

Benzene (C₆H₆)
CAS 71-43-2; UN 1114

Synonyms include benzol, coal tar naphtha, phenyl hydride, and cyclohexatriene.

- **Persons exposed only to benzene vapor do not pose substantial risks of secondary contamination to others. Persons whose clothing or skin is contaminated with liquid benzene can cause secondary contamination by direct contact or through off-gassing vapor.**
- **Benzene is a highly volatile, flammable liquid. Its vapor is heavier than air and may accumulate in low-lying areas. Benzene's sweet aromatic odor generally provides adequate warning of hazardous concentrations for acute exposure.**
- **Benzene is absorbed rapidly and extensively after inhalation and ingestion. It is absorbed less extensively through intact skin; however, percutaneous absorption may contribute to total body burden.**

Description

At room temperature, benzene is a clear, colorless-to-light yellow liquid that is highly flammable. Because it is volatile, it can spread to a distant source of ignition. Benzene has a sweet aromatic odor. It is only slightly soluble in water but readily soluble with most organic solvents. Benzene is less dense than water and will float on the surface of water.

Routes of Exposure

Inhalation

Most exposures to benzene occur by inhalation. Its odor threshold generally provides adequate warning of acutely hazardous concentrations (odor threshold 1.5–5 ppm). Benzene vapor is heavier than air and may cause asphyxiation in enclosed, poorly ventilated, or low-lying areas.

Children exposed to the same levels of benzene vapor as adults may receive larger dose because they have greater lung surface area:body weight ratios and increased minute volumes:weight ratios. In addition, they may be exposed to higher levels than adults in the same location because of their short stature and the higher levels of benzene vapor found nearer to the ground.

Skin/Eye Contact

Benzene splashed in the eyes can result in pain and corneal injury. Repeated or prolonged skin contact with liquid benzene can degrease the skin, causing it to crack and peel. Percutaneous absorption is slow through intact skin; however, benzene absorbed through the skin may contribute to systemic toxicity.

Children are more vulnerable to toxicants absorbed through the skin because of their larger surface area:weight ratio.

Ingestion

Acute toxic effects can result from ingestion of benzene. A burning sensation of the oral mucous membranes, esophagus, and stomach may occur after ingestion. Nausea, vomiting, and abdominal pain may also result from oral ingestion.

Source/Uses

Benzene is the 17th most abundantly produced chemical in the United States. It is obtained primarily from crude petroleum. Benzene is used mainly as a raw material for synthesizing chemicals such as styrene, phenol, and cyclohexane and for manufacturing dyes, detergents, explosives, rubber, plastics, and pharmaceuticals. It is found in trace amounts in cigarette smoke and drinking water, as a contaminant in some industrial solvents, and as a constituent of motor fuels, unleaded gasoline in particular.

Standards and Guidelines

OSHA PEL (permissible exposure limit) = 1 ppm (averaged over an 8-hour workshift).

OSHA STEL (short-term exposure limit) = 5 ppm (15-minute sample).

NIOSH IDLH (immediately dangerous to life or health) = 500 ppm.

AIHA ERPG-2 (maximum airborne concentration below which it is believed that nearly all persons could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action) = 150 ppm.

Physical Properties

Description: Clear, colorless-to-light-yellow liquid

Warning properties: Sweet solvent odor at 1.5 to 5 ppm. Adequate warning for acute exposure; inadequate for chronic exposure as olfactory fatigue can occur.

Molecular weight: 78.1 daltons

Boiling point (760 mm Hg): 176 °F (80.1 °C)

Freezing point: 41.9 °F (5.5 °C)

Specific gravity: 0.88 (water = 1)

Vapor pressure: 75 mm Hg at 68 °F (20 °C)

Gas density: 2.8 (air = 1)

Water solubility: Slightly water soluble (0.07% at 68 °F)
(20 °C)

Flammability: Flammable at temperatures ~12 °F (-11 °C)

Flammable range: 1.2 to 7.8% (concentration in air).

Incompatibilities

Benzene reacts explosively with strong oxidizers, such as perchlorates and nitric acid, and many fluorides.

Health Effects

- Benzene is mildly irritating to the skin, eyes, and respiratory tract.
- Benzene may cause central nervous system depression and arrhythmias to persons acutely exposed. Longer-term exposure to benzene may cause anemia, alterations to the immune system, and leukemia.

Acute Exposure

The effects of acute exposure to high concentrations of benzene (neurological, dermal, respiratory, gastrointestinal) can be evident immediately after exposure. Neurological effects appear to be due primarily to the direct effects of benzene on the central nervous system. The anesthetic action of benzene on the central nervous system is similar to that of other anesthetic gases, first inducing excitation followed by depression, and if exposure continues, death through respiratory failure. Dermal, respiratory, and gastrointestinal effects are due to benzene's irritative properties.

Benzene is metabolized by the liver and its metabolites are excreted by the kidney. Benzene toxicity in large part is due to generation of oxygen radicals via cytochrome P450. Benzene's water soluble metabolites which are formed in the liver are responsible for its hematopoietic effects. Benzene can cause death in acute exposure primarily by its anesthetic properties (respiratory arrest) or its myocardial sensitizing properties (fatal arrhythmias).

Children do not always respond to chemicals in the same way that adults do. In addition, children of different ages (e.g., *in utero*, infants, toddlers, older children) may have different responses to certain chemical exposures, and thus, different protocols for managing their care may be needed.

CNS

Generally, symptoms of CNS toxicity are apparent immediately after inhalation of high concentrations of benzene (3,000 ppm for 5 minutes), and 30 to 60 minutes after ingestion. Mild effects include headache, lightheadedness, dizziness, confusion, nausea, impaired gait, and blurred vision. More severe effects include tremors, respiratory depression, confusion, loss of consciousness, coma, and death. Unconsciousness may be prolonged, although most victims regain consciousness rapidly after they are removed from exposure.

Respiratory Acute exposure to benzene vapor may irritate the mucous membranes of the respiratory tract. With massive exposure (20,000 ppm for 5 minutes), accumulation of fluid in the lungs and respiratory arrest may ensue. Pulmonary aspiration of toxic vomitus or ingested liquid benzene may cause severe hemorrhagic inflammation of the lungs.

Cardiovascular Exposure to very high concentrations (more than 1,000 ppm) of benzene may lower the threshold of the heart muscle to the effects of epinephrine, resulting in life threatening arrhythmias such as ventricular fibrillation. These effects are usually reversible if exposure is terminated.

Dermal Benzene can cause skin irritation and because it is a lipid solvent it degrades the skin, particularly after prolonged or repeated contact with the liquid. Locally, benzene can produce erythema, a burning sensation, and in more severe cases, edema and even blistering.

Because of their larger surface area:body weight ratio, children are more vulnerable than adults to toxicants absorbed through the skin.

Gastrointestinal If swallowed, benzene can irritate the stomach, causing nausea, vomiting, and diarrhea. The estimated lethal oral dose is 100 mL (about 1 g/kg, for a 75 kg man), although as little as 15 mL or 50 mg/kg has caused death.

Ocular High concentrations of benzene vapor can cause eye irritation and visual blurring. When splashed in the eyes, benzene may cause burning pain and sloughing of the eye surface.

Potential Sequelae Recovery from moderate exposure to benzene may take 1 to 4 weeks. During this time, patients may continue to experience impaired gait, nervous irritability, and breathlessness for 2 weeks. Cardiac distress and yellow coloration of the skin may persist for up to a month.

Chronic Exposure

Repeated exposure to high levels of benzene (> 200 ppm) can result in persistent CNS effects. Chronic benzene exposure in the workplace has been associated with hematologic disorders (i.e., thrombocytopenia, aplastic anemia, pancytopenia, and acute myelogenous leukemia). Chronic exposure may be more serious for children because of their potential longer latency period.

Carcinogenicity

The Department of Health and Human Services has determined that benzene is a known human carcinogen. Hematologic neoplasms such as acute myelogenous leukemia have been documented to occur with chronic exposures as low as 10 ppm benzene. Other neoplasms have been documented in animal models.

*Reproductive and
Developmental Effects*

Benzene is not included in *Reproductive and Developmental Toxicants*, a 1991 report published by the U.S. General Accounting Office (GAO) that lists 30 chemicals of concern because of widely acknowledged reproductive and developmental consequences. However, it has been shown to cross the placenta in humans and to be fetotoxic in animals. No information was located as to the presence of benzene in breast milk or of the potential transfer to nursing infants.

Benzene has very weak genotoxicity. Nonetheless, special consideration regarding the exposure of pregnant women is warranted. Medical counseling is recommended for the acutely exposed pregnant woman.

Prehospital Management

- **Victims exposed only to benzene vapor do not pose significant risks of secondary contamination to rescuers outside the Hot Zone. Victims whose clothing or skin is contaminated with liquid benzene can secondarily contaminate response personnel by direct contact or through off-gassing vapor.**
- **Benzene may cause central nervous system depression, cardiac arrhythmias, cutaneous burns and respiratory irritation.**
- **There is no specific antidote for benzene. Treatment consists of support of respiratory and cardiovascular functions.**

Hot Zone

Rescuers should be trained and appropriately attired before entering the Hot Zone. If the proper equipment is not available, or if rescuers have not been trained in its use, assistance should be obtained from a local or regional HAZMAT team or other properly equipped response organization.

Rescuer Protection

Benzene vapor is absorbed well by inhalation and is a mild respiratory-tract irritant. The liquid is a mild skin irritant with slow skin absorption.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response situations that involve exposure to potentially unsafe levels of benzene vapor (i.e., greater than 300 ppm for 1 hour).

Skin Protection: Chemical-protective clothing is not generally required when only vapor exposure is expected because benzene vapor is neither irritating nor absorbed well through the skin. Chemical-protective clothing is recommended when contact with liquid benzene is anticipated because skin irritation and dermal absorption occur.

ABC Reminders

Quickly access for a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible.

Victim Removal

If victims can walk, lead them out of the Hot Zone to the Decontamination Zone. Victims who are unable to walk may be removed on backboards or gurneys; if these are not available, carefully carry or drag victims to safety.

Consider appropriate management of chemically-contaminated children, such as measures to reduce separation anxiety if a child is separated from a parent or other adult.

Decontamination Zone

Victims exposed only to benzene vapor who have no skin or eye irritation do not need decontamination. They may be transferred immediately to the Support Zone. All others require decontamination as described below.

Rescuer Protection

If exposure levels are determined to be safe, decontamination may be conducted by personnel wearing a lower level of protection than that worn in the Hot Zone (described above).

ABC Reminders

Quickly access for a patent airway, ensure adequate respiration and pulse. Stabilize the cervical spine with a collar and a backboard if trauma is suspected. Administer supplemental oxygen as required. Assist ventilation with a bag-valve-mask device if necessary.

Basic Decontamination

Victims who are able and cooperative may assist with their own decontamination. Remove and double-bag contaminated clothing and personal belongings. Leather absorbs benzene; items such as leather shoes, gloves, and belts may require disposal by incineration.

Flush liquid-exposed skin and hair with plain water for 2 to 3 minutes, then wash with mild soap. Rinse thoroughly with water.

Flush exposed or irritated eyes with plain water or saline for at least 15 minutes or until pain resolves. Remove contact lenses if easily removable without additional trauma to the eye.

In case of ingestion, **do not induce emesis**. Administer a slurry of activated charcoal if the victim is alert and is able to swallow (at 1 gm/kg, usual adult dose 60–90 g, child dose 25–50 g).

If patient exhibits seizures, administer a benzodiazepine; Diazepam (adult: 5 to 10 mg i.v., repeat every 10 to 15 minutes as needed; child: 0.2 to 0.5 mg/kg i.v., repeat every 5 minutes as needed) or Lorazepam (adult: 4 to 8 mg i.v.; child: 0.05 to 0.1 mg/kg i.v.). Consider phenobarbital and/or phenytoin or fosphenytoin if seizures are uncontrollable or recur after diazepam 30 mg (adults) or 10 mg (children >5 years).

Consider appropriate management of chemically contaminated children at the exposure site. Also, provide reassurance to the

child during decontamination, especially if separation from a parent occurs. If possible, seek assistance from a child separation expert.

Transfer to Support Zone

As soon as basic decontamination is complete, move the victim to the Support Zone.

Support Zone

Be certain that victims have been decontaminated properly (see Decontamination Zone above). Persons who have undergone decontamination or have been exposed only to vapor pose no serious risks of secondary contamination. Support Zone personnel require no specialized protective gear in such cases.

ABC Reminders

Quickly access for a patent airway. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible. Ensure adequate respiration and pulse. Administer supplemental oxygen as required. Establish intravenous access if necessary. Place on a cardiac monitor.

Additional Decontamination

Continue irrigating exposed skin and eyes, as appropriate.

In cases of ingestion, **do not induce emesis**. If activated charcoal has not been given previously, administer a slurry (at 1 gm/kg, usual adult dose 60–90 g, child dose 25–50 g) if the patient is alert and able to swallow.

Advanced Treatment

Monitor for arrhythmia, hypotension, respiratory depression, and hypoxia. Evaluate for hypoglycemia and electrolyte disturbances.

Patients who are comatose or have cardiac arrhythmias should be treated according to ALS protocols.

In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so.

Use extreme caution when treating patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Wherever possible avoid the use of sympathomimetics in benzene exposed patients. Try

to avoid administering epinephrine due to the possible myocardial sensitizing effect of benzene.

If massive exposure is suspected or if the patient is hypotensive, intravenous saline or lactated Ringer's solution should be infused. For adults, bolus 1,000 mL/hour intravenous saline or lactated Ringer's solution if blood pressure is under 80 mm Hg; if systolic pressure is over 90 mm Hg, an infusion rate of 150 to 200 mL/hour is sufficient. For children with compromised perfusion administer a 20 mL/kg bolus of normal saline over 10 to 20 minutes, then infuse at 2 to 3 mL/kg/hour.

Transport to Medical Facility

Only decontaminated patients or patients not requiring decontamination should be transported to a medical facility. "Body bags" can increase exposure and are not recommended.

Report to the base station and the receiving medical facility the condition of the patient, treatment given, and estimated time of arrival at the medical facility.

If benzene has been ingested, prepare the ambulance in case the victim vomits toxic material. Have ready several towels and open plastic bags to quickly clean up and isolate vomitus. Take measures to avoid pulmonary aspiration, i.e., place patient in lateral position.

Multi-Casualty Triage

Consult with the base station physician or the regional poison control center for advice regarding triage of multiple victims.

Patients who have histories or evidence of substantial exposure and all persons who have ingested benzene should be transported to a medical facility for evaluation. Patients who have histories of cardiac dysrhythmias or other heart conditions are at special risk. These patients should also be transported for evaluation.

Patients who have inhalation exposure who did not experience alteration of consciousness (e.g., confusion, syncope, unconsciousness) are not likely to have had a significant exposure. After their names, addresses, and telephone numbers are recorded, these patients may be released from the scene with instructions to rest and to seek medical care promptly if symptoms develop (see *Patient Information Sheet* below).

Emergency Department Management

- **Hospital personnel can be secondarily exposed by direct contact or by vapor off-gassing from heavily contaminated clothing or skin. Patients do not pose contamination risks after clothing is removed and the skin is washed. Toxic vomitus from patients who have ingested benzene may off-gas benzene vapor.**
- **Benzene may cause central nervous system depression, cardiac dysrhythmias, cutaneous burns, and respiratory irritation.**
- **There is no specific antidote for benzene. Treatment consists of supportive measures.**

Decontamination Area

Previously decontaminated patients and patients exposed only to benzene vapor who have no skin or eye irritation may be transferred immediately to the Critical Care Area. Other patients will require decontamination as described below.

Be aware that use of protective equipment by the provider may cause fear in children, resulting in decreased compliance with further management efforts.

Because of their relatively larger surface area:weight ratio, children are more vulnerable to toxicants absorbed through the skin. Also, emergency room personnel should examine children's mouths because of the frequency of hand-to-mouth activity among children.

ABC Reminders

Evaluate and support airway, breathing, and circulation. Children may be more vulnerable to corrosive agents than adults because of the smaller diameter of their airways. In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so.

Use extreme caution when treating patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Wherever possible avoid

the use of sympathomimetics in benzene exposed patients. Try to avoid administering epinephrine due to the possible myocardial sensitizing effect of benzene.

Patients who are hypotensive or have seizures should be treated in the conventional manner.

In the patient who has suffered from seizures, coma, or cardiac arrhythmia evaluate for acidosis and treat appropriately by administering intravenously sodium bicarbonate (initial adult dose = 1 ampule; pediatric dose = 1 Eq/kg). Further bicarbonate therapy should be guided by arterial blood gas measurements.

Basic Decontamination

Patients who are able and cooperative may assist with their own decontamination. If the patient's clothing is wet with benzene, remove and double-bag the contaminated clothing and personal belongings.

Flush exposed skin with soap and water for 2 to 5 minutes (preferably under a shower). Rinse thoroughly with water.

Irrigate irritated eyes with copious amounts of tepid water for at least 15 minutes or until pain resolves. Remove contact lenses if present and if removable without additional trauma to the eye.

In cases of ingestion, **do not induce emesis**. (More information is provided in Ingestion Exposure under *Critical Care Area* below.) If not already done, administer a slurry of activated charcoal (at 1 gm/kg, usual adult dose 60–90 g, usual child dose 25–50 g). A soda can and a straw may be of assistance when offering charcoal to a child.

Critical Care Area

Be certain that appropriate decontamination has been carried out (see *Decontamination Area* above).

ABC Reminders

Evaluate and support airway, breathing, and circulation as in ABC Reminders above. Children may be more vulnerable to corrosive agents than adults because of the smaller diameter of their airways. Establish intravenous access in seriously ill patients. Continuously monitor cardiac rhythm. Take measures to minimize patient excitation, excessive catecholamine release can induce life threatening arrhythmia due to benzene's sensitizing effect on the myocardium.

Patients who are comatose, hypotensive, or have seizures or cardiac arrhythmia should be treated in the conventional manner.

Inhalation Exposure

Administer supplemental oxygen by mask to patients who have respiratory symptoms. Use extreme caution when treating patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Wherever possible avoid the use of sympathomimetics in benzene exposed patients. Try to avoid administering epinephrine due to the possible myocardial sensitizing effect of benzene.

Skin Exposure

If the skin was in prolonged contact with liquid benzene, irritation may result; treat as thermal burns.

Because of their larger surface area:weight ratio, children are more vulnerable to toxicants absorbed through the skin.

Eye Exposure

Continue irrigation for at least 15 minutes. If eye irritation or injury is evident, test visual acuity. Examine the eyes for corneal damage and treat appropriately. Immediately consult an ophthalmologist for patients who have severe corneal injuries.

Ingestion Exposure

Do not induce emesis.

Consider gastric lavage with a small nasogastric tube if: (1) a large dose has been ingested; (2) the patient's condition is evaluated within 30 minutes; (3) the patient has oral lesions or persistent esophageal discomfort; and (4) the lavage can be administered within 1 hour of ingestion. Care must be taken when placing the gastric tube because blind gastric-tube placement may further injure the chemically damaged esophagus or stomach.

If the patient is alert, administer a slurry of activated charcoal if not done previously (at 1 gm/kg, usual adult dose 60–90 g, child dose 25–50 g). A soda can and straw may be of assistance when offering charcoal to a child. When small amounts of benzene have been ingested, activated charcoal may be administered orally without emptying the gut.

Consider endoscopy to evaluate the extent of gastrointestinal tract injury. Extreme throat swelling may require endotracheal intubation or cricothyroidotomy. Gastric lavage is useful in

certain circumstances to remove caustic material and prepare for endoscopic examination.

Because children do not ingest large amounts of corrosive materials, and because the risk of perforation from NG intubation, lavage is discouraged in children unless intubation is performed under endoscopic guidance.

*Antidotes and
Other Treatments*

There is no antidote for benzene. Hemodialysis and hemoperfusion are not effective.

Laboratory Tests

The diagnosis of acute benzene toxicity is primarily clinical, based on effects on neurological signs and symptoms and respiratory effects. However, laboratory testing is useful for monitoring the patient and evaluating complications. Routine laboratory studies for all exposed patients include CBC, glucose, and electrolyte determinations. Additional tests for patients who have substantial benzene exposure include ECG monitoring, urinalysis, determinations of BUN, creatinine, and liver function test. Chest radiography and pulse oximetry (or ABG measurements) are recommended for severe inhalation exposure or if pulmonary aspiration is suspected.

Blood levels of benzene or phenol, a metabolite of benzene, may be used to document exposure, although they are not useful clinically. The OSHA benzene standard mandates that urinary phenol-testing be performed on all workers exposed to benzene in an emergency situation (see *Follow-up* below). However, other factors that may contribute to a high phenol level must be evaluated, such as ingestion of benzoate preservatives, certain medications (e.g., Pepto-Bismol and Chloraseptic), and smoking. Other urinary metabolites of benzene can also be used to document exposure. The ACGIH biological exposure index for benzene is 25 µg S-phenyl-N-acetyl cysteine (PhAC)/g creatinine, and muconic acid is also a sensitive marker of benzene.

**Disposition and
Follow-up**

Consider hospitalizing symptomatic patients who have significant inhalation exposure and patients who have ingested large amounts of benzene.

Delayed Effects

Observe hospitalized patients for signs of acute tubular necrosis, encephalopathy, and dysrhythmias. In addition, patients exposed by inhalation should be observed for signs of pulmonary edema, and those who have ingested benzene should be watched for signs of aspiration pneumonitis, which can occur up to 72 hours after exposure.

Patient Release Patients who have remained asymptomatic 6 to 12 hours after exposure may be discharged, advised to rest and to seek medical care promptly if symptoms develop (see the *Benzene—Patient Information Sheet* below).

Follow-up Obtain the name of the patient's primary care physician so that the hospital can send a copy of the ED visit to the patient's doctor.

Patients who have received significant exposures (as determined by histories or clinical signs and symptoms such as dysrhythmias, syncope, or confusion) should be monitored for hematopoietic effects. OSHA mandates that acutely exposed workers who have urinary phenol levels above 75 mg/L receive periodic CBCs (at least monthly for 3 months) to monitor potential bone marrow effects. Patients who have corneal injuries should be reexamined within 24 hours.

Reporting

If a work-related incident has occurred, you may be legally required to file a report; contact your state or local health department.

Other persons may still be at risk in the setting where this incident occurred. If the incident occurred in the workplace, discussing it with company personnel may prevent future incidents. If a public health risk exists, notify your state or local health department or other responsible public agency. When appropriate, inform patients that they may request an evaluation of their workplace from OSHA or NIOSH. See Appendices III and IV for a list of agencies that may be of assistance.

Benzene

Patient Information Sheet

This handout provides information and follow-up instructions for persons who have been exposed to benzene.

What is benzene?

Benzene is a clear, colorless liquid with a sweet odor when in pure form. It burns readily. Benzene is obtained from crude petroleum. Small amounts may be found in products such as cigarette smoke, paints, glues, pesticides, and gasoline.

What immediate health effects can be caused by exposure to benzene?

Breathing benzene vapor in small amounts can cause headache, dizziness, drowsiness, or nausea. With more serious exposure, benzene may cause sleepiness, stumbling, irregular heartbeats, fainting, or even death. Benzene vapors are mildly irritating to the skin, eyes, and lungs. If liquid benzene contacts the skin or eyes, it may cause burning pain. Liquid benzene splashed in the eyes can damage the eyes. The degree of symptoms depends on the amount of exposure. Special consideration regarding the exposure of pregnant women is warranted since benzene has been shown to have a small negative effect on genes and crosses the placenta; thus, medical counseling is recommended for the acutely exposed pregnant woman.

Can benzene poisoning be treated?

There is no specific antidote for benzene, but its effects can be treated, and most exposed persons recover fully. Persons who have experienced serious symptoms may need to be hospitalized.

Are any future health effects likely to occur?

A single small exposure from which a person recovers quickly is not likely to cause delayed or long-term effects. After a severe exposure, some symptoms may take a few days to develop. Repeated exposure to benzene may cause a blood disorder (i.e., aplastic anemia and pancytopenia) and cancer of blood-forming cells (i.e., leukemia). Aplastic anemia and leukemia have been reported in some workers exposed repeatedly to benzene over long periods of time.

What tests can be done if a person has been exposed to benzene?

Specific tests for the presence of benzene in blood generally are not useful to the doctor. Phenol, muconic acid or S-phenyl-N-acetyl cysteine (PhAC), breakdown products of benzene, can be measured in urine to prove benzene exposure. Other tests may show whether injury has occurred in the heart, kidneys, blood, or nervous system. Testing is not needed in every case.

Where can more information about benzene be found?

More information about benzene can be obtained from your regional poison control center; the state, county, or local health department; the Agency for Toxic Substances and Disease Registry (ATSDR); your doctor; or a clinic in your area that specializes in occupational and environmental health. If the exposure happened at work, you may wish to discuss it with your employer, the Occupational Safety and Health Administration (OSHA), or the National Institute for Occupational Safety and Health (NIOSH). Ask the person who gave you this form for help in locating these telephone numbers.

Follow-up Instructions

Keep this page and take it with you to your next appointment. Follow *only* the instructions checked below.

Call your doctor or the Emergency Department if you develop any unusual signs or symptoms within the next 24 hours, especially:

- eye and skin irritation
- bronchial irritation, cough, hoarseness, tightness in chest
- drowsiness, dizziness, headache, convulsions
- irregular heart beats

No follow-up appointment is necessary unless you develop any of the symptoms listed above.

Call for an appointment with Dr. _____ in the practice of _____.
When you call for your appointment, please say that you were treated in the Emergency Department at _____ Hospital by _____ and were advised to be seen again in _____ days.

Return to the Emergency Department/ _____ Clinic on (date) _____ at _____ AM/PM for a follow-up examination.

Do not perform vigorous physical activities for 1 to 2 days.

You may resume everyday activities including driving and operating machinery.

Do not return to work for _____ days.

You may return to work on a limited basis. See instructions below.

Avoid exposure to cigarette smoke for 72 hours; smoke may worsen the condition of your lungs.

Avoid drinking alcoholic beverages for at least 24 hours; alcohol may worsen injury to your stomach or have other effects.

Avoid taking the following medications: _____

You may continue taking the following medication(s) that your doctor(s) prescribed for you: _____

Other instructions: _____

• Provide the Emergency Department with the name and the number of your primary care physician so that the ED can send him or her a record of your emergency department visit.

• You or your physician can get more information on the chemical by contacting: _____
_____ or _____, or by checking out the following Internet Web sites: _____;

Signature of patient _____ Date _____

Signature of physician _____ Date _____