Iron and Related Compounds

SUBSTANCE IDENTIFICATION
Greenish or yellowish, solid in fine or lumpy crystals. Can be found in solution form. Used as fertilizers; herbicides; water treatment processes; reducing agent in chemical processes; and in process engraving. Elemental iron is an essential metal for hemoglobin synthesis.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion

TARGET ORGANS
Primary
Respiratory system
Gastrointestinal system
Hepatic
Metabolism
Blood
Secondary
Skin
Eyes
Central nervous system
Cardiovascular system

LIFE THREAT
Hypovolemic shock from fluid loss.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse, hypovolemic shock, increased venous pooling, hypotension, and tachycardia.
Respiratory: Rapid, shallow respirations. Occasionally acidosis may cause a rapid and deep breathing pattern, similar to Kussmaul respirations. Chronic occupational inhalation of iron oxides may produce pulmonary fibrosis (pulmonary siderosis).
CNS: Drowsiness and hyporeflexia. CNS depression, cerebral edema, and coma.
Gastrointestinal: Nausea, prolonged vomiting (hematemesis), bloody diarrhea, and abdominal pain.
Eye: Dilated pupils.
Skin: Cool skin with pallor and cyanosis.
Hepatic: Liver damage with hepatocyte iron accumulation (hemochromatosis) to fulminate hepatic failure.
Metabolism: Metabolic acidosis and hyperglycemia.
Blood: Coagulation defects.
Other: Acute iron ingestion may be categorized into four stages:
Stage I: Nausea, hematemesis, abdominal pain (0.5 to 2 hours).
Stage II: Apparent symptom remission or latent period (6 to 24 hours).
Stage III: Multisystem toxicity, including shock, coma, acidosis, hepatic necrosis,
coagulopathy (2 to 96 hours).
Stage IV: Late complications of GI system and obstruction (2 to 4 weeks).

SYMPOTOM ONSET FOR ACUTE EXPOSURE
Immediate
Some symptoms may be delayed.
There may be a period of apparent recovery followed by severe symptoms.

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Ferrous sulfate: Sulfur oxides
Ferrous chloride: Hydrogen chloride
Ferrous ammonium sulfate: Sulfur oxides, ammonia, nitrogen oxides

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Eye disorders
Skin disorders
Respiratory disorders
Liver disorders
Kidney disorders

DECONTAMINATION
- Wear positive-pressure SCBA and protective equipment specified by references such as the DOT Emergency Response Guidebook or the CANUTEC Initial Emergency Response Guide. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient’s clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- Rinse patient with warm water, 30°C/86°F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.
- Refer to decontamination protocol in Section Three.

IMMEDIATE FIRST AID
- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
- Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.
- Keep victim quiet and maintain normal body temperature.
- Obtain medical attention.

BASIC TREATMENT
- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
- For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml
of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool (refer to ingestion protocol in Section Three).

**ADVANCED TREATMENT**

- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious.
- Monitor cardiac rhythm and treat arrhythmias if necessary (refer to cardiac protocol in Section Three).
- Start an IV with lactated Ringer’s TKO. Watch for signs of fluid overload.
- For hypotension with signs of hypovolemia, administer fluid cautiously. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

**INITIAL EMERGENCY DEPARTMENT**

- Useful initial laboratory studies include complete blood count, platelet count and coagulation profile (prothrombin and partial thromboplastin times), serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile, including serum aminotransferases (AST and ALT), calcium, phosphorus, and magnesium. Determination of anion and osmolar gaps may be helpful. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Monitor serum iron and total iron binding capacity (TIBC) initially and 4 to 6 hours after ingestion. Serum iron concentration greater than 450 to 500 μg/dl and/or higher than the TIBC usually means that acute poisoning is possible. CAUTION: In acute iron ingestion, the TIBC may be falsely elevated, thus negating its diagnostic usefulness. Serum iron concentrations may need to be repeated at 8 to 12 hours after exposure if delayed toxicity expected.
- Increased white blood cell count greater than 15,000 and/or glucose greater than 150 mg/dl may indicate acute iron toxicity.
- Products may cause acidosis; hyperventilation and sodium bicarbonate may be beneficial. Bicarbonate therapy should be guided by patient presentation, ABG determination, and serum electrolyte considerations.
- Deferoxamine (Desferal) chelation may be beneficial in symptomatic patients (refer to deferoxamine protocol in Section Four).
- Abdominal radiograph may be helpful in oral ingestions as iron tablets are radiopaque.
- Obtain toxicological consultation as necessary.
Lead and Related Compounds

SUBSTANCE IDENTIFICATION
A heavy, soft, gray metal. Usually found as a solid, but can also be a component of liquid compounds. Used in storage batteries, printers’ type, solder, pipes, shot, paints, rustproofers, primers, pottery, alloys (antimony, tin, arsenic), and insecticide sprays.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

TARGET ORGANS
Primary
Skin
Eyes
Central nervous system
Gastrointestinal system
Renal
Blood
Secondary
Cardiovascular system
Respiratory system
Hepatic

LIFE THREAT
Circulatory collapse, coma, and rare seizures. Toxicity from multiple exposures (i.e., chronic) is more common than from a single exposure.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse and shock.
Respiratory: Tachypnea.
CNS: Muscle weakness with muscle and joint pain, paresthesias, depression, and headache. Mild anxiety, delirium, hallucinations, memory loss, insomnia, delusions, and decreased level of consciousness to coma (lead encephalopathy) may be present with severe acute or chronic exposure. Increased intracranial pressure and seizures. Gastrointestinal: Anorexia, nausea, vomiting, diarrhea, constipation, and abdominal pain of a burning nature. Pain may become colicky and severe in nature. Metallic taste in the mouth.
Eye: Chemical conjunctivitis.
Skin: Irritation from some liquid compounds.
Renal: Kidney damage.
Hepatic: Liver damage.
Blood: Anemia (microcytic or normocytic), basophilic stippling.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Usually delayed
CO-EXPOSURE CONCERNS
Other heavy metals

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Lead oxide fumes
Hydrogen chloride

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Diseases of the blood and bone marrow
Diseases of kidneys, nervous system
Diseases of reproductive system

DECONTAMINATION
- Wear positive-pressure SCBA and protective equipment specified by references such as the *DOT Emergency Response Guidebook* or the *CANUTEC Initial Emergency Response Guide*. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient’s clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- Rinse patient with warm water, 30°C/86°F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.
- Refer to decontamination protocol in Section Three.

IMMEDIATE FIRST AID
- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
- Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.
- Keep victim quiet and maintain normal body temperature.
- Obtain medical attention.

BASIC TREATMENT
- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
- Anticipate seizures and treat if necessary (refer to seizure protocol in Section Three).
- For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Administer activated charcoal (refer to ingestion protocol in Section Three and activated charcoal protocol in Section Four).

ADVANCED TREATMENT
- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious.
• Use hyperventilation to help control increased intracranial pressure.
• Start an IV with lactated Ringer's to support vital signs.
• For hypotension with signs of hypovolemia, administer fluid cautiously. Watch for signs of fluid overload (refer to shock protocol in Section Three).
• Treat seizures with diazepam (Valium) (refer to diazepam protocol in Section Four).
• Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

**INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS**

- Useful initial laboratory studies include complete blood count, serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile, including serum aminotransferases (AST and ALT), calcium, phosphorus, and magnesium. Determination of anion and osmolar gaps may be helpful. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Specific laboratory measurements include blood or 24-hour urine lead, free erythrocyte protoporphyrin (FEP) or zinc protoporphyrin (ZPP), ALA-D (δ-aminolevulinic dehydratase). There is some question as to whether FEP or ZPP determinations should be used to give the most accurate picture of body lead burden. This is not as critical as consistently using the same method to follow an individual.
- Hyperventilation and diuretics (mannitol and furosemide) may be beneficial in treating increased intracranial pressure.
- Chelation therapy (Calcium EDTA, BAL, D-Penicillamine, Succimer [DMSA]) may be beneficial in treating symptomatic patients. Therapy should be guided by patient presentation and laboratory values.
- Obtain toxicological consultation as necessary.

**SPECIAL CONSIDERATIONS**

- Children are especially sensitive to CNS lead effects. This has prompted the removal of lead from house paints and organic lead compounds (tetraethyl lead) from gasoline.
- Lead exposure effects are cumulative. These include: fatigue, mood changes, stomach pains, arthralgias, myalgias, difficulty sleeping, hypertension, gout, and bone marrow damage. Peripheral nerve disorders: motor nerve axonal neuropathy, ulnar nerve neuropathy, and nerve entrapment syndrome such as carpal tunnel/tarsal tunnel. Kidney and reproductive system damage (reduced fertility, decreased sperm count and abnormal spermatogenesis). Some products may present a human teratogenic and carcinogenic risk.
SUBSTANCE IDENTIFICATION
Silvery white, odorless metal that becomes yellowish or grey on exposure to moist air. Also found in soluble form that is clear to yellow liquid. Used in metallurgy, in the production of grease and ceramics, in alkaline storage batteries and the nuclear power industry, in photographic products, as corrosion inhibitors, and as a catalyst for chemical reactions. Lithium carbonate is used to treat manic-depressive and other psychiatric illnesses.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion

TARGET ORGANS
Primary
Skin
Eyes
Respiratory system
Gastrointestinal system
Secondary
Central nervous system
Cardiovascular system
Renal
Metabolism

LIFE THREAT
Products can be extremely corrosive and cause damage to the respiratory tract leading to pulmonary edema.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse, arrhythmias, and hypotension.
Respiratory: Irritation of respiratory tract, sore throat, cough, dyspnea, pneumonitis, pulmonary edema, and respiratory arrest.
CNS: Coarse tremors, confusion, ataxia, hyperreflexia, dysarthria, CNS depression, and coma. Seizures. Neurobehavioral changes.
Gastrointestinal: Mucosal burns, abdominal pain, nausea, vomiting, and diarrhea.
Eye: Conjunctivitis and burns.
Skin: Irritant dermatitis and chemical burns
Renal: Albuminuria and kidney damage.
Metabolism: Thyroid enlargement, hypothyroidism (rare), hyponatremia, and elevated serum calcium (hypercalcemia).

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Some symptoms (respiratory) possibly delayed
THERMAL DECOMPOSITION PRODUCTS INCLUDE
Hydrogen gas
Lithium hydroxide
Lithium oxide

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Current therapy with lithium medication
Hyponatremia

DECONTAMINATION
- Wear positive-pressure SCBA and protective equipment specified by references such as the DOT Emergency Response Guidebook or the CANUTEC Initial Emergency Response Guide. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient's clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- If water-reactive products are embedded in the skin, no water should be applied. The embedded products should be covered with a light oil (mineral or cooking oil), and the patient transported for surgical debridement. If products are not embedded, gently brush away as much as possible and flush with copious amounts of water to rapidly remove any residual product.
- Rinse patient with warm water, 30° C/86° F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.
- Refer to decontamination protocol in Section Three.

IMMEDIATE FIRST AID
- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
- Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.
- Keep victim quiet and maintain normal body temperature.
- Obtain medical attention.

BASIC TREATMENT
- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Monitor for pulmonary edema and treat if necessary (refer to pulmonary edema protocol in Section Three).
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
- Anticipate seizures and treat if necessary (refer to seizure protocol in Section Three).
- For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during treatment (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml...
Lithium and Related Compounds

of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool (refer to ingestion protocol in Section Three).

- Cover skin burns with dry sterile dressings after decontamination (refer to chemical burn protocol in Section Three).

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious or in severe respiratory distress.
- Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial.
- Monitor cardiac rhythm and treat arrhythmias if necessary (refer to cardiac protocol in Section Three).
- Start an IV with D5W TKO. Use lactated Ringer's if signs of hypovolemia are present.
- Consider drug therapy for pulmonary edema (refer to pulmonary edema protocol in Section Three).
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors for hypotension with a normal fluid volume. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Treat seizures with diazepam (Valium) (refer to diazepam protocol in Section Four).
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS

- Useful initial laboratory studies include complete blood count, serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile, including serum aminotransferases (ALT and AST), thyroid profile, calcium, phosphorus, and magnesium. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Monitor serum lithium concentrations. Lithium has a very low therapeutic index. Patients on lithium therapy have concentrations ranging 0.5 to 1.3 mmol/L. Acute toxicity is usually seen with concentrations greater than 2 mmol/L. Chronic poisoning patients may have lithium concentrations near the therapeutic range.
- Positive end-expiratory pressure (PEEP)–assisted ventilation may be necessary in patients with acute parenchymal injury who develop pulmonary edema or adult respiratory distress syndrome.
- Maintain adequate fluid and electrolyte balance (especially sodium concentration).
- Hemodialysis may be beneficial in the symptomatic patient. Therapy should be guided by clinical presentation and laboratory results.
- Obtain toxicological consultation as necessary.

SPECIAL CONSIDERATIONS

- Persistent neurobehavioral changes are possible, even after acute symptoms have resolved.
Magnesium and Related Compounds

SUBSTANCE IDENTIFICATION
Bright, silvery or colorless metal. Found in powder, crystal, or in solution form. Used as drying agents and in making refractory materials, magnesia cements, petroleum additives, and fertilizers. Also used in optical instruments and semiconductors, in the paper industry, and in the manufacture of structural parts. Magnesium has a variety of medical uses, including in oral cathartics and antacids, magnesium sulfate (Epsom salts), magnesium hydroxide (Milk of Magnesia), and magnesium citrate.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion

TARGET ORGANS
Primary
Skin
Eyes
Respiratory system
Secondary
Central nervous system
Cardiovascular system
Gastrointestinal system
Renal

LIFE THREAT
Cardiovascular collapse and respiratory depression

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse, hypotension. Prolongation of PR, QRS, and QT intervals may be observed. Asystole.
Respiratory: Irritation of respiratory tract with dyspnea and pulmonary edema. Hypoventilation and respiratory paralysis secondary to muscle paralysis.
CNS: Headache, dizziness, CNS depression, seizures, neuromuscular paralysis, and hyporeflexia.
Gastrointestinal: Nausea, vomiting, diarrhea. Irritation and hypomotility of the gastrointestinal tract.
Eye: Conjunctivitis.
Skin: Drying of the skin, cyanosis and dermatitis. Particles may become embedded in skin.
Renal: Kidney damage.
Other: Metal fume fever (flu-type symptoms).

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Most symptoms can be delayed

CO-EXPOSURE CONCERNS
Calcium and ammonium compounds
Magnesium and Related Compounds

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Carbon dioxide
Carbon monoxide
Hydrogen
Hydrogen chloride
Magnesium oxide fumes
Nitrogen oxides

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory conditions
Dermatitis
Central nervous system dysfunction
Impaired kidney function

DECONTAMINATION
- Wear Positive-pressure SCBA and protective equipment specified by references such as the DOT Emergency Response Guidebook or the CANUTEC Initial Emergency Response Guide. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient's clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- If water-reactive products are embedded in the skin, no water should be applied. The embedded products should be covered with a light oil (mineral or cooking oil) and the patient transported for surgical debridement. If products are not embedded, gently brush away as much as possible and flush with copious amounts of water to rapidly remove any residual product.
- Rinse patient with warm water, 30°C/86°F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.
- Refer to decontamination protocol in Section Three.

IMMEDIATE FIRST AID
- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
- Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.
- Keep victim quiet and maintain normal body temperature.
- Obtain medical attention.

BASIC TREATMENT
- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Monitor for pulmonary edema and treat if necessary (refer to pulmonary edema protocol in Section Three).
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
Magnesium and Related Compounds

- For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool (refer to ingestion protocol in Section Three).

ADVANCED TREATMENT
- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious or in severe respiratory distress.
- Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial.
- Monitor cardiac rhythm and treat arrhythmias if necessary (refer to cardiac protocol in Section Three).
- Start an IV with D5W TKO. Use lactated Ringer’s if signs of hypovolemia are present. Watch for signs of fluid overload.
- Consider drug therapy for pulmonary edema (refer to pulmonary edema protocol in Section Three).
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors for hypotension with a normal fluid volume. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS
- Useful initial laboratory studies include complete blood count, serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile. including serum aminotransferases (ALT and AST), calcium, phosphorus, and magnesium. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Normal plasma magnesium concentrations range from 1.5 to 2.2 mEq/L. Symptoms of toxicity usually become evident at 3.0 mEq/L or above.
- Products may cause acidosis: hyperventilation and sodium bicarbonate may be beneficial. Bicarbonate therapy should be guided by patient presentation and ABG determination.
- Hemodialysis or forced diuresis may be beneficial in the symptomatic patient. Treatment should be guided by clinical presentation and laboratory results.
- Obtain toxicological consultation as necessary.

SPECIAL CONSIDERATIONS
- Metal fume fever, also termed “Monday Morning Fever,” may develop from exposure to magnesium fumes. Symptoms include metallic taste, dry cough, shortness of breath, diaphoresis, fever chills, fatigue, and myalgia. Symptoms usually begin 4 to 12 hours after exposure, are self-limited, remit during the work week, and reappear with exposure after the weekend. This is most likely an immune-mediated problem related to occupational exposures.
Manganese and Related Compounds

SUBSTANCE IDENTIFICATION
Reddish-gray or silvery metallic element. Found in solid, dust, and solution forms. Used in the manufacture of steel, ceramics, matches, glass, dyes, welding rods; and in dry cell batteries.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion

TARGET ORGANS
Primary
Skin
Eyes
Central nervous system
Respiratory system
Secondary
Cardiovascular system
Gastrointestinal system
Hepatic

LIFE THREAT
Respiratory tract irritation and pulmonary edema

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse, hypotension.
Respiratory: Metal fume fever (flu-type symptoms), manganese pneumonitis (fever, chills, coughing, and congestion). Irritation of respiratory tract, dyspnea, and possibly pulmonary edema.
CNS: No acute symptoms reported. Chronic symptoms include intoxication-type symptoms, speech impairment, loss of balance, incoordination, and muscle cramps.
Gastrointestinal: Nausea, irritation and burns to GI tract.
Eye: Conjunctivitis and corneal damage.
Skin: Irritation and dermatitis.
Hepatic: Liver damage.
Other: Some products may present a human carcinogenic risk.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Metal fume fever symptoms immediate
Other symptoms delayed

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Manganese chloride
Manganese oxide

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory system disorders
Neurological disorders
Anemia
COPD DECONTAMINATION

- Wear positive-pressure SCBA and protective equipment specified by references such as the DOT Emergency Response Guidebook or the CANUTEC Initial Emergency Response Guide. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient’s clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- If water-reactive products are embedded in the skin, no water should be applied. The embedded products should be covered with a light oil (mineral or cooking oil), and the patient transported for surgical debridement. If products are not embedded, gently brush away as much as possible and flush with copious amounts of water to rapidly remove any residual product.
- Rinse patient with warm water, 30° C/86° F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.
- Refer to decontamination protocol in Section Three.

IMMEDIATE FIRST AID

- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
- Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.
- Keep victim quiet and maintain normal body temperature.
- Obtain medical attention.

BASIC TREATMENT

- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Monitor for pulmonary edema and treat if necessary (refer to pulmonary edema protocol in Section Three).
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
- For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool (refer to ingestion protocol in Section Three).

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious or in severe respiratory distress.
- Monitor cardiac rhythm and treat arrhythmias if necessary (refer to cardiac protocol in Section Three).
Manganese and Related Compounds

- Start an IV with D$_3$W TKO. Use lactated Ringer’s if signs of hypovolemia are present.
- Consider drug therapy for pulmonary edema (refer to pulmonary edema protocol in Section Three).
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors for hypotension with a normal fluid volume. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

**INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS**

- Useful initial laboratory studies include complete blood count, serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile, including serum aminotransferases (AST and ALT), calcium, phosphorus, and magnesium. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Positive end-expiratory pressure (PEEP)-assisted ventilation may be necessary in patients with acute parenchymal injury who develop pulmonary edema or adult respiratory distress syndrome.
- Manganese pneumonitis may require bronchodilator and antibiotic therapy.

**SPECIAL CONSIDERATIONS**

- Metal fume fever, also termed “Monday Morning Fever,” may develop from exposure to manganese fumes. Symptoms include metallic taste, dry cough, shortness of breath, diaphoresis, fever chills, fatigue, and myalgia. Symptoms usually begin 4 to 12 hours after exposure, are self-limited, remit during the work week, and reappear with exposure after the weekend. This is most likely an immune-mediated problem related to occupational exposures.
- Chronic occupational exposure produces the following clinical picture:
  
  * **Prodromal phase:** Cognitive dysfunction, emotional disturbances, muscular pain.
  * **Intermediate phase:** Inappropriate emotional outbursts, clumsiness of movement, hyperreflexia in lower extremities, manganese facies (mask-type expression), visual hallucinations, excessive salivation (sialorrhea), confusion.
  * **Established phase:** General muscle weakness, difficulty in walking, impaired speech, and tremors.
Mercury and Related Compounds

SUBSTANCE IDENTIFICATION
Found as a silvery, odorless liquid. In many inorganic and organic forms such as dusts, wettable powders, solutions, and vapors. Used in dental amalgams, thermometers, and barometers; in the manufacture of industrial and medical equipment; and in gold extraction. Also found in the manufacture of pesticides, antiseptics, paints, explosives, and germicides.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

TARGET ORGANS
Primary
Skin
Eyes
Central nervous system
Respiratory system
Hepatic
Renal
Secondary
Cardiovascular system
Gastrointestinal system
Blood

LIFE THREAT
Circulatory collapse, arrhythmias, respiratory failure, pulmonary edema, and neurotoxic effects.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse with a rapid, weak pulse. Ventricular arrhythmias.
Respiratory: Severe respiratory tract irritant. Manifested by acute bronchitis and interstitial pneumonitis. Dyspnea, cough, chest pain, and tightness of the chest may be present. Large vapor exposures may induce pulmonary edema.
CNS: Headache, irritability, indecision, malaise, neurobehavioral changes, excessive fatigue, muscle weakness, and tremors. Seizures and cerebral edema may occur.
Gastrointestinal: Corrosive ulceration and hemorrhage of mucous membranes. Burning pain and cramps in mouth and stomach. Nausea, profuse vomiting, and bloody diarrhea. Increased salivation, thirst, and metallic taste in the mouth.
Eye: Chemical conjunctivitis.
Skin: Irritation, pallor, and pruritus.
Renal: Acute renal failure, nephrotic syndrome, and glomerulonephritis.
Blood: Thrombocytopenia, neutropenia, and agranulocytosis.
Other: Some products may present a human teratogenic risk.
SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Many symptoms possibly delayed

CO-EXPOSURE CONCERNS
Copper

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Mercury vapor

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
CNS disorders
Alcoholism
Kidney disorders

DECONTAMINATION
- Wear positive-pressure SCBA and protective equipment specified by references such as the DOT Emergency Response Guidebook or the CANUTEC Initial Emergency Response Guide. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient's clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- Rinse patient with warm water, 30° C/86° F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.
- Refer to decontamination protocol in Section Three.

IMMEDIATE FIRST AID
- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
- Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.
- Keep victim quiet and maintain normal body temperature.
- Obtain medical attention.

BASIC TREATMENT
- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Monitor for pulmonary edema and treat if necessary (refer to pulmonary edema protocol in Section Three).
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
- Anticipate seizures and treat if necessary (refer to seizure protocol in Section Three).
- For eye contamination, flush eyes immediately with available water. Irrigate each eye continuously with normal saline during transport (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not
drool. Administer activated charcoal (refer to ingestion protocol in Section Three and activated charcoal protocol in Section Four).

**ADVANCED TREATMENT**
- Consider orotracheal or nasotracheal intubation for airway control in the patient with severe pulmonary edema or respiratory arrest.
- Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial.
- Monitor cardiac rhythm and treat arrhythmias if necessary (refer to cardiac protocol in Section Three).
- Start an IV with D₅W. Use lactated Ringer’s if signs of hypovolemia are present. Watch for signs of fluid overload.
- Consider drug therapy for pulmonary edema (refer to pulmonary edema protocol in Section Three).
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors if hypotensive with a normal fluid volume. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Treat seizures with diazepam (Valium) (refer to diazepam protocol in Section Four).
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

**INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS**
- Useful initial laboratory studies include complete blood count, serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile, including serum aminotransferases (ALT and AST), calcium, phosphorus, and magnesium. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Blood and 24-hour urine mercury concentrations may be done. Urine mercury is helpful in assessing body burden. Background mercury levels will vary with occupational exposure and fish consumption. Normal range usually less than 5 µg/dl. Toxicity is usually seen with concentrations over 20 µg/dl in blood or 50 µg/L in urine.
- Positive end-expiratory pressure (PEEP)-assisted ventilation may be necessary in patients with acute parenchymal injury who develop pulmonary edema or adult respiratory distress syndrome.
- Chelation therapy (D-Penicillamine, BAL, N-Acetyl-Penicillamine [NAP], 2,3-Dimercaptosuccinic acid [DMSA]) may be beneficial in the symptomatic patient. Therapy should be guided by clinical presentation and laboratory results.
- Hemodialysis may be required for renal failure.
- Obtain toxicological consultation as necessary.

**SPECIAL CONSIDERATION**
- Chronic poisoning with either elemental, inorganic, or organic mercury compounds produces cumulative effects: neurobehavioral changes, personality and mood disorders, paresthesia, weakness, muscle tremors, gait disturbances, thyroid enlargement, gingivitis, loss of teeth and increased salivation, digestive disorders, dermatitis, dermatographism, nephrotic syndrome, glomerulonephritis, renal failure, liver damage, and anemia.
Nickel and Related Compounds

SUBSTANCE IDENTIFICATION
Found as a silvery, white metal. Nickel salts are blue or green, clear or opaque crystals. Most products are odorless. Used in nickel-plating, electroplating, coinage, blackening zinc and brass, storage batteries, and dying and printing fabric. Also used in the production of catalysts, spark plugs, enamels, ceramics, glass, corrosion-resistant copper, manganese, zinc or steel alloys. Reaction of unrefined nickel and carbon monoxide during the nickel refining process produces nickel carbonyl (Ni[CO₄]), which is an extremely toxic gas. Dermal or oral exposure toxicity effects from nickel and nickel compounds are primarily allergic in nature, causing either allergic dermatitis or acute allergic reactions. Inhalational exposure of nickel carbonyl, other gas compounds, or dusts may produce pneumonitis or pulmonary edema.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

TARGET ORGANS
Primary
Respiratory system
Skin
Eyes
Secondary
Central nervous system
Cardiovascular system
Gastrointestinal system
Hepatic
Renal

LIFE THREAT
Respiratory failure; cerebral edema; allergic reactions.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Arrhythmias, electrocardiogram changes, hypotension, cardiovascular collapse.
Respiratory: Dyspnea, hyperpnea, rhinitis, sinusitis, chest pain, and pneumonitis with a nonproductive cough. Wheezing, asthma, bronchitis or anaphylactoid reaction. Pulmonary edema. Pulmonary fibrosis may occur as a late complication.
CNS: Headache, giddiness, blurred vision, and dizziness. Cerebral edema.
Gastrointestinal: Irritation of the GI tract, epigastric pain, nausea, vomiting, and diarrhea.
Eye: Chemical conjunctivitis, ocular burns, and corneal damage.
Skin: Allergic dermatitis. Irritant dermatitis. Dermatitis symptoms include burning sensations, itching, and inflammation. Some compounds may produce severe dermal burns. Cyanosis with respiratory failure.
Hepatic: Liver damage.
Renal: Kidney dysfunction.
Other: Nickel is an occupational respiratory tract (nasal and lung) carcinogen.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Some symptoms such as pulmonary edema may be delayed.

CO-EXPOSURE CONCERNS
Benz(a)pyrene
Alkaline materials

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Nickel carbonyl
Nitrogen oxides
Nickel sulfates: Sulfur oxides, carbon monoxide, and carbon dioxide
Nickel acetates: Carbon monoxide and carbon dioxide

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory disorders
Kidney disorders
Liver disorders
Nervous system disorders

DECONTAMINATION
- Wear positive-pressure SCBA and protective equipment specified by references such as the DOT Emergency Response Guidebook or the CANUTEC Initial Emergency Response Guide. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient’s clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- Rinse patient with warm water, 30°C/86°F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.
- Refer to decontamination protocol in Section Three.

IMMEDIATE FIRST AID
- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
- Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.
- Keep victim quiet and maintain normal body temperature.
- Obtain medical attention.

BASIC TREATMENT
- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
Nickel and Related Compounds

- Monitor for pulmonary edema and treat if necessary (refer to pulmonary edema protocol in Section Three).
- For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool (refer to ingestion protocol in Section Three).

**ADVANCED TREATMENT**

- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious.
- Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial.
- Monitor cardiac rhythm and treat arrhythmias if necessary (refer to cardiac protocol in Section Three).
- Consider drug therapy for pulmonary edema (refer to pulmonary edema protocol in Section Three).
- Start an IV with D5W TKO. Use lactated Ringer’s if signs of hypovolemia are present.
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors for hypotension with a normal fluid volume. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

**INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS**

- Useful initial laboratory studies include complete blood count, serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile, including serum aminotransferases (ALT and AST), calcium, phosphorus, and magnesium. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Monitor urine, plasma, or blood nickel levels. Decision to institute chelation therapy should be based on clinical presentation and urinary nickel concentrations.
- Chelation may be required in cases of acute poisoning with nickel carbonyl. *D*-Penicillamine is possibly effective. Diethylthiocarbamate (DDC) is an investigational drug showing the most therapeutic promise for nickel carbonyl poisoning. Disulfiram (tetraethylthiuram disulfide) has also been proposed as a chelating agent because it converts to two molecules of DDC.
- Severe divalent nickel (Ni^{2+}): poisoning with renal failure, cardiac toxicity or neurotoxicity may require hemodialysis. DDC is not indicated for nickel poisoning.
- Obtain toxicological consultation as necessary.
Selenium and Related Compounds

SUBSTANCE IDENTIFICATION
Found as a red crystalline solid or amorphous powder. May be found as a gas (hydrogen selenide) or in solution. Used in the manufacture of glass, ceramics, pigments, paints and glazes, pharmaceuticals, inks, photographic processes, and insecticides. Also used in the manufacture of many commercial products, including rubber (vulcanizing agent), steel, various alloys, and electronic and semiconductor devices (selenium photocells). Selenious acid is found in gun-blueing solution. Environmental exposure is seen in copper smelting and lead and uranium mining. Selenium is used in antidandruff shampoos. Selenium is an essential dietary trace element. Selenium deficiency has been associated with cardiomypathy. Selenium may be found as elemental selenium (Se\(^0\)), selenite (Se\(^{+4}\)), selanate (Se\(^{+6}\)), and selenide (Se\(^{-2}\)).

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

TARGET ORGANS
Primary
Skin
Eyes
Central nervous system
Cardiovascular system
Respiratory system
Gastrointestinal system
Hepatic
Renal
Secondary
Blood
Metabolism

LIFE THREAT
Arrhythmias, pulmonary edema, bronchospasm, and seizures. Vomiting with GI bleeding.

SIGNS AND SYMPTOMS BY SYSTEM
Respiratory: Rhinitis, respiratory tract irritation, depression, or arrest, wheezes (reactive airways disease), and pulmonary edema.
CNS: Headache, fatigue, vertigo, anxiety, delirium, syncope, CNS depression, muscle cramps, paresthesias, coma, and seizures.
Selenium and Related Compounds

Gastrointestinal: Burning pain, nausea, vomiting, excess salivation, and bloody diarrhea. GI burns and bleeding with hematemesis and hematoschezia. Intense thirst. Metallic taste and garlic odor of breath.

Eye: Chemical conjunctivitis and corneal injury.

Skin: Irritant dermatitis and burns. Loss of hair and nails or discoloration of nails. Pallor, cyanosis, and cold extremities.

Renal: Kidney damage.

Hepatic: Liver damage.

Metabolism: Metabolic acidosis and hyperglycemia

Blood: Increased white blood count (leukocytosis).

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Some symptoms possibly delayed

CO-EXPOSURE CONCERNS
Mercury
Thallium

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Hydrogen selenide gas
Metal oxide fumes
Nitrogen oxides
Selenious acid

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory system disorders
Nervous system disorders
Liver disorders
Kidney disorders
Skin disorders
Eye disorders

DECONTAMINATION
- Wear positive-pressure SCBA and protective equipment specified by references such as the DOT Emergency Response Guidebook or the CANUTEC Initial Emergency Response Guide. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until trained personnel and proper protective equipment are available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient's clothing, jewelry, and shoes.
- Gently brush away dry particles and blot excess liquids with absorbent material.
- Rinse patient with warm water, 30°C/86°F, if possible.
- Wash patient with Tincture of Green soap or a mild liquid soap and large quantities of water.

IMMEDIATE FIRST AID
- Ensure that adequate decontamination has been carried out.
- If victim is not breathing, start artificial respiration, preferably with a demand-valve resuscitator, bag-valve-mask device, or pocket mask as trained. Perform CPR if necessary.
- Immediately flush contaminated eyes with gently flowing water.
Do not induce vomiting. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.

Keep victim quiet and maintain normal body temperature.

Obtain medical attention.

**BASIC TREATMENT**

- Establish a patent airway. Suction if necessary.
- Watch for signs of respiratory insufficiency and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min
- Monitor for shock and treat if necessary (refer to shock protocol in Section Three).
- Monitor for pulmonary edema and treat if necessary (refer to pulmonary edema protocol in Section Three).
- Treat seizures if necessary (refer to seizure protocol in Section Three).
- For eye contamination, flush eyes immediately with water. Irrigate each eye continuously with normal saline during transport (refer to eye irrigation protocol in Section Three).
- Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of water for dilution if the patient can swallow, has a strong gag reflex, and does not drool. Administer activated charcoal (refer to ingestion protocol in Section Three and activated charcoal protocol in Section Four).

**ADVANCED TREATMENT**

- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious.
- Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial.
- Monitor cardiac rhythm and treat arrhythmias if necessary (refer to cardiac protocol in Section Three).
- Start an IV with D5W TKO. Use lactated Ringer’s if signs of hypovolemia are present. Watch for signs of pulmonary edema.
- Consider drug therapy for pulmonary edema (refer to pulmonary edema protocol in Section Three).
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors for hypotension with a normal fluid volume. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Treat seizures with diazepam (Valium) (refer to diazepam protocol in Section Four).
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

**INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS**

- Useful initial laboratory studies include complete blood count, serum electrolytes, blood urea nitrogen (BUN), creatinine, glucose, urinalysis, and baseline biochemical profile, including serum aminotransferases (ALT and AST), alkaline phosphatase, calcium, phosphorus, and magnesium. Determination of the anion gap may be helpful. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Positive end-expiratory pressure (PEEP)-assisted ventilation may be necessary in patients with acute parenchymal injury developing pulmonary edema or adult respiratory distress syndrome.
Selenium and Related Compounds

- Products may cause acidosis; hyperventilation and sodium bicarbonate may be beneficial. Bicarbonate therapy should be guided by patient presentation, ABG determination, and serum electrolyte considerations.
- Bronchospastic symptoms should be treated with an inhalation medication regime similar to that used for reactive airways disease. Inhaled corticosteroids may be of value in severe bronchospasm.
- Closely monitor hydration state and urinary output and maintain if necessary.
- Obtain toxicological consultation if necessary.