

1. PUBLIC HEALTH STATEMENT FOR TOLUENE

This Public Health Statement summarizes the Agency for Toxic Substances and Disease Registry's (ATSDR) findings on toluene, 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 toluene in at least 990 of the 1,832 current or former NPL sites. The total number of NPL sites evaluated for toluene is not known. But the possibility remains that as more sites are evaluated, the sites where toluene is found may increase. This information is important because these future sites may be sources of exposure, and exposure to toluene may be harmful.

If you are exposed to toluene, 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 TOLUENE?

Toluene is a clear, colorless liquid with a distinctive smell. It is a good solvent (a substance that can dissolve other substances). Toluene occurs naturally in crude oil and in the tolu tree. It is produced in the process of making gasoline and other fuels from crude oil and in making coke from coal.

Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. It is used in the production of benzene, nylon, plastics, and polyurethane and the synthesis of trinitrotoluene (TNT), benzoic acid, benzoyl chloride, and toluene diisocyanate. It is also added to gasoline along with benzene and xylene to improve octane ratings.

WHAT HAPPENS TO TOLUENE WHEN IT ENTERS THE ENVIRONMENT?

Toluene can be released into the air, water, and soil at places where it is produced or used. Toluene is commonly found in air, particularly when there is heavy vehicular traffic. Monitoring data of outdoor air in the United States shows that toluene is present at average levels of approximately 1–35 parts per billion

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by volume (ppbv). Indoor air samples can contain higher levels of toluene in places where products such as paint thinners, solvents, or tobacco products are used.

Toluene can enter surface waters and groundwater (e.g. wells) from solvent and petroleum products spills. Toluene can also leak from underground storage tanks at gasoline stations and other facilities. When toluene-containing products are placed in landfills or waste disposal sites, toluene can enter the soil and water near the waste site. It is possible for toluene to be broken down in subsurface (below ground) water primarily by anaerobic microorganisms. Toluene will readily evaporate into the air or be degraded by microorganisms in surface waters. Leaking underground storage tanks can contaminate the soil with toluene and other petroleum-product components. Toluene in surface soils rapidly evaporates into the air. Toluene is readily broken down to other chemicals by microorganisms in the soil.

HOW MIGHT I BE EXPOSED TO TOLUENE?

Toluene enters the environment when you use materials that contain it, such as paints, paint thinners, adhesives, fingernail polish, and gasoline; it evaporates rapidly from these materials and becomes mixed with the air you breathe.

Individuals who work with gasoline, paint, lacquer, or dyes have greater exposures to toluene, as do individuals who smoke or intentionally inhale products containing toluene for its euphoric effects.

HOW CAN TOLUENE ENTER AND LEAVE MY BODY?

Toluene can enter your body from the air, water, or soil. You are exposed to toluene by breathing outdoor or indoor air containing this substance. Gasoline contains toluene and so do some other products used in occupational or home settings (e.g., solvents, paint thinners). Inhalation and dermal exposure is possible when using these products.

Toluene is not frequently detected in drinking water. If you are using a well that has been contaminated by toluene from an accidental spill, you may ingest some; however, this route of exposure is less likely than breathing in toluene from air. Toluene evaporates quickly from soils. Therefore, it is unlikely you will be exposed to it from soil, unless you come in contact with soil near a hazardous waste site containing it or an accidental spill.

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When you breathe toluene, it is taken directly into your blood from your lungs. Similarly, when you touch products containing toluene (e.g., nail polish remover) or bathe in water containing toluene, toluene can pass through your skin into your bloodstream. When you ingest food or drink containing toluene, it is also absorbed from your GI tract into your bloodstream. Factors such as your age, sex, body composition, and health status affect what happens to toluene once it is in your body.

After being taken into your body, the majority of toluene is removed from your body within a day; however, a small amount may accumulate in fat tissue with daily exposure. Toluene may leave your body unchanged in the air you breathe out or in your urine after some of it has been changed to other chemicals. Generally, your body turns toluene into less harmful chemicals such as hippuric acid. More information on how toluene can enter and leave your body can be found in Chapter 3.

HOW CAN TOLUENE AFFECT MY HEALTH?

A serious health concern is that toluene may have an effect on your nervous system (brain and nerves). Nervous system effects can be temporary, such as headaches, dizziness, or unconsciousness. However, effects such as incoordination, cognitive impairment, and vision and hearing loss may become permanent with repeated exposure, especially at high levels associated with intentional solvent abuse. High levels of toluene exposure during pregnancy, such as those associated with solvent abuse, may lead to developmental effects, such as retardation of mental abilities and growth in children. Other health effects of potential concern may include immune, kidney, liver, and reproductive effects.

Single exposures to toluene or repeated exposures over a few weeks can cause headaches and sleepiness, and can impair your ability to think clearly. Whether or not toluene does this to you depends on the amount you take in, how long you are exposed, how frequently you are exposed, and your genetic susceptibility and age. One very dangerous activity is to expose yourself to a large amount of toluene in a short time by deliberately inhaling/sniffing paint or glue. At first, you will feel light-headed. If exposure continues, you can become dizzy, sleepy, or unconscious. When exposure is stopped, the sleepiness and dizziness usually goes away. However, you could die, because high-level toluene can interfere with the way you breathe and the way your heart beats. If you deliberately breathe in large amounts of toluene during pregnancy, developmental effects, such as retardation of mental abilities and growth, may occur in your children.

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Day-after-day exposure to low to moderate levels of toluene in the workplace may cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite in some people. These symptoms usually disappear when exposure is stopped. You may experience some hearing and color vision loss after long-term daily exposure to toluene in the workplace. Combinations of toluene and some common medicines like aspirin and acetaminophen may increase the effects of toluene on your hearing. Researchers do not know if the low levels of toluene that you breathe at work will cause any permanent effects on your brain or body after many years. If you choose to repeatedly breathe in toluene from glue or paint thinners, you may permanently damage your brain. You may also experience problems with your speech, vision, or hearing, have loss of muscle control, loss of memory, poor balance, and decreased mental ability.

Some studies in people have shown reproductive effects, such as an increased risk of spontaneous abortions, from repeated, low to moderate levels of toluene in the workplace. However, other factors, such as exposure to other chemicals, smoking, and alcohol use, may have affected the results of the studies, so it is not possible to say definitively whether toluene has reproductive effects in people. No reports are available of developmental effects in children of pregnant women exposed to low to moderate levels of toluene in the workplace.

The effects of toluene on animals are similar to those seen in humans. The main effect of toluene is on the brain and nervous system, but animals exposed to moderate or high levels of toluene also show harmful effects in their liver, kidneys, and lungs and impaired immune function. Animal studies do not indicate that toluene exposure results in reproductive effects (e.g., damage to reproductive organs, infertility, abortion, premature birth), but do indicate that high levels of toluene during pregnancy can produce developmental effects, similar to those observed in human mothers who intentionally breathed in high levels of toluene during pregnancy (see next section regarding how toluene may affect children).

Studies in workers and animals exposed to toluene generally indicate that toluene is not carcinogenic (cancer-causing). The International Agency for Research on Cancer determined that toluene is not classifiable as to its carcinogenicity in humans (Group 3). The EPA determined there is inadequate information to assess the carcinogenic potential of toluene. The American Conference of Governmental Industrial Hygienists (ACGIH) determined that toluene is not classifiable as a human carcinogen (A4). The U.S. National Toxicology Program (NTP) has not considered the carcinogenic potential of toluene.

See Chapters 2 and 3 for more information on health effects of toluene.

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HOW CAN TOLUENE AFFECT CHILDREN?

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

Children may breathe air contaminated with toluene by family use of glues, paints, or cleaning solvents, or by accidents involving products containing toluene. Toluene vapors are heavier than air and since young children are closer to the ground or floor because of their height, they may breathe more toluene than adults during accidental exposures. Also, children have faster breathing rates than adults and may therefore breathe in more toluene. Older children and adolescents may be exposed to toluene if they breathe household products containing it to get "high". Nursing mothers who breathe toluene in workplace air may transfer some toluene in breast milk to their infants. Toluene is not stored in the body. Toluene in the body either rapidly leaves or is turned into less harmful chemicals. Thus, nursing mothers, who do not currently work in jobs with toluene and who do not deliberately breathe large amounts of toluene, are expected to transfer very little toluene in breast milk.

The effects of toluene on children have not been studied very much, but toluene is likely to produce the same types of effects on the brain and nervous system in children as it does in adults. Some older children and adolescents who have repeatedly breathed large amounts of toluene to get high have developed loss of muscle control, loss of memory, poor balance, and decreased mental abilities. Some of these changes may last for a long time after toluene has left the body. Young animals exposed to toluene have shown changes in behavior, hearing loss, and chemical changes in their brains.

Human fetuses and newborn babies may be more sensitive to toluene than adults, because their bodies may not be as able to turn toluene into less harmful chemicals. Some animal studies suggest that young animals might be more susceptible to toluene effects on health; however, shortly after birth, human babies begin to develop the ability to turn toluene into less harmful chemicals. By the time children are 1–3 years of age, they may be equal to adults in this ability.

Some mothers who breathed large amounts of toluene during pregnancy to get high have had children with birth defects, including retardation of mental abilities and growth. Results from animal studies have found similar effects in newborn animals that had mothers that breathed large amounts of toluene during pregnancy; however, when the animal mothers breathed small amounts of toluene during pregnancy, no

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birth defects were found in their newborn animals. When pregnant animals breathe small amounts of toluene during pregnancy, studies show that very little toluene reaches the developing fetus.

More information on the effects of toluene on children can be found in Chapter 3.

HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO TOLUENE?

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

Toluene is a solvent that is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber. Toluene is added to gasoline and is used in some printing and leather tanning processes. Follow instructions on product labels to minimize exposure to toluene. Families can reduce their risk of exposure to toluene by using consumer products containing the chemical (such as paints, glues, inks, and stain removers) in well-ventilated areas or using consumer products without toluene. When not in use, toluene-containing products should be tightly covered to prevent evaporation into the air. Household chemicals should be stored out of the reach of young children to prevent accidental poisonings. Storing items that contain toluene in a locked shed or another secure area outside location may reduce the potential for accidental exposure in young children (or intentional exposure by older youth). Always store household chemicals in their original labeled containers. Never store household chemicals in containers that children would find attractive to eat or drink from, such as old soda bottles. Keep your Poison Control Center's number next to the phone.

If you have concerns about the presence of toluene in your tap water, you can call your local health department and request information on testing results of local public drinking water or ask how to get your well tested. If concerns remain, use bottled water for drinking. Prevent children from eating or playing in the dirt if you live near a waste site that has been contaminated with toluene, and always have them wash their hands prior to eating in case of potential exposure.

Your children may be exposed to toluene by inhaling products that contain it. Sometimes, older children sniff household chemicals in an attempt to get high. Talk with children about the dangers of sniffing chemicals such as toluene.

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

Toluene and its breakdown products (metabolites) can be measured in blood and urine. However, the detection of toluene or its metabolites cannot predict the kind of health effects that might develop from that exposure. Because toluene and its metabolites leave the body fairly rapidly, the tests need to be conducted within days after exposure.

For more information on the different substances formed by toluene 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.

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.

The EPA has recommended a drinking water guideline value of 1 mg/L for toluene. OSHA has set a legal limit for workers of 200 ppm for toluene in air averaged over an 8-hour workday. NIOSH has set a

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recommended limit of 100 ppm for toluene in air averaged over a 10-hour workday. ACGIH recommends that toluene in workplace air not exceed 20 ppm (average levels over 8 hours).

More information on federal and state government regulations and guidelines for toluene in air and water can be found in Chapter 8.

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 F-57
Atlanta, GA 30329-4027

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

<http://www.atsdr.cdc.gov>.