## Sources of Exposure

### General Populations

- The general population may be exposed to nitrobenzene via inhalation of air and possibly from drinking water.
- Levels of nitrobenzene in air may be higher near manufacturing facilities, especially petroleum refineries, leather finishing facilities, and some chemical manufacturers.

### Occupational Populations

- Workers who use or produce nitrobenzene may have significantly higher exposure than the general population.
- Occupational exposure is most likely to occur through inhalation or dermal contact.
- Nitrobenzene is readily absorbed through the skin and lungs. Workers who may be exposed to this chemical should wear personal protective equipment.
- Populations working in explosive, pharmaceutical, aniline, pesticide, and dye-stuff manufacturing are at a higher risk of exposure to nitrobenzene.

## Toxicokinetics and Biomonitoring

### Toxicokinetics

- Nitrobenzene may be absorbed after oral, inhalation, or dermal exposure.
- Nitrobenzene is believed to be widely distributed throughout the body after absorption. There is indication that nitrobenzene is lipophilic and is therefore easily absorbed by fatty tissues.
- Nitrobenzene undergoes metabolism through reduction and oxidation reactions. The reductive metabolites of nitrobenzene are likely associated with many toxicological effects.
- Urinary excretion is the main route of removal of nitrobenzene from the body.

### NHANES Biomonitoring

- Nitrobenzene in blood is measured in the U.S. National Health and Nutrition Examination Survey. However, nitrobenzene was not detected in blood at concentrations above the detection limit of 0.320 ng/mL in the most recent survey (NHANES 2013–2016).

## Biomarkers/Environmental Levels

### Biomarkers.

Nitrobenzene in the blood is indicative of recent exposure. Nitrobenzene metabolites in urine, including p-nitrophenol and p-aminophenol, may indicate exposure to nitrobenzene but are not specific to nitrobenzene. Methemoglobinemia is a biomarker of nitrobenzene effects but is also not specific to nitrobenzene.

### Environmental Levels

- Air:
  - Range 0.02–5.7 ppbv
- Surface water:
  - Range 0.0005–115 ppb
- Groundwater:
  - Range 0.5–139 ppb
- Drinking water:
  - Range 0.7–100 ppb
- Soil and sediment:
  - Range 2–8,000 ppb based on limited data.

### Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2023. Toxicological Profile for Nitrobenzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

# ToxGuide™ for Nitrobenzene

$C_6H_5NO_2$

CAS# 98-95-3

January 2024

**U.S. Department of Health and Human Services**
**Public Health Service**
**Agency for Toxic Substances and Disease Registry**
www.atsdr.cdc.gov

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

## Chemical and Physical Information

### Nitrobenzene is found either in crystal form or as an oily liquid

- Nitrobenzene is colorless to pale yellow.
- Nitrobenzene is a synthetic chemical, and it does not occur naturally in the environment.
- It is sparingly soluble in water and most organic solvents.
- Nitrobenzene has a relatively high vapor pressure, which contributes to its flammability.
- Nitrobenzene is primarily used in the synthesis of aniline and in producing the chemical intermediate to polyurethane.
- Its odor is similar to bitter almonds or shoe polish.

## Routes of Exposure

- Inhalation – Inhalation exposure from nitrobenzene released into the atmosphere or volatilized from water may occur near hazardous waste sites or near industries where nitrobenzene is released. Inhalation is a primary route of exposure for the general population and workers.
- Oral – Exposure may occur through ingestion of contaminated water, but this is less likely than inhalation or dermal exposure.
- Dermal – Dermal contact is a potential route of exposure for workers. Nitrobenzene is readily absorbed through the skin.

### Nitrobenzene in the Environment

- Nitrobenzene exists in the atmosphere as a vapor. The half-life for photodegradation of nitrobenzene in air is estimated to be 44 days.

In water, photolysis and biodegradation are significant degradation pathways. The half-life of nitrobenzene in water has been estimated to range from 17 hours to 22 days. Nitrobenzene biodegrades under both aerobic and anaerobic conditions in soil.

Nitrobenzene is not likely to bioaccumulate in fish or other aquatic species but may accumulate in plants.

## Relevance to Public Health (Health Effects)

**Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.**

### Minimal Risk Levels (MRLs)

*Inhalation*

- An acute-duration (≤14 days) inhalation MRL of 0.1 ppm was derived for nitrobenzene.
- An intermediate-duration (15–364 days) inhalation MRL of 0.003 ppm was derived for nitrobenzene.
- A chronic-duration (≥365 days) inhalation MRL of 0.0002 ppm was derived for nitrobenzene.

*Oral*

- An acute-duration oral MRL of 0.05 mg/kg/day was derived for nitrobenzene.
- An intermediate-duration oral MRL of 0.02 mg/kg/day was derived for nitrobenzene.
- No chronic-duration oral MRL was derived for nitrobenzene.

### Health Effects

- The main target of nitrobenzene toxicity is the hematopoietic system. Nitrobenzene may increase methemoglobin in the blood decreasing delivery of oxygen to tissues and organs and can also induce hemolytic anemia, leading to lesions in the spleen, liver, and kidney.

### Health Effects

- Respiratory effects have been observed in chronic-duration inhalation studies in animals, including bronchiolization of the alveoli and nasal lesions.
- Animal studies have demonstrated that nitrobenzene effects on the liver including increased liver weights, degenerative changes in hepatocytes, hepatocytomegaly, and centrilobular necrosis.
- Renal effects of nitrobenzene in animals include increases in kidney weight, increased incidence or severity of nephrosis, renal tubular hyperplasia, cysts, fibrosis, glomerular shrinkage, and degenerative changes in the cortical tubules.
- Nitrobenzene is a known male reproductive toxicant in animals, causing decreased testes weight, testicular lesions, and impairment of spermatogenesis.
- The National Toxicology Program has determined that nitrobenzene is reasonably anticipated to be a human carcinogen. The U.S. Environmental Protection Agency has classified nitrobenzene as a likely human carcinogen. The International Agency for Research on Cancer has determined that nitrobenzene is possibly carcinogenic to humans.

### Children's Health

- In the first 6 months of life, there is increased risk of methemoglobinemia. Older children would be expected to experience similar effects as adults.