Overview
We define a public health statement and show how it can help you learn about hexachlorobenzene.

Introduction
A public health statement summarizes information about a hazardous substance. The information is taken from a toxicological profile developed by ATSDR’s Division of Toxicology and Human Health Sciences (DTHHS). A toxicological profile is a thorough review of a hazardous substance.

This toxicological profile examines hexachlorobenzene. This public health statement summarizes the DTHHS’s findings on hexachlorobenzene, describes the effects of exposure to it, and describes what you can do to limit that exposure.

Hexachlorobenzene at hazardous waste sites
The U.S. Environmental Protection Agency (U.S. EPA) identifies the most serious hazardous waste sites in the nation. U.S. EPA then includes these sites on the National Priorities List (NPL) and targets them for federal clean-up activities. U.S. EPA has found hexachlorobenzene in at least 113 of the 1,699 current or former NPL sites.

The total number of NPL sites evaluated for hexachlorobenzene is not known. But the possibility remains that as more sites are evaluated, the number of sites at which hexachlorobenzene is found may increase. This information is important; these future sites may be sources of exposure, and exposure to hexachlorobenzene may be harmful.
Why a hexachlorobenzene release can be harmful

When a contaminant 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. But such a release doesn’t always lead to exposure. You can only be exposed to a contaminant when you come in contact with it. That contact—and therefore that exposure—can occur when you breathe, eat, or drink the contaminant, or when it touches your skin.

Even if you’re exposed to hexachlorobenzene, you might not be harmed. Whether you are harmed will depend on such factors as the dose (how much), the duration (how long), and how you happen to contact it. Harm might also depend on whether you’ve been exposed to any other chemicals, as well as your age, sex, diet, family traits, lifestyle, and state of health.

A Closer Look at Hexachlorobenzene

Overview
This section describes hexachlorobenzene in detail and how you can be exposed to it.

What is hexachlorobenzene?
Hexachlorobenzene is a white, crystalline solid at room temperature.

How is hexachlorobenzene used?
Hexachlorobenzene is not currently manufactured as a commercial end product in the United States, and evidence indicates that it has not been commercially produced since the late 1970s. Hexachlorobenzene was used as a fungicide in the United States until 1984, when the last registered use of the compound as a pesticide was voluntarily cancelled. Small amounts of hexachlorobenzene can still be used in chemical laboratories for research purposes.

Where is hexachlorobenzene found?
Hexachlorobenzene can mostly be found in treated and background soils, sediments, and oceans. It can also be found in air, surface water, and groundwater due to use and disposal of hexachlorobenzene products and as a byproduct of other processes. Because it is bioaccumulative, hexachlorobenzene is also found in biota and hence in the food chain (for example, in fish). It has also been detected in breast milk.
Although hexachlorobenzene is not currently manufactured, it is formed as a waste product in the production of several chlorinated hydrocarbons, such as tetrachloroethylene and trichloroethylene, and is a contaminant in some pesticides, such as pentachloronitrobenzene and pentachlorophenol. Small amounts of hexachlorobenzene can also be produced during combustion processes, such as burning municipal waste. Hexachlorobenzene may also be produced as a byproduct in waste streams of chlor-alkali plants and wood preserving plants.

<table>
<thead>
<tr>
<th>Possible Sources</th>
<th>Outcome</th>
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<tbody>
<tr>
<td><strong>Air:</strong> Hexachlorobenzene is usually detected in air at low levels (typically in the nanogram per cubic meter [ng/m³] range). Incineration of chlorinated materials is also a source of hexachlorobenzene.</td>
<td>Hexachlorobenzene is very slow to break down in air and is subject to long-range transport in the atmosphere.</td>
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<tr>
<td><strong>Water:</strong> Hexachlorobenzene has been detected in groundwater, drinking water, and surface water. Levels are typically in the low parts per billion (ppb) to parts per trillion (ppt) range.</td>
<td>Hexachlorobenzene is very slow to break down in water. It tends to adsorb to suspended particles and sediment in the water column. It is highly bioaccumulated by aquatic organisms like fish.</td>
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<tr>
<td><strong>Soil:</strong> Hexachlorobenzene has been detected in soil and sediment samples both in agricultural areas where it was formerly used and in urban soils near production and waste disposal sites. The levels of hexachlorobenzene can vary greatly in soil and sediment. Hexachlorobenzene levels as high as 53,000 ppb were observed in soil from a contaminated area.</td>
<td>Hexachlorobenzene has low mobility in soil and may evaporate from soil surfaces. It is very persistent and takes many years to break down. It is slowly degraded by soil microorganisms.</td>
</tr>
<tr>
<td><strong>Food Items:</strong> Hexachlorobenzene has been detected in fish and food products. The Food and Drug Administration (FDA) Total Diet Study market basket surveys have found trace levels (&lt;1 ppb) of hexachlorobenzene in many store-purchased food items. Fish from contaminated areas can contain levels of hexachlorobenzene greater than 100 ppb.</td>
<td>The main exposure pathway for the general public to hexachlorobenzene is from the ingestion of food, including fish caught in contaminated areas, and the ingestion of contaminated breast milk for infants.</td>
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</tbody>
</table>
How Hexachlorobenzene Can Affect Your Health

Overview
This section looks at how hexachlorobenzene enters your body and potential hexachlorobenzene health effects found in human and animal studies.

How hexachlorobenzene enters your body
Hexachlorobenzene can enter your body from the air, water, or contaminated food or soil.

<table>
<thead>
<tr>
<th>Possible Sources</th>
<th>Possible Exposure Pathway</th>
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</thead>
<tbody>
<tr>
<td>Air</td>
<td>If you breathe air containing hexachlorobenzene, some of it will enter your body through your lungs.</td>
</tr>
<tr>
<td>Water</td>
<td>Some of the hexachlorobenzene in contaminated drinking water will rapidly enter your body through the digestive tract.</td>
</tr>
<tr>
<td>Food/soil</td>
<td>Some of the hexachlorobenzene in contaminated food, soil, or breast milk will rapidly enter your body through the digestive tract. This is the most likely route of significant exposure to hexachlorobenzene.</td>
</tr>
</tbody>
</table>

Where hexachlorobenzene goes in your body
Hexachlorobenzene rapidly spreads through your blood to many tissues, especially fat, where it can remain for years. Hexachlorobenzene easily moves from blood of pregnant mothers, across the placenta to the unborn child and from the breast milk of a nursing mother to her baby. Because hexachlorobenzene accumulates in fat, levels in babies (particularly breast-fed babies) may be higher than those in the mothers.

How hexachlorobenzene leaves your body
Most hexachlorobenzene leaves your body as hexachlorobenzene in the feces. Some hexachlorobenzene is converted to other chemicals in your body and some of these chemicals leave your body in the urine.
<table>
<thead>
<tr>
<th>Introduction to hexachlorobenzene health effects</th>
<th>The health effects of hexachlorobenzene depend on how much hexachlorobenzene you are exposed to and the length of that exposure. Environmental monitoring data suggest that any hexachlorobenzene 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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term exposure effects</td>
<td>Exposure to very high levels of hexachlorobenzene for short periods caused effects on the nervous system such as weakness, tremors, and convulsions; skin sores; liver effects such as porphyria, which is a decrease in the production of the heme (iron-protein) portion of red blood cell hemoglobin that carries oxygen to cells; and thyroid effects such as decreased thyroid hormones. These types of effects were seen in some people in Turkey who were exposed to high levels of hexachlorobenzene in bread made from grain that had been treated with the chemical as a pesticide.</td>
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<tr>
<td>Long-term exposure effects</td>
<td>Long-term exposure to hexachlorobenzene can cause effects similar to those from short-term exposure. Because hexachlorobenzene accumulates in fat (including breast tissue) where it can remain for long periods, long-term exposure can result in a build-up of hexachlorobenzene in the body. Therefore, long-term exposure may be more serious than acute or short-term exposure.</td>
</tr>
<tr>
<td>Hexachlorobenzene and cancer</td>
<td>Studies in animals suggest that eating foods with hexachlorobenzene for months or years can cause cancer of the liver, kidney, and thyroid.</td>
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</tbody>
</table>
| Some cancer findings by government and other agencies | - The U.S. Department of Health and Human Services (HHS) considers hexachlorobenzene as reasonably anticipated to be a human carcinogen.  
- The U.S. EPA says that hexachlorobenzene is a probable human carcinogen.  
- The International Agency for Research on Cancer (IARC) says that hexachlorobenzene is possibly carcinogenic to humans. |

See Chapters 2 and 3 for more information on hexachlorobenzene health effects.
Children and Hexachlorobenzene

Overview
This section discusses potential health effects of hexachlorobenzene exposure in humans from when they’re first conceived to 18 years of age, and how you might protect against such effects.

Infants and young children appeared to be especially sensitive to the effects of hexachlorobenzene in the Turkish grain poisoning epidemic. Breastfed infants of mothers known to have eaten bread contaminated with high levels of hexachlorobenzene developed a skin disorder known as pembe yara or “pink sore”. Other symptoms were weakness and convulsions. Many of the sickened infants died from this disease. Young children beyond 2 years of age did not get pink sore, but they did develop skin, nervous system, and bone abnormalities later in life.

Although hexachlorobenzene has been banned in the United States since 1966 and globally under the Stockholm Convention since 2004, it is ubiquitous in the environment. This environmental lingering exists because of its past production and use as an organic synthesis compound, and former applications as fungicides and pesticides. However, it is unlikely that hexachlorobenzene will be detected in soil samples in the United States at or near levels that caused the epidemic in Turkey during the 1950’s when it was added as a fungicide to wheat seedlings. For more information on the releases, occurrences, and movements of this substance, see Chapters 5 and 6.

One study found higher levels of hexachlorobenzene in the milk of breastfed babies who had ear infections than in milk of breastfed babies without ear infections. We do not know if hexachlorobenzene increased susceptibility to infection in these babies.

Young animals exposed to hexachlorobenzene before and soon after birth are especially sensitive to hexachlorobenzene. Liver lesions developed during adulthood in rats treated with combined pre- and postnatal exposure. Effects on the nervous system and immune function occurred at lower doses in the young developing animals than in adults. Animal studies also showed that hexachlorobenzene has effects on various endocrine organs, including the thyroid gland (hypothyroidism), parathyroid gland (hyperparathyroidism), adrenal gland, and ovaries. These tissues produce hormones that are important for normal growth and development of the organism.
What about birth defects? Higher levels of hexachlorobenzene were found in the fat of boys with a specific type of birth defect, undescended testis, than in the fat of boys without this defect, however, we do not know if hexachlorobenzene caused the birth defect. Other investigators found little evidence for associations between hexachlorobenzene levels in maternal blood, breast milk, umbilical cord blood, or children’s blood and developmental end points such as preterm birth, birth weight, postpartum growth, or results of infant intelligence testing.

How Can Families Reduce the Risk of Exposure to Hexachlorobenzene?

If your doctor finds that you have been exposed to significant amounts of hexachlorobenzene, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

Food

The primary way that most people are exposed to hexachlorobenzene is through food. Fatty food may be higher in hexachlorobenzene than less fatty food. Additionally, when hexachlorobenzene is present in food, more may be absorbed when the food is fatty than when the food is less fatty. Therefore, eating less fatty food may reduce the risk of exposure to hexachlorobenzene.

Drinking water

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

If you live near an industrial site where hexachlorobenzene was produced or is produced as an unintentional byproduct or you live near a hazardous waste site where it has been discarded, there may be high levels of hexachlorobenzene in the water and soil. Substituting cleaner sources of water and limiting contact with soil (for example, through use of a dense ground cover or thick lawn) would reduce family exposure to hexachlorobenzene. Produce grown in contaminated soil should not be eaten. 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.

Check product labels for hexachlorobenzene

In the past, some technical-grade pesticides or solvents when produced were found to contain trace amounts of hexachlorobenzene as an impurity. However, levels of hexachlorobenzene would be expected to be much lower than those causing health problems.

Medical Tests to Determine Hexachlorobenzene Exposure

Overview

We identify medical tests that can detect whether hexachlorobenzene is in your body, and we recommend safe toxic-substance practices.

Hexachlorobenzene can be measured in blood, breast milk, urine, and feces

Blood, breast milk, urine, and feces may be tested to determine if you have ever been exposed to hexachlorobenzene. These tests are not usually available at a doctor's office because they require special equipment found at county, state, university, and independent analytical laboratories. Because hexachlorobenzene can deposit and remain in human fat for several years, tests for hexachlorobenzene and its breakdown products (metabolites) can tell you only that you have been exposed to hexachlorobenzene, but not when or to how much. Furthermore, the detection of hexachlorobenzene or its metabolites cannot predict the kind of health effects that might develop from that exposure. Blood, urine, and feces can also be monitored for porphyrins. High porphyrin levels indicate slowed formation of heme, which is a major effect of hexachlorobenzene in the body. The production of persistent purple urine is diagnostic. The usefulness of this test as a sign of hexachlorobenzene exposure is limited, because there are many other potential causes of high porphyrin levels.

DEPARTMENT of HEALTH AND HUMAN SERVICES, Public Health Service
Agency for Toxic Substances and Disease Registry

www.atsdr.cdc.gov  Telephone: 1-800-232-4636  Fax: 770-488-4178  E-Mail: edcinfo@cdc.gov
levels.

For more information on the different substances formed by hexachlorobenzene and tests to detect these substances in the body, see Chapters 3 and 7.

Federal Government Recommendations to Protect Human Health

Overview
One way the federal government promotes public health is by regulating toxic substances or recommending ways to handle or to avoid toxic substances.

The federal government regulates toxic substances
Regulations are enforceable by law. The U.S. EPA, the Occupational Safety and Health Administration (OSHA), and the FDA are some federal agencies that have adopted toxic substances regulations.

The federal government recommends safe toxic substance practices
The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH) have made recommendations about toxic substances. Unlike enforceable regulations, these recommendations are advisory only.

Toxic substance regulations
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 (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.

Some regulations and recommendations for hexachlorobenzene include

<table>
<thead>
<tr>
<th>Federal Organization</th>
<th>Regulation or Recommendation</th>
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<tbody>
<tr>
<td>U.S. Environmental Protection Agency</td>
<td>The U.S. EPA has determined that exposures to hexachlorobenzene in drinking water of adults or children (10 years old or younger) at concentrations less than or equal to 0.05 milligrams per liter (mg/L) for up to 10 days or adults at less than or equal to 0.03 mg/L for a lifetime (assuming 100% of hexachlorobenzene exposure is from drinking water) are not expected to cause any adverse noncancer effects.</td>
</tr>
</tbody>
</table>

Additional Information

Overview
Where to find more information about hexachlorobenzene.

Whom to contact first
If you have any more questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below.

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

DEPARTMENT of HEALTH AND HUMAN SERVICES, Public Health Service
Agency for Toxic Substances and Disease Registry

www.atsdr.cdc.gov/  Telephone: 1-800-232-4636  Fax: 770-488-4178  E-Mail: cdcinfo@cdc.gov
Toxicological profiles are also available online at www.atsdr.cdc.gov and on CD-ROM. Request a copy of the ATSDR ToxProfiles™ CD-ROM by:

- Calling the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636),
- E-mailing cdcinfo@cdc.gov, or
- Writing to

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences
1600 Clifton Road NE
Mailstop F-57
Atlanta, GA 30333
Fax: 1-770-488-4178

For-profit organizations should request final toxicological profile copies from

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: http://www.ntis.gov/