

1. PUBLIC HEALTH STATEMENT

This public health statement tells you about barium and barium compounds and the effects of exposure to these chemicals.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. Barium and barium compounds have been found in at least 798 of the 1,684 current or former NPL sites; however, the total number of NPL sites evaluated for these substances is not known. This information is important because these sites may be sources of exposure and exposure to this substance may harm you.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. You can be 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 barium and barium compounds, many factors will determine whether you will be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with them. You must also consider any other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

1.1 WHAT IS BARIUM?

Barium is a silvery-white metal that takes on a silver-yellow color when exposed to air. Barium occurs in nature in many different forms called compounds. These compounds are solids, existing as powders or crystals, and they do not burn well. Two forms of barium, barium sulfate and barium carbonate, are often found in nature as underground ore deposits. Barium is sometimes found naturally in drinking water and food. Because certain barium compounds (barium sulfate and barium carbonate) do not mix well with water, the amount of barium usually found in drinking water is small. Other barium compounds, such as barium chloride, barium nitrate, and barium hydroxide, are manufactured from barium sulfate. Barium compounds such

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as barium acetate, barium chloride, barium hydroxide, barium nitrate, and barium sulfide dissolve more easily in water than barium sulfate and barium carbonate, but because they are not commonly found in nature, they do not typically end up in drinking water unless the water is contaminated by barium compounds that are released from waste sites.

Barium and barium compounds are used for many important purposes. Barium sulfate ore is mined and used in several industries. It is used mostly by the oil and gas industries to make drilling muds. Drilling muds make it easier to drill through rock by keeping the drill bit lubricated. Barium sulfate is also used to make paints, bricks, tiles, glass, rubber, and other barium compounds. Some barium compounds, such as barium carbonate, barium chloride, and barium hydroxide, are used to make ceramics, insect and rat poisons, and additives for oils and fuels; in the treatment of boiler water; in the production of barium greases; as a component in sealants, paper manufacturing, and sugar refining; in animal and vegetable oil refining; and in the protection of objects made of limestone from deterioration. Barium sulfate is sometimes used by doctors to perform medical tests and take x-ray photographs of the stomach and intestines.

More information on the chemical and physical properties and use of barium is found in Chapters 4 and 5.

1.2 WHAT HAPPENS TO BARIUM WHEN IT ENTERS THE ENVIRONMENT?

The length of time that barium will last in air, land, water, or sediments following release of barium into these media depends on the form of barium released. Barium compounds that do not dissolve well in water, such as barium sulfate and barium carbonate, can persist for a long time in the environment. Barium compounds, such as barium chloride, barium nitrate, or barium hydroxide, that dissolve easily in water usually do not last in these forms for a long time in the environment. The barium in these compounds that is dissolved in water quickly combines with sulfate or carbonate that are naturally found in water and become the longer lasting forms (barium sulfate and barium carbonate). Barium sulfate and barium carbonate are the barium compounds most commonly found in the soil and water. If barium sulfate and barium carbonate

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are released onto land, they will combine with particles of soil. More information on the environmental fate of barium is found in Chapter 6.

1.3 HOW MIGHT I BE EXPOSED TO BARIUM?

Background levels of barium in the environment are very low. The air that most people breathe contains about 0.0015 parts of barium per billion parts of air (ppb). The air around factories that release barium compounds into the air has about 0.33 ppb or less of barium. Most surface water and public water supplies contain on average 0.030 parts of barium per million parts of water (ppm) or less, but can average as high as 0.30 ppm in some regions of the United States. In some areas that have underground water wells, drinking water may contain more barium than the 2 ppm limit set by EPA. The highest amount measured from these water wells has been 10 ppm. The amount of barium found in soil ranges from about 15 to 3,500 ppm. Some foods, such as Brazil nuts, seaweed, fish, and certain plants, may contain high amounts of barium. The amount of barium found in food and water usually is not high enough to be a health concern. However, information is still being collected to determine if long-term exposure to low levels of barium causes any health problems.

People with the greatest known risk of exposure to high levels of barium are those working in industries that make or use barium compounds. Most of these exposed persons breathe air that contains barium sulfate or barium carbonate. Sometimes they are exposed to one of the more harmful barium compounds (for example, barium chloride or barium hydroxide) by breathing the dust from these compounds or by getting them on their skin. Barium carbonate can be harmful if accidentally eaten because it will dissolve in the acids within the stomach unlike barium sulfate, which will not dissolve in the stomach. Many hazardous waste sites contain barium compounds, and these sites may be a source of exposure for people living and working near them. Exposure near hazardous waste sites may occur by breathing dust, eating soil or plants, or drinking water that is polluted with barium. People near these sites may also get soil or water that contains barium on their skin. More information on how you might be exposed to barium is found in Chapter 6.

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1.4 HOW CAN BARIUM ENTER AND LEAVE MY BODY?

Barium enters your body when you breathe air, eat food, or drink water containing barium. It may also enter your body to a small extent when you have direct skin contact with barium compounds. The amount of barium that enters the bloodstream after you breathe, eat, or drink it depends on the barium compound. Some barium compounds that are soluble, such as barium chloride, can enter bloodstream more easily than insoluble barium compounds such as barium sulfate. Some barium compounds (for example, barium chloride) can enter your body through your skin, but this is very rare and usually occurs in industrial accidents at factories where they make or use barium compounds. Barium at hazardous waste sites may enter your body if you breathe dust, eat soil or plants, or drink water polluted with barium from this area.

Barium that enters your body by breathing, eating, or drinking is removed mainly in feces and urine. Most of the barium that enters your body is removed within 1–2 weeks. Most of the small amount of barium that stays in your body goes into the bones and teeth. More information on how barium enters and leaves your body is found in Chapter 3.

1.5 HOW CAN BARIUM AFFECT MY HEALTH?

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

The health effects associated with exposure to different barium compounds depend on how well the specific barium compound dissolves in water or in the stomach. For example, barium sulfate

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does not easily dissolve in water and causes few harmful health effects. Doctors sometimes give barium sulfate orally or by placing it directly in the rectum of patients for purposes of making x-rays of the stomach or intestines. The use of this particular barium compound in this type of medical test is not harmful to people. Barium compounds such as barium acetate, barium chloride, barium hydroxide, barium nitrate, and barium sulfide that dissolve in water can cause harmful health effects. Barium carbonate does not dissolve in water, but does dissolve in the stomach; it can also cause harmful health effects.

Eating or drinking very large amounts of barium compounds that dissolve in water or in the stomach can cause changes in heart rhythm or paralysis in humans. Some people who did not seek medical treatment soon after eating or drinking a very large amount of barium have died. Some people who eat or drink somewhat smaller amounts of barium for a short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. One study showed that people who drank water containing as much as 10 ppm of barium for 4 weeks did not have increased blood pressure or abnormal heart rhythms. The health effects of barium have been studied more often in experimental animals than in humans. Rats that ate or drank barium over short periods had swelling and irritation of the intestines, changes in organ weights, decreased body weight, and increased numbers of deaths. Rats and mice that drank barium over long periods had damage to the kidneys, decreases in body weight, and decreased survival. We have no information about the ability of barium to affect reproduction in humans; a study in experimental animals did not find reproductive effects.

Some studies of humans and experimental animals exposed to barium in the air have reported damage to the lungs, but other studies have not found these effects. We have no reliable information about the health effects in humans or experimental animals that are exposed to barium by direct skin contact.

Barium has not been shown to cause cancer in humans or in experimental animals drinking barium in water. The Department of Health and Human Services and the International Agency for Research on Cancer have not classified barium as to its carcinogenicity. The EPA has

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determined that barium is not likely to be carcinogenic to humans following ingestion and that there is insufficient information to determine whether it will be carcinogenic to humans following inhalation exposure.

More information on the health effects of barium can be found in Chapter 3.

1.6 HOW CAN BARIUM AFFECT CHILDREN?

This section discusses potential health effects in humans from exposures during the period from conception to maturity at 18 years of age.

We do not know whether children will be more or less sensitive than adults to barium toxicity. A study in rats that swallowed barium found a decrease in newborn body weight; we do not know if a similar effect would be seen in humans.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO BARIUM?

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

The greatest potential source of barium exposure is through food and drinking water. However, the amount of barium in foods and drinking water are typically too low to be of concern.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO BARIUM?

There is no routine medical test to determine whether you have been exposed to barium. Doctors can measure barium in body tissues and fluids, such as bones, blood, urine, and feces, using very complex instruments. These tests cannot be used to predict the extent of the exposure or potential health effects. This is normally done only for cases of severe barium poisoning and for medical research.

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More information on testing for barium exposure is found in Chapters 3 and 7.

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

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 that is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans. Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or other factors.

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 provides it. Some regulations and recommendations for barium include the following:

The EPA has determined that drinking water should not contain more than 2.0 milligrams (mg) barium per liter (L) of water (2.0 mg/L).

OSHA has a legally enforceable occupational exposure limit of 0.5 mg of soluble barium compounds per cubic meter (m^3) of air averaged over an 8-hour work day. The OSHA 8-hour exposure limit for barium sulfate dust in air is 15 mg/ m^3 for total dust. NIOSH considers

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exposure to barium chloride levels of 50 mg/m³ and higher as immediately dangerous to life or health.

More information on government regulations can be found in Chapter 8.

1.10 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 contact ATSDR at the address and phone number below.

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.

Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may 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), by e-mail at cdcinfo@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE
Mailstop F-32
Atlanta, GA 30333
Fax: 1-770-488-4178

Organizations for-profit may request copies of final Toxicological Profiles from the following:

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/>