

**Aniline (C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>)**  
**CAS 62-53-3; UN 1547**

Synonyms include aminobenzene, aminophen, arylamine, benzenamine, aniline oil, and phenylamine.

- **Persons exposed only to aniline vapor do not pose risks of secondary contamination to others. Persons whose clothing or skin is contaminated with liquid aniline can cause secondary contamination by direct contact or through off-gassing vapor.**
- **Aniline vapor is heavier than air and may accumulate in low-lying areas. The vapor is combustible. Aniline has a characteristic aromatic or fishy odor which provides adequate warning of acute exposure.**
- **Aniline is rapidly absorbed after inhalation and ingestion. Aniline liquid and vapor are also absorbed well through skin, and this can contribute to systemic toxicity.**

### **Description**

At room temperature, aniline, the simplest aromatic amine, is a clear to slightly yellow, oily liquid that darkens to a brown color on exposure to air. It has a low vapor pressure at room temperature. Aniline is slightly soluble in water and is miscible with most organic solvents.

### **Routes of Exposure**

#### *Inhalation*

Inhaled aniline is rapidly and almost completely absorbed from the lungs, leading to systemic toxicity. Its aromatic or fishy odor can generally be perceived at 1 ppm which is below established occupational safety limits (OSHA PEL-TWA is 5 ppm), and thus, odor usually provides an adequate indication of hazardous concentrations. Aniline vapor is heavier than air and may cause asphyxiation in enclosed, poorly ventilated, or low-lying areas.

Children exposed to the same levels of aniline 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 aniline vapor found nearer to the ground.

#### *Skin/Eye Contact*

Contact with liquid aniline may cause mild irritation to skin or eyes. Aniline is absorbed well through the skin, and this can contribute to systemic toxicity. The effects of skin absorption can be delayed for several hours.

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

*Ingestion*

Aniline is rapidly absorbed from the gastrointestinal tract. Ingestion can lead rapidly to severe systemic toxicity, nausea and vomiting usually occur.

**Sources/Uses**

Aniline is synthesized by catalytic hydrogenation of nitrobenzene or by ammonolysis of phenol. In industry, aniline is an initiator or intermediary in the synthesis of a wide variety of products, most notably polyurethane foam, agricultural chemicals, analgesics, synthetic dyes, antioxidants, stabilizers for the rubber industry, and hydroquinone for photographic developing. Aniline has been used as an octane booster in gasoline.

**Standards and Guidelines**

OSHA PEL (permissible exposure limit) = 5 ppm (skin) (averaged over an 8-hour workshift)

NIOSH IDLH (immediately dangerous to life or health) = 100 ppm

**Physical Properties**

*Description:* Slightly yellow-to-brown, clear oily liquid

*Warning properties:* Aromatic or fishy odor at about 1 ppm; adequate warning for acute exposure

*Molecular weight:* 93.1 daltons

*Boiling point* (760 mm Hg): 363 °F (184.4 °C)

*Freezing point:* 21 °F (-6.2 °C)

*Specific gravity:* 1.02 (water = 1)

*Vapor pressure:* 0.6 mm Hg at 68 °F (20 °C)

*Gas density:* 3.2 (air = 1)

*Water solubility:* Water soluble (4% at 68 °F) (20 °C)

*Flammability:* Flammable at temperatures >158 °F (70 °C)

*Flammable range:* 1.3% to 25% (concentration in air)

**Incompatibilities**

Aniline reacts with strong oxidizers, strong acids, alkalis and toluene diisocyanate. It reacts violently with benzenediazonium-2-carboxylate, boron trichloride, dibenzoyl peroxide 90% performic acid, N-bromosuccinimide, trichloronitromethane, and

perchromate, and it spontaneously ignites in the presence of red fuming nitric acid.



## Health Effects

- **Aniline is irritating to the skin, eyes, and respiratory tract. Effects can result from all routes of exposure. Aniline induces methemoglobinemia, which impairs the delivery of oxygen to tissues.**
- **Aniline may also cause the destruction of red blood cells, which manifests as acute or delayed hemolytic anemia. Heart, liver, and kidney effects may be secondary to hemolysis.**
- **Insufficient delivery of oxygen and destruction of red blood cells may cause cardiopulmonary complaints with the development of ischemia, arrhythmia and shock.**

### Acute Exposure

Many of the adverse health effects of aniline are due in part to the formation of methemoglobinemia. Aniline converts the  $\text{Fe}^{+2}$  in hemoglobin to  $\text{Fe}^{+3}$  which impairs its oxygen transport capacity. The mechanism by which aniline produces methemoglobin in the blood appears to be related to an active metabolite. Methemoglobin formation from aniline exposure may develop insidiously, and onset of symptoms may be delayed for hours. Production of methemoglobin may continue for up to 20 hours after exposure. Exposure to 7–53 ppm aniline vapor causes slight symptoms after several hours, and concentrations greater than 100–160 ppm cause serious disturbances. As little as 1 g of ingested aniline can be fatal to humans, the mean lethal dose is 5–30 g (HSDB 2000).

Children do not always respond to chemicals in the same way that adults do. Different protocols for managing their care may be needed. The very young and the very old can be more adversely affected by aniline in an acute exposure.

### *Hematologic*

Aniline causes methemoglobinemia and hemolysis; these changes can be detected by blood tests or by the color and appearance of the blood. Methemoglobinemia is a concern in infants up to 1 year old. Children may be more vulnerable to loss of effectiveness of hemoglobin because of their relative anemia, higher metabolic rate and greater sensitivity to hypoxia compared to adults. The elderly are more vulnerable due to limited cardiovascular reserves. Signs and symptoms expected at various percentages of methemoglobin formation are outlined below. Patients who have underlying diseases may develop signs and symptoms at even lower methemoglobin percentages.

Methemoglobin Level:	Signs and Symptoms:
30–50%	Headache, fatigue, dizziness, rapid heart rate, mild shortness of breath
50–70%	Stupor, slow heart rate, respiratory depression, irregular heart rhythm, acid-base imbalance
60–70%	Cardiac arrest, loss of consciousness, coma, death

When methemoglobin levels are 15% to 30%, the patient's skin may become bluish in color, which is due to the dark color of methemoglobin and not to inadequate oxygen in the blood. The blood itself has a chocolate-brown appearance. Methemoglobin levels exceeding 70% are potentially lethal if untreated.

Acute or delayed (2 to 7 days) hemolytic anemia (caused by destruction of red blood cells) also results from aniline exposure. Aniline induces the formation of Heinz bodies. Persons with glucose-6-phosphate dehydrogenase (G6PD) deficiency or alcoholism are at increased risk of aniline-induced hemolysis.

#### *Cardiovascular*

Cardiac effects of acute aniline exposure, such as irregular heart rhythm, heart block, and acute congestive heart failure, may be caused by decreased oxygen delivery to the tissues. Death can result from progressive acidosis, ischemia and cardiovascular collapse.

#### *CNS*

Acute aniline exposure can cause confusion, ringing in the ears, weakness, disorientation, dizziness, impaired gait, lethargy, drowsiness, convulsions, loss of consciousness, and coma. These effects are usually transitory and probably secondary to lack of oxygen.

#### *Renal*

Acute aniline exposure can cause painful urination; blood, hemoglobin or methemoglobin in the urine; decreased urinary output; and acute kidney failure. Bladder-wall irritation, kidney ulceration, and tissue death can also occur.

#### *Dermal*

Moderate skin irritation and sensitization and dermatitis have been reported. Systemic effects can result from skin contact with aniline vapor or liquid. Patients who have methemoglobinemia can appear gray, bronze, or blue.

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

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<i>Ocular</i>	Aniline can cause mild to severe eye irritation, corneal damage, and discoloration.
<i>Hepatic</i>	Liver damage and jaundice may occur.
<i>Gastrointestinal</i>	Nausea and vomiting can occur.
<i>Respiratory</i>	Inhalation of aniline can cause respiratory tract irritation with cough, or difficulty in breathing. Methemoglobin causes absorption interference with pulse oximetry reading, rendering falsely high values as with the calculated value from the arterial blood gas (ABG) analyzer. Accurate oxygen saturation determinations require co-oximeter measurements.  Children may be more vulnerable because of increased minute ventilation per kg and failure to evacuate an area promptly when exposed.
<i>Potential Sequelae</i>	Persons exposed to aniline may have chronic effects due to the persistence of acutely produced damage to the brain, heart, and kidneys.
<b>Chronic Exposure</b>	Chronic exposure to aniline may cause anemia, headaches, tremor, parathesis, pain, narcosis or coma, and cardiac arrhythmia. Heart, kidney, and liver damage may also occur, possibly as secondary effects of hemolysis.  Chronic exposure may be more serious for children because of their potential longer latency period.
<i>Carcinogenicity</i>	The International Agency for Research on Cancer (IARC) has determined that aniline is not classifiable as to its carcinogenicity to humans. Bladder cancers reported in aniline-exposed workers, but have been attributed to concurrent exposure to chemicals other than aniline.
<i>Reproductive and Developmental Effects</i>	Aniline is not listed in the TERIS or Reprotex databases. One gavage study in pregnant rats is noted in Shepard's Catalog of Teratogenic Agents, and this study resulted in no teratogenic effects. Aniline is not included in <i>Reproductive and Developmental Toxicants</i> , 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. A high incidence of gynecological disorders and excess frequency of spontaneous abortions have been reported in chemically exposed women.

Aniline can cross the placental barrier. Aniline induces the production of methemoglobin in both adults and children. The fetal liver can also N-oxygenate aniline to form phenylhydroxylamine which has a high potency for methemoglobin production. Because fetal hemoglobin is more easily oxidized to methemoglobin than is adult hemoglobin and is less easily reduced back to normal hemoglobin, methemoglobin is likely to be at higher levels in fetuses than in exposed mothers. No data were located to assess potential transfer of aniline to nursing infants via breast milk.



## Prehospital Management

- **Persons exposed only to aniline vapor do not pose secondary contamination risks to rescuers. Those whose clothing or skin is contaminated with liquid aniline can secondarily contaminate response personnel by direct contact or through off-gassing vapor.**
- **Aniline is irritating to the eyes and skin. Systemic effects occur from all routes of exposure and can include methemoglobinemia and hemolysis. CNS depression and cardiovascular collapse may also result, primarily secondary to hypoxia.**
- **Immediate treatment for aniline overexposure consists of decontamination and cardiopulmonary support. Symptomatic individuals should be administered supplemental oxygen and the methemoglobin antidote, methylene blue, as soon as possible.**

### **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*

Aniline is a highly toxic systemic poison that is absorbed well by inhalation and through the skin.

*Respiratory Protection:* Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response situations that involve exposure to potentially unsafe levels of aniline vapor.

*Skin Protection:* Chemical-protective clothing is recommended because aniline vapor and liquid can be dermally absorbed and may contribute to systemic toxicity. Direct contact with liquid aniline can cause skin burns.

### *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. Victims should not be allowed to overexert themselves, as exposure to aniline can

produce hypoxia (due to methemoglobinemia) which can be exacerbated by physical effort.

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**

Patients exposed only to aniline vapor who have no skin or eye irritation may be transferred immediately to the support zone. Other patients will 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. Assist ventilation with a bag-valve-mask device if necessary.

#### *Basic Decontamination*

Victims who are able may assist with their own decontamination, but minimize patient exertion since this could exacerbate symptoms of hypoxemia. Because aniline is absorbed through the skin, it is important to remove wet clothing quickly. Remove and double-bag contaminated clothing and personal belongings.

Flush exposed skin and hair with plain water for 2 to 3 minutes, then wash thoroughly with mild soap. Rinse thoroughly with water. Use caution to avoid hypothermia when decontaminating children or the elderly. Use blankets or warmers when appropriate.

Irrigate exposed or irritated eyes with tepid water for 15 minutes. Remove contact lenses if easily removable without additional trauma to the eye. If pain or injury is evident, continue irrigation while transferring the victim to the support zone.

In cases of ingestion, **do not induce emesis**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal 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.

Consider appropriate management of chemically contaminated children at the exposure site. Provide reassurance to the child

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	during decontamination, especially if separation from a parent occurs.
<i>Transfer to Support Zone</i>	As soon as basic decontamination is complete, move the victim to the Support Zone.
<b>Support Zone</b>	Be certain that victims have been decontaminated properly (see Decontamination Zone above). Victims who have undergone decontamination or who have been exposed only to vapor pose no serious risks of secondary contamination to rescuers. Support Zone personnel require no specialized protective gear in such cases.
<i>ABC Reminders</i>	Quickly access for a patent airway. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard. Ensure adequate respiration and pulse; administer supplemental oxygen. Establish intravenous access if necessary. At low levels of methemoglobin, skin color is not a reliable sign for judging hypoxemia or poor perfusion because the apparent cyanosis is not caused by true hypoxemia but by methemoglobin pigmentation. Place on a cardiac monitor.
<i>Additional Decontamination</i>	Continue irrigating exposed skin and eyes, as appropriate.  In cases of ingestion, <b>do not induce emesis</b> . If the victim is alert and asymptomatic, administer a slurry of activated charcoal if it has not been given 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.
<i>Advanced Treatment</i>	In cases of respiratory compromise secure airway and respiration by endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so.  Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Also 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). Aniline poisoning is not known to pose additional risk during the use of bronchial or cardiac sensitizing agents.  Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine

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solution in water, repeat every 20 minutes as needed cautioning for myocardial variability.

Patients who are comatose, hypotensive, or have seizures or cardiac dysrhythmias should be treated according to advanced life support (ALS) protocols.

*Antidotes*

Administer methylene blue antidote to patients who have cardiopulmonary symptoms. The standard intravenous dose is 1 to 2 mg of methylene blue per kg of body weight (0.1 to 0.2 mL/kg of a 1% solution) over 5 to 10 minutes, repeated in one hour if needed. Clinical response is usually observed within 30 to 60 minutes. The total dose over a 24 hour period should not exceed 7 mg/kg, methylene blue itself can cause hemolysis at greater doses.

Consider hyperbaric oxygen therapy in patients who are refractory to methylene blue therapy.

*Transport to Medical Facility*

Only decontaminated patients or patients not requiring decontamination should be transported to a medical facility. "Body bags" 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 aniline has been ingested, prepare the ambulance in case the patient vomits toxic material. Have ready several towels and open plastic bags to quickly clean up and isolate toxic material.

**Multi-Casualty Triage**

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

Patients with evidence of significant exposure (e.g., cyanosis, dizziness, headache or severe skin irritation) should be transported to a medical facility for evaluation. Others may be discharged from the scene after their names, addresses, and telephone numbers are recorded. They should be advised to seek medical care promptly if symptoms develop (see *Patient Information Sheet* below).

## Emergency Department Management

- **Hospital personnel in an enclosed area can be secondarily exposed by vapor off-gassing from heavily contaminated clothing or from the vomitus of victims who have ingested aniline. Patients exposed only to aniline vapor or who have been decontaminated do not pose secondary contamination risks to hospital personnel.**
- **Aniline exposure can cause methemoglobinemia and hemolysis. CNS depression and cardiovascular collapse may result, primarily secondary to hypoxia.**
- **Immediate treatment for aniline overexposure consists of cardiopulmonary support and administration of the methemoglobinemia antidote, methylene blue.**

### Decontamination Area

Patients who have been decontaminated should be taken immediately to the Critical Care area. Patients who have ingested aniline or have skin contact with liquid aniline 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 larger surface area:body 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. Secure the airway and respiration via endotracheal intubation in cases of respiratory compromise. If the patient's condition precludes intubation, surgically create an airway.

Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Also 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). Aniline poisoning is not known to pose additional risk during the use of bronchial or cardiac sensitizing agents.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed cautioning for myocardial variability.

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

### *Basic Decontamination*

Patients who are able may assist with their own decontamination. Because aniline is absorbed through the skin, hospital personnel should don 2 layers of latex gloves when decontaminating patients. If the patient's clothing is wet with aniline, quickly remove the contaminated clothing while flushing exposed skin and hair with plain water for 2 to 3 minutes (preferably under a shower). Then wash twice with mild soap. Rinse thoroughly with water. Double-bag the contaminated clothing and all personal belongings.

Use caution to avoid hypothermia when decontaminating children or the elderly. Use blankets or warmers when appropriate.

Irrigate exposed eyes with tepid water for at least 15 minutes. Remove contact lenses if easily removable without additional trauma. If pain or injury is evident, continue irrigation while transferring the patient to the Critical Care Area.

In cases of ingestion, **do not induce emesis**. If the victim is alert and asymptomatic, administer a slurry of activated charcoal if it has not been given 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.

### **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 ill patients if this has not been done previously. Continuously monitor cardiac rhythm. Place symptomatic patients on oxygen.

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

*Inhalation Exposure*

Administer supplemental oxygen and treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Also 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). Aniline poisoning is not known to pose additional risk during the use of bronchial or cardiac sensitizing agents.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed cautioning for myocardial variability.

*Skin Exposure*

Treat dermal irritation or burns with standard topical therapy. Patients developing hypersensitivity reactions may require treatment with systemic or topical corticosteroids or antihistamines.

*Eye Exposure*

Ensure that adequate eye irrigation has been completed. 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.**

Gastric lavage is useful in certain circumstances to remove caustic material and prepare for endoscopic examination. Consider gastric lavage with a small nasogastric tube if: (1) a large dose has been ingested; (2) the patient has oral lesions or persistent esophageal discomfort; and (3) the lavage can be performed 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 and charcoal has not been given previously, administer a slurry of activated charcoal (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.

Consider endoscopy to evaluate the extent of gastrointestinal tract injury. Extreme throat swelling may require endotracheal intubation or cricothyriodotomy.

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

Toxic vomitus or gastric washings should be isolated (e.g., by attaching the lavage tube to isolated wall suction or another closed container).

*Antidotes and  
Other Treatments*

Methylene blue (tetramethylthionine chloride) should be considered for patients who have signs and symptoms of hypoxia (other than cyanosis) or for patients who have methemoglobin levels >30%. Cyanosis alone does not require treatment. Methylene blue may not be effective in patients who have G6PD deficiency and may cause hemolysis.

The standard dose of methylene blue is 1 to 2 mg/kg body weight (0.1 to 0.2 mL/kg of a 1% solution) intravenously over 5 to 10 minutes, repeated in one hour if needed. The total 24 hour dose should not exceed 7 mg/kg. (Doses greater than 15 mg/kg may cause hemolysis.) Clinical response to methylene blue treatment is usually observed within 30 to 60 minutes. Side effects include nausea, vomiting, abdominal and chest pain, dizziness, diaphoresis, and dysuria.

Consider hyperbaric oxygen therapy in patients who are refractory to methylene blue therapy.

Consider exchange transfusions for severely poisoned patients who are deteriorating clinically in spite of methylene blue treatment. Intravenous ascorbic acid administered to severely poisoned patients has not proved to be effective.

*Laboratory Tests*

Routine laboratory studies for all exposed patients include CBC, glucose, and electrolyte determinations. Additional studies for patients exposed to aniline include peripheral blood smear, renal-function tests, and determination of methemoglobin and unconjugated bilirubin levels. ABG measurements, chest radiography, and ECG should be performed if cyanosis or dyspnea are present. Methemoglobin causes absorption interference with pulse oximetry reading, rendering falsely high values as with the calculated value from the arterial blood gas



(ABG) analyzer. Accurate oxygen saturation determinations require co-oximeter measurements.

Methemoglobinemia can be detected at the bedside by the characteristic chocolate-brown color that it imparts to blood. Methemoglobin levels greater than 10% can usually be detected by comparing a drop of the patient's blood with a drop of normal blood on white filter paper or gauze.

Measurement of methemoglobin should be repeated at frequent intervals for 24 hours to ensure that the level is decreasing.

## **Disposition and Follow-up**

Patients should be observed for at least 6 hours for the delayed development of methemoglobinemia. Consider hospitalization for symptomatic patients who have elevated methemoglobin levels.

### *Delayed Effects*

Hemolysis may begin 24 or more hours after exposure. Observe hospitalized patients for signs of acute renal failure and arrhythmias.

### *Patient Release*

Patients who have remained asymptomatic for 6 to 12 hours after exposure may be discharged and advised to seek medical care promptly if symptoms develop (see the *Aniline—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.

Monitor patients who have received significant exposure (as determined by symptoms and methemoglobin levels) for effects of hypoxia and hemolysis. A Heinz-body hemolytic crisis may follow the development of methemoglobinemia by 2 to 7 days. Heart, liver, and kidney effects may be secondary to hemolysis.

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.

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## Aniline

### Patient Information Sheet

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

#### **What is aniline?**

Aniline is a manufactured chemical used to make a variety of products including polyurethane foam, photographic developers, rubber, dyes, and pesticides. At room temperature, it is a clear to slightly yellow, oily liquid that may turn brown if left in contact with air. It has a weak fishy odor.

#### **What immediate health effects can be caused by exposure to aniline?**

Aniline can cause effects when it is breathed or swallowed. It can also pass rapidly through the skin. Aniline causes changes in hemoglobin, which carries oxygen in the blood; hence, the blood turns brown and tissues are unable to get enough oxygen (a condition known as methemoglobinemia). Headaches, weakness, drowsiness, and shortness of breath can occur. The skin, lips, and nailbeds can turn blue or slate gray. Aniline can cause the membrane of the red blood cells to burst (hemolysis), which also will prevent oxygen from reaching tissues. Generally, the more serious the exposure, the more severe the symptoms.

#### **Can aniline poisoning be treated?**

A solution of methylene blue may be given through a vein to patients who have been seriously exposed to aniline. Most patients recover within 24 hours, but they may need to be hospitalized for several days. The urine of a patient who has received methylene blue treatment may temporarily become blue to blue-green.

#### **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 serious exposure or repeated exposures to aniline, anemia can occur. There is no evidence that aniline causes cancer. Some workers exposed to aniline over many years developed bladder cancer, but this was probably due to simultaneous exposure to other chemicals. High incidences of gynecological disorders and excess frequency of spontaneous abortions have been reported for women chemically exposed to aniline.

#### **What tests can be done if a person has been exposed to aniline?**

Specific blood tests for the presence of methemoglobin may be useful. If a severe exposure has occurred, blood and urine analyses, and other tests may show whether damage has been done to the liver, heart, and brain. Testing is not needed in every case.

#### **Where can more information about aniline be found?**

More information about aniline can be obtained from your regional poison control center; your 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:

- difficulty breathing, shortness of breath, or chest pain
- weakness, nausea, or vomiting
- blood in the urine (brown- or bronze-colored urine)
- blue, brown, or gray color of the skin, lips, or nailbeds

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 \_\_\_\_\_