

Q&A on Public Health Impacts of Benzene Exposure: General Information

The following questions and answers have been prepared to provide community information on benzene air exposures as highlighted in the [Sarnia Area Environmental Health Project](#) (SAEHP) and recent peaks of benzene levels.

Discussion of other exposure such as those for workers (e.g., occupational exposures) and accidental releases of concentrated benzene (e.g., chemical spills) are limited to providing context to community exposures.

There are two Q&As available. This version is supplemented by a technical information Q&A that supports health care providers should people in the community seek advice for their symptoms and concerns on benzene exposures.

The following organizations have reviewed and provided comments on an earlier draft of this document: Public Health Ontario, Health Canada, Environment and Climate Change Canada, Ministry of Health, Ministry of Environment, Conservation and Parks, Ontario Health, Lambton Public Health, and representatives from Aamjiwnaang First Nation.

What is benzene?

Benzene is a chemical that is clear with a sweet-smelling odour that evaporates into the air quickly. Benzene is part of a group of chemicals called volatile organic compounds (VOCs). Benzene is a byproduct of the refining of petroleum and is also used to make a common chemical used in plastic manufacturing called styrene.

How does benzene get into the air?

Benzene mainly gets into the environment through industrial activities. There are also natural sources of benzene, such as forest fires and volcanoes, but these usually add only small amounts to the environment.

Most benzene is made from petroleum products and is used to make a variety of items, such as Styrofoam, plastics, and rubber. It is also added to gasoline in small amounts to help engines work better.

Benzene is also formed and gets into the air when any material containing carbon is burned. This includes fossil fuels like coal, diesel, and gasoline.

In some areas near petrochemical and petroleum industries, like the area studied in the [Sarnia Area Environmental Health Project](#), benzene levels are higher than other communities in Southwestern Ontario and measure highest when the winds are blowing from the directions of main industrial sources.

Outdoor benzene levels can vary based on factors like closeness to industrial sources, weather, and natural events like forest fires. In Canada, median annual average levels of

benzene in outdoor air range from 0.2 µg/m³ to 2.2 µg/m³ across Canada, with higher levels typically observed in urban settings.¹

The [Clean Air Sarnia and Area](#) (CASA) website provides data on ambient air monitors across Sarnia. In Aamjiwnaang, monitoring from 2019 to 2023 shows annual concentrations ranging between 3.3 µg/m³ and 7.0 µg/m³ at the Ada (Lockridge) Rogers Station by the Aamjiwnaang First Nation Band Office. Further south, the annual average concentrations ranged between 0.5 µg/m³ and 1.5 µg/m³ at the Errol Gray Sr. station by the E'Mino Bmaad-Zijig Gamig Health Centre.

In addition to elevated long-term exposures in these communities, intermittent high "peaks" in benzene concentration in air can also occur at varying frequencies.

Based on the Ministry of the Environment, Conservation and Parks (MECP) data, between January 1st, 2019, and May 24th, 2024, the maximum benzene level measured over 1-hour was 372 µg/m³ (in 2023) and the maximum over 24-hours was 84 µg/m³ (in 2019).

Indoor air generally has higher levels of benzene than outdoor air in most communities across Canada. In Canada, the median levels of benzene in indoor air range from 0.4 µg/m³ to 2.2 µg/m³. Benzene in indoor air can come from many sources, such as building materials, furniture, paints, glues, and consumer products (for example, plastic items). Cars parked in attached garages can also add to indoor benzene levels. It is also assumed that benzene concentrations in indoor air can be negatively impacted from infiltration of outdoor air, especially for communities in the vicinity of an emitter.

How are people exposed to benzene?

Benzene quickly evaporates into the air, so most of it ends up there. This means that everyone is exposed to small amounts of benzene outdoors (such as motor vehicle exhaust), at home (such as furnaces and fireplaces), and at work. However, people who work with benzene or live near industrial sources of benzene are exposed to higher levels.

People who work in certain industries or jobs may be exposed to higher levels of benzene than the general public. The most common workplace exposures for benzene in Canada include car repair and maintenance, taxi and limo services, printing, firefighting, and car dealers. Other industries include petrochemical and petroleum refining, rubber tire manufacturing, and transport/storage of benzene.

Benzene is unlikely to stick to clothing or surfaces because it evaporates so quickly. It can also be ingested from food and drinks, but this is a minor source of exposure for most people.

Benzene exposures through skin contact may occur during an accidental release of benzene (e.g., benzene released in a large fuel spill). While unlikely, a spill may also contaminate food or water supplies.

Cigarette smoke is also a major source of benzene, so people who smoke or live with smokers may be exposed to more benzene. For example, smokers may have as much as ten times the daily intake of benzene compared to non-smokers. For most non-smokers in

¹ The concentration of an air pollutant (e.g., benzene) is given in micrograms (one-millionth of a gram) per cubic meter air or µg/m³.

Canada, benzene in the air (both indoors and outdoors) makes up 98-99% of their total exposure.

What happens to benzene in the body?

When people breathe in benzene, about half of it enters the bloodstream through the lungs. As the liver and bone marrow metabolize benzene, some of the harmful effects of benzene exposure may occur in these sites. The body mostly gets rid of benzene in urine within 48 hours of exposure.

What are the health effects of exposure to benzene?

In general, breathing in benzene can have negative effects on the central nervous system, cause respiratory irritation, and affect blood cells and the immune system. Benzene has also been classified as a human carcinogen, meaning it can cause cancer after years of exposure. The International Agency for Research on Cancer identifies benzene as a known human carcinogen, and it is associated particularly with a type of leukemia (specifically acute myeloid leukemia).

The potential short- and long-term health effects of benzene depend on many factors such as how much and how long a person is exposed, how often they are exposed, the route of exposure, and individual factors like age, health, genetics, lifestyle, and other potential chemical exposures. These risk factors can also be influenced by social, economic, and environmental conditions.

What are the health effects following short-term exposure?

Short-term exposure to benzene in air may lead to changes in blood cell counts and effects on the immune system. At very high levels, benzene inhalation can irritate the nose and throat and affect the nervous system, causing symptoms like headache, nausea, dizziness, drowsiness, and confusion.

The MECP applies short-term environmental benchmarks for benzene in outdoor air, well below the concentrations that would cause short-term health effects. However, benzene is also a well-recognized carcinogen and therefore all exposures should be minimized.

What are the health effects following long-term exposure?

The International Agency for Research on Cancer (IARC) has classified benzene as a carcinogen, meaning it can cause cancer. IARC has also found limited evidence linking benzene exposure to other cancers, such as lung cancer and non-Hodgkin lymphoma.

Long-term exposure to benzene can increase the risk of developing cancer, particularly acute myeloid leukemia. It can also affect the blood and immune system, causing diseases like aplastic anemia. Any exposure to benzene, including levels found inside homes and in outdoor air, is associated with some degree of cancer risk.

Most of the evidence about benzene's cancer-causing effects comes from animal studies and studies of workers who were repeatedly exposed to high levels of benzene over a long period of time. There is limited information on associations with cancer for people living near industrial areas.

Are children, pregnant people, and the elderly at higher risk of toxic effects from benzene?

Some people may be more sensitive to the health effects of benzene, including women, children, and pregnant individuals. There is no evidence to suggest that benzene exposure affects people with active cancer or cancer in remission differently than those without cancer. While it is thought that people with increased bone marrow activity (such as fetuses, infants, and individuals with blood conditions) may be more susceptible to benzene's effects on the blood, there is currently no direct human evidence to support this.

What should people do if they have any symptoms that could be associated with benzene exposure?

There are no specific treatments or testing used to medically manage benzene exposures. Healthcare providers can manage individual concerns and symptoms based on their clinical assessment.

If you have any symptoms that may be related to benzene exposure, it is important to speak with your healthcare provider.

How can people reduce their exposure to benzene?

Most exposures are regulated by governmental agencies to limit health risks through industrial sources. However, individuals can take steps to reduce their exposure to benzene from sources such as cigarette smoke and gasoline.

This includes avoiding exposing others to second-hand smoke in enclosed environments, ensuring a tight seal between the home and garage, installing an exhaust fan, and avoiding idling cars in the garage, and removing solvents, gasoline, and other fuels from the garage. Air cleaners with charcoal filters may be able to lower volatile organic compound (VOC) levels indoors, but their effectiveness for benzene removal has not been evaluated. High efficiency particulate air (HEPA) filters will not remove benzene and other VOCs from the air.

Are there any standards and benchmarks for benzene levels in the air?

The Ministry of the Environment, Conservation and Parks (MECP) has set a number of standards and benchmarks to evaluate short-term and long-term air quality. They are set at levels which are protective against adverse health effects over different periods of time.

For contaminants that can cause cancer, like benzene, the MECP sets a level for long-term (annual) air quality associated with a one in a million chance of getting cancer over their lifetime, assuming a person is continuously exposed over the long term. Short-term benchmarks for benzene in outdoor air are well below the concentrations that would cause effects after short term exposures.

Benchmarks for evaluating air quality:

- 0.45 µg/m³: for long-term (annual) average air concentrations
- 30 µg/m³: for short-term (24-hour) average air concentration
- 90 µg/m³: for short-term (1-hour) average air concentration

The MECP uses these levels to understand the health risks, track air quality, and manage emissions.

Exposures to benzene levels above these levels does not mean an adverse effect will occur, but risks of developing the adverse effects increase as the magnitude (how high), the duration (how long) and frequency (how many times) increases.

How much benzene can you be exposed to over the long term?

Benzene is a chemical that can cause cancer, so it is important to limit exposure as much as possible. Risks of developing cancer increase as the exposure magnitude (how high), the duration (how long) and frequency (how many times) increases.

Based on the MECP's long term (annual) benchmark of $0.45 \mu\text{g}/\text{m}^3$, the additional risk of cancer would be:

- One in 1,000,000 - if a person were to be exposed to an average concentration of $0.45 \mu\text{g}/\text{m}^3$ (annually) over their lifetime.
- One in 100,000 - if a person were exposed to an average concentration of $4.5 \mu\text{g}/\text{m}^3$ over their lifetime.
- One in 10,000 - if a person were exposed to an average concentration of $45 \mu\text{g}/\text{m}^3$ over their lifetime.

How much benzene can you be exposed to over the short term?

Benzene is a well-recognized carcinogen and therefore all exposures (both short-and long-term) should be minimized. The MECP has short-term air quality benchmarks for benzene in outdoor air, which are set well below the concentrations that would cause health effects in short-term exposures to benzene. MECP short-term benchmarks are:

- $30 \mu\text{g}/\text{m}^3$: for short-term (24-hour) average air concentration
- $90 \mu\text{g}/\text{m}^3$: for short-term (1-hour) average air concentration

Exposures to benzene levels above these limits does not mean an adverse effect will occur, but risks of developing the adverse effects increase as the magnitude (how high), the duration (how long) and frequency (how many times) increases.

Key Messages

- **Benzene is a chemical that can cause health effects such as changes to the central nervous system, respiratory irritation, changes to blood cells and the immune system, and certain cancers.**
- **Most Canadians are exposed to benzene through inhalation, with potential sources including industrial emissions, motor vehicle exhaust, gas stations, furnaces, and fireplaces.**
- **There are no specific treatments or testing used to medically manage benzene exposures, including at concentrations**

reported in the community. Healthcare providers can manage individual concerns and symptoms based on their clinical assessment.

- **Some people may be more susceptible to the health effects of benzene, including women, children, and pregnant individuals.**
- **If you have symptoms that could be associated with benzene exposure, talk to your healthcare provider.**