily enter your body when you breathe. Most of the trichloroethylene that you breathe in will go into your bloodstream and into other organs. A small amount of trichloroethylene in the air can also move through your skin and into your bloodstream.

When trichloroethylene is found in water, it can enter your body when you drink or touch the water or when you breathe in steam from the water. Most of the trichloroethylene that you breathe in or drink will move from your stomach or lungs into your bloodstream. When you touch water containing

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trichloroethylene (such as showering or bathing with trichloroethylene-contaminated water), some of it can get through your skin into your body. Also, you can be exposed when trichloroethylene in groundwater evaporates and migrates into air spaces beneath buildings to enter the indoor air, a process termed vapor intrusion, and you breathe that contaminated indoor air.

Trichloroethylene has been detected in table-ready foods at concentrations generally in the range of 2–100 ppb.

You can be exposed to trichloroethylene in soil when small amounts of soil are transferred to your mouth accidentally, when your skin touches the soil, or when you breathe air or dust coming from the soil. You can also be exposed when trichloroethylene in soil evaporates and migrates into air spaces beneath buildings to enter the indoor air, a process termed vapor intrusion, and you breathe that contaminated indoor air.

Once in your blood, your liver changes much of the trichloroethylene into other chemicals. When the body absorbs more trichloroethylene than it can break down quickly, some of the trichloroethylene or its breakdown products can be stored in body fat for a brief period. However, once absorption ceases, trichloroethylene and its breakdown products quickly leave the fat.

You will quickly breathe out much of the trichloroethylene that reaches your bloodstream; most of the trichloroethylene breakdown products leave your body in the urine within a day.

HOW CAN TRICHLOROETHYLENE AFFECT MY HEALTH?

The health effects of trichloroethylene depend on how much trichloroethylene you are exposed to and the length of that exposure. Environmental monitoring data suggest that trichloroethylene levels the public might encounter by direct contact or through air, water, food, or soil, are generally much lower than the levels at which adverse effects are elicited in animal studies. However, some drinking water sources and working environments have been found to contain levels of trichloroethylene that may cause health problems.

Trichloroethylene was once used as an anesthetic for surgery. People who are overexposed to moderate amounts of trichloroethylene may experience headaches, dizziness, and sleepiness; large amounts of trichloroethylene may cause coma and even death. Some people who breathe high levels of

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trichloroethylene may develop damage to some of the nerves in the face. Other effects seen in people exposed to high levels of trichloroethylene include evidence of nervous system effects related to hearing, seeing, and balance, changes in the rhythm of the heartbeat, liver damage, and evidence of kidney damage. Some people who get concentrated solutions of trichloroethylene on their skin develop rashes.

Relatively short-term exposure of animals to trichloroethylene resulted in harmful effects on the nervous system, liver, respiratory system, kidneys, blood, immune system, heart, and body weight.

Exposure to trichloroethylene in the workplace may cause scleroderma (a systemic autoimmune disease) in some people. Some men occupationally-exposed to trichloroethylene and other chemicals showed decreases in sex drive, sperm quality, and reproductive hormone levels.

Long-term exposure studies in animals have mainly focused on carcinogenicity and relatively insensitive noncancer end points following oral exposure; these studies are not helpful in defining noncancer end points in humans following long-term exposure. However, depressed body weight and evidence of effects on the thymus were reported in one recent study of mice exposed to trichloroethylene via their mothers during gestation and lactation and via the drinking water for up to 12 months thereafter.

There is strong evidence that trichloroethylene can cause kidney cancer in people and some evidence that it causes liver cancer and malignant lymphoma (a blood cancer). Lifetime exposure to trichloroethylene resulted in increased liver cancer in mice and increased kidney cancer in rats at relatively high exposure levels. There is some evidence for trichloroethylene-induced testicular cancer and leukemia in rats and lymphomas and lung tumors in mice.

The Department of Human Health Services (HHS) has classified trichloroethylene as “*known to be a human carcinogen*” based on sufficient evidence of carcinogenicity from humans. Similarly, the International Agency for Research on Cancer (IARC) has classified it as “carcinogenic to humans” and EPA has characterized it as “carcinogenic in humans by all routes of exposure.” These agencies concluded that there were sufficient evidence from human studies that trichloroethylene exposure can cause kidney cancer in humans. There is also some evidence of an association between trichloroethylene exposure and non-Hodgkin’s lymphoma in humans.

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HOW CAN TRICHLOROETHYLENE AFFECT CHILDREN?

This section discusses potential health effects of trichloroethylene exposure in humans from when they're first conceived to 18 years of age.

Trichloroethylene is expected to affect children in the same manner as adults. It is not known whether children are more susceptible than adults to the effects of trichloroethylene.

Some human studies indicate that trichloroethylene may cause developmental effects such as spontaneous abortion, congenital heart defects, central nervous system defects, and small birth weight. However, these people were exposed to other chemicals as well. In some animal studies, exposure to trichloroethylene during development may have caused effects such as decreased body weight, increased incidences of heart defects, functional or structural changes in the developing nervous system, and effects on the immune system.

HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO TRICHLOROETHYLENE?

If your doctor finds that you have been exposed to significant amounts of trichloroethylene, 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.

Exposure to contaminated drinking water should be limited. Trichloroethylene has been detected in some drinking water supplies. For bottled water, consumers should contact the bottler with specific questions on potential contaminants.

If you live near an industrial site where trichloroethylene is produced or is a byproduct or you live near a hazardous waste site where it has been discarded, there may be high levels of trichloroethylene in the water and soil. If you find your home water supply and/or soil to be contaminated with trichloroethylene, consider using a cleaner source of water and limiting contact with soil (for example, through use of a dense ground cover or thick lawn) to reduce exposure to trichloroethylene. By paying careful attention to dust and dirt control in the home (air filters, frequent cleaning), you can reduce family exposure to contaminated dirt. Some children eat a lot of dirt. You should prevent your children from eating dirt. You should discourage your children from putting objects in their mouths. Make sure that they wash their hands frequently and before eating. Discourage your children from putting their hands in their mouths or from other hand-to-mouth activity.

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Trichloroethylene is widely used as a solvent for extraction, waterless drying, and finishing, and as a general purpose solvent in adhesives, lubricants, paints, varnishes, paint strippers, pesticides, and cold metal cleaners. Follow instructions on product labels to minimize exposure to trichloroethylene.

ARE THERE MEDICAL TESTS TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO TRICHLOROETHYLENE?

Trichloroethylene and its breakdown products (metabolites) can be measured in blood and urine. Because trichloroethylene and its metabolites leave the body fairly rapidly, the tests need to be conducted within a few hours after exposure. Tests for trichloroethylene and its metabolites in the blood or urine require special analytical equipment not readily available at medical facilities. Some metabolites of trichloroethylene can be formed from chemicals other than trichloroethylene, so detection of these metabolites in blood or urine does not guarantee that one has been exposed to trichloroethylene.

For more information on the different substances formed by trichloroethylene breakdown and on tests to detect these substances in the body, see Chapters 3 and 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.

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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 set a maximum contaminant level goal (MCLG) of zero as a national primary drinking standard for trichloroethylene; EPA noted liver problems and increased risk of cancer as potential health effects from long-term exposure above the maximum contaminant level (MCL) of 0.005 milligrams per liter (mg/L; 5 ppb).

OSHA set a permissible exposure limit (PEL) of 100 ppm for trichloroethylene in air averaged over an 8-hour work day, an acceptable ceiling concentration of 200 ppm provided the 8-hour PEL is not exceeded, and an acceptable maximum peak of 300 ppm for a maximum duration of 5 minutes in any 2 hours.

NIOSH considers trichloroethylene to be a potential occupational carcinogen and established a recommended exposure limit (REL) of 2 ppm (as a 60-minute ceiling) during the usage of trichloroethylene as an anesthetic agent and 25 ppm (as a 10-hour time-weighted average [TWA]) during all other exposures.

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
- Write to:
Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences
1600 Clifton Road NE
Mailstop S102-1
Atlanta, GA 30329-4027

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Toxicological profiles and other information are available on ATSDR's web site:
<http://www.atsdr.cdc.gov>.