Phosgene and Related Compounds

SUBSTANCE IDENTIFICATION
Found as a colorless liquid or gas with a low water solubility. At low air concentrations, compounds have a sweet odor, like hay. A sharp, pungent odor is present at higher concentrations. Can be liberated from the combustion of chlorinated hydrocarbons. Used in the manufacture of insecticides, plastics, dyes, and pharmaceuticals and in metallurgy. Prepared for military use as a choking agent known as CG.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

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

LIFE THREAT
Severe respiratory irritant that can cause damage to the alveoli and resultant pulmonary edema. Phosgene has been used as a chemical warfare agent gas and is extremely toxic.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse, hypovolemia, shock, and arrhythmias.
Respiratory: Throat dryness, pharyngitis, with primarily lower respiratory tract mucous membrane irritation, including pneumonitis and pneumonia. Acute or delayed pulmonary edema, dyspnea, and tachypnea. Cough with thick, bloody, foamy sputum. Noncardiac chest pain. Pulmonary damage (bronchitis, emphysema, fibrosis) may be late sequelae.
CNS: Headache, CNS depression to coma and seizures.
Gastrointestinal: Nausea, vomiting, and abdominal pain.
Eye: Chemical conjunctivitis, corneal damage, and burns. Lacrimation and spasm of the eyelids (blepharospasm).
Skin: Irritant dermatitis and chemical burns. Cyanosis.
Other: Ability to detect product by smell may be lost after a relatively brief exposure time (olfactory nerve fatigue).

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Some symptoms especially pulmonary edema may be delayed 2 to 24 hours.
Phosgene and Related Compounds

**CO-EXPOSURE CONCERNS**
Chlorine active compounds
Corrosive vapors

**THERMAL DECOMPOSITION PRODUCTS INCLUDE**
Carbon monoxide
Chloride
Hydrochloric acid if moisture or steam is present

**MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE**
Respiratory 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 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).
- 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 (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, has severe pulmonary edema, or is in 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 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).
• 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. Determination of anion and osmolar gaps may be helpful. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
• Obtain serial chest x-rays and monitor ABGs and respiratory function.
• 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.
• Obtain toxicological consultation as necessary.

SPECIAL CONSIDERATIONS
• Phosgene’s poor water solubility limits its effects on the upper airway, allowing most of the product to penetrate into the lower airways. Phosgene reacts with moisture in the lower airways to form hydrochloric acid and carbon dioxide with resulting pulmonary edema. This is the mechanism for the delayed onset pulmonary edema.
SUBSTANCE IDENTIFICATION
Found as odorless, grayish-white, flexible fibers with a soft texture. Asbestos is a generic term used for a number of naturally occurring amphibole and serpentine hydrated magnesium silicates that are incombustible and can be separated into fibers. Types of fibers include actinolite, amosite (brown asbestos), anthophyllite, chrysotile (white asbestos), crocidolite (blue asbestos), and tremolite. All fibers belong to the amphibole group: long, straight fibers packed in parallel rows: with the exception of chrysotile, which is the only member of the serpentine group, with wavy fibers packed as intertwined bundles. The most widely used asbestos fiber in the United States was chrysotile [Mg₆Si₄O₁₉(OH)₈]. Asbestos has been used in noise and thermal insulation materials, asbestos (cement products), floor covering materials, friction products (brake linings), gaskets, and fireproof textiles. Asbestos fibers may be firmly bonded in the product or easily broken apart. The latter are considered to be friable and will generate more airborne fibers.

ROUTES OF EXPOSURE
Inhalation
Ingestion

TARGET ORGANS
Primary
Respiratory system
Gastrointestinal system

LIFE THREAT
Asbestosis/lung cancer/malignant mesothelioma

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: None.
Respiratory: Irritation of the nose and throat.
Gastrointestinal: No acute effects from ingestion.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Delayed. Usual latency period 10 to 20 years for asbestosis. Malignancies may have longer latent periods.

CHRONIC EXPOSURE/CARCINOGENIC EFFECTS INCLUDE
Asbestosis
Pleural plaques
Pleural thickening
Benign pleural effusion
Lung cancer
Malignant mesothelioma
Possibly increased cancer risk of the larynx, GI tract, pancreas, and colon

CO-EXPOSURE CONCERNS
Smoking
Other agents capable of causing pneumoconiosis (e.g., barium, beryllium, coal dust, nitrogen oxides, talc)
MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE

Pulmonary disease
Coalworker's pneumoconiosis
Silo Filler's disease (nitrogen oxides)

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.
- Obtain medical attention.

BASIC TREATMENT

- Establish a patent airway. Suction if necessary.
- Assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Treat any associated injury and/or illness if necessary.

ADVANCED TREATMENT

- Treat any associated injury and/or illness if necessary.

INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS

- Initial examination should include a chest x-ray and pulmonary function testing.
- Obtain toxicological consultation as necessary.

SPECIAL CONSIDERATIONS

- Risk of asbestos exposure should be considered in cases of building fires or explosions where encapsulated or previously unknown/undisturbed sources of asbestos insulation may be released. The risk of asbestos exposure is also increased at asbestos abatement projects where large quantities of removed product may be stored.
- Asbestos-related diseases have developed in family members of workers who inadvertently brought fibers home on contaminated clothing.
- Hazardous material personnel exposed to asbestos or at risk for asbestos exposure require ongoing medical monitoring programs.
SUBSTANCE IDENTIFICATION
Boron compounds may be found as solids, liquids, or gases. For example, decaborane (B₁₀H₁₄) is a colorless, crystalline powder with a strong pungent odor; pentaborane (B₅H₅) is a colorless, volatile liquid; and boron hydride (B₂H₆, diborane) is a flammable, colorless gas that fumes in moist air with a sharp, irritating odor. Can be found as liquids at low temperatures or when stored under pressure. Used as solvents, in cleaning operations, in metal treatment, and in various manufacturing processes.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

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

LIFE THREAT
Respiratory tract irritant that may cause laryngeal spasm, laryngeal edema, and pulmonary edema. May cause severe chemical burns.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Tachycardia and cardiovascular collapse.
Respiratory: Severe irritation of the respiratory system, coughing, and choking; causes pulmonary edema, laryngeal spasm. Upper airway obstruction.
CNS: CNS depression, coma, dizziness, muscle tremors, ataxia, seizures. Neurobehavorial changes.
Gastrointestinal: Nausea, vomiting, and abdominal pain.
Eye: Chemical conjunctivitis and severe burns, possibly causing permanent loss of vision.
Skin: Irritant dermatitis and severe chemical burns.
Renal: Kidney damage.
Hepatic: Liver damage.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Some symptoms may be delayed
CO-EXPOSURE CONCERNS
Corrosives
Other boron compounds

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Ammonia
Hydrochloric acid
Nitrogen oxides
Oxides

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory system disorders
Skin 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 liquid 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.
- Aggressive airway management may be 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. Administer activated charcoal (refer to ingestion protocol in Section Three and activated charcoal protocol in Section Four).

- 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, has severe pulmonary edema, or is in respiratory arrest. Early intubation at the first sign of upper airway obstruction may be necessary.
- 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).
- Consider vasopressors to treat hypotension without signs of hypovolemia (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. Determination of anion and osmolar gaps 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 who develop pulmonary edema or adult respiratory distress syndrome.
- Obtain toxicological consultation as necessary.

**SPECIAL CONSIDERATIONS**

- Some products may cause olfactory fatigue and therefore have poor warning properties.
Ozone (O₃) and Related Compounds

SUBSTANCE IDENTIFICATION
A colorless gas with a sharp odor. At very low temperatures, ozone is found as a dark blue liquid. Used for purifying air and water; as an oxidizing agent, disinfectant, and bleaching agent; and in the treatment of industrial wastes.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation

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

LIFE THREAT
Pulmonary edema and airway obstruction

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse and hypotension.
Respiratory: Irritation of respiratory tract, coughing, choking, dyspnea, and in severe exposures, pulmonary edema. Chest pain or tightness of the chest may be present.
CNS: Headache, fatigue, dizziness, insomnia, inability to concentrate, and drowsiness.
Gastrointestinal: Gastroenteritis symptoms including nausea and vomiting.
Eye: Chemical conjunctivitis.
Skin: Dermatitis, burns with liquid product exposure. Expanding gases may cause frostbite.
Other: The ability to detect the product by smell may be lost shortly after exposure.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate

CO-EXPOSURE CONCERNS
Other airway irritants

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory system disorders
Asthma/reactive airways disease 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.
Ozone (O₃) and Related Compounds

- If concurrent liquid or solid exposure exists:
  - 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).
- 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).
- Use rapid rewarming techniques for frostbite (refer to frostbite protocol in Section Three).

**ADVANCED TREATMENT**
- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious or has severe pulmonary edema.
- 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).
- Consider vasopressors to treat hypotension without signs of hypovolemia (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. Determination of anion and osmolar gaps 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 who develop pulmonary edema or adult respiratory distress syndrome.
- Asthma/reactive airways disease symptoms may require inhaled bronchodilator therapy. Pulmonary function testing is recommended.
- Obtain toxicological consultation as necessary.
Sulfur and Related Compounds

SUBSTANCE IDENTIFICATION
Sulfur compounds are commonly found as odorless, brown-to-yellow solids or as a yellow dispersion. Used in the manufacture of insecticides, chemicals, gunpowder, plastics, dyes, rubber, matches, pharmaceuticals, sulfuric acid, enamels, and metal-glass cement and in wood pulp processes. Organic sulfur compounds such as methyl mercaptan are added as odorants to natural gas. Sulfur dioxide (SO₂) is a colorless gas with a sharp, irritating odor. It is commonly used as a disinfectant; for bleaching textile fibers; in wood pulp treatment; in ore and metal refining; and in the manufacture of preservatives, bleaches, and glues. A by-product of coal-burning power plants, sulfur dioxide contributes to air pollution. Sulfites are used as food preservatives and parental medication additives.

ROUTE OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion

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

LIFE THREAT
Respiratory tract irritation leading to pulmonary edema. Anaphylaxis.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Tachycardia, hypotension, and cardiovascular collapse.
Respiratory: Respiratory tract irritation, rhinitis, sinusitis, pharyngitis, upper airway edema, coughing, bronchoconstriction, chest discomfort, and failure. Pulmonary edema. Exposure may cause asthma/reactive airways disease.
CNS: Headaches, vertigo, memory loss, decreased level of consciousness, seizures, and coma.
Gastrointestinal: Nausea, vomiting, and abdominal pain.
Eye: Irritation, lacrimation, and chemical burns
Skin: Irritation and chemical burns. Frostbite may occur from exposure to liquefied product or expanding gas. Urticaria and allergic reactions with sulfites.
Renal: Kidney damage.
Metabolism: Acidosis and hyperkalemia.
SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Some symptoms (renal) may be delayed
CO-EXPOSURE CONCERNS
Other respiratory irritants
THERMAL DECOMPOSITION PRODUCTS INCLUDE
Carbon disulfide
Hydrogen sulfide
Sulfur dioxide
MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory system disorders
Cardiovascular 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).
- Anticipate seizures and treat if necessary (refer to seizure 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. Administer activated charcoal (refer to ingestion protocol in Section Three and activated charcoal protocol in Section Four).

- Cover skin burns with 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. Early intubation at the first sign of upper airway obstruction may be necessary.
- 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).
- Treat seizures with diazepam (Valium) (refer to diazepam protocol in Section Four).
- 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. Determination of anion and osmolar gaps 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 who develop pulmonary edema or adult respiratory distress syndrome.
- Bronchodilator therapy may be indicated in cases of severe bronchospasm. Observe for signs of anaphylaxis.
- 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.
- Obtain toxicological consultation as necessary.

**SPECIAL CONSIDERATIONS**

- Sulfite compounds may cause bronchospasm and/or allergic reactions in asthmatics. Individuals not known to be asthmatic or allergic to sulfites may develop anaphylaxis or anaphylactoid reactions as well.
Tri-Ortho-Cresyl Phosphate (TOCP) and Related Compounds

SUBSTANCE IDENTIFICATION
Found as a colorless, odorless liquid. Used as a flame retardant; a plasticizer in lacquers and varnishes; and a gasoline/hydraulic fluid additive. Tri-Ortho-Cresyl Phosphate (TOCP) is an organophosphate compound that may cause a peripheral axonopathy without the acute symptoms of cholinergic poisoning (SLUDGE syndrome) that are commonly seen in cases of other organophosphate insecticide poisonings.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

TARGET ORGANS
Primary
Central nervous system
Secondary
Skin
Eyes
Gastrointestinal system

LIFE THREAT
A delayed neurotoxin that causes an ascending paralysis of the extremities

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Acute symptoms unlikely.
Respiratory: Acute symptoms unlikely.
CNS: Delayed 3 to 30 days; sharp, cramping pain in the calves and sensory disturbances, including paresthesias of the lower extremities. There is an abrupt onset of flaccid paralysis of the extremities, 10 to 14 days later. The paralysis can spread to the upper extremities. Upper extremity recovery may occur with a resultant, permanent lower-extremity paralysis with spasticity, hyperreflexia, hypertonicity, clonus, and slapping gait.
Gastrointestinal: Sudden onset of nausea, vomiting, diarrhea, and abdominal pain starting shortly after exposure. This lasts for approximately 48 hours and is followed by an asymptomatic, latent period of 8 to 35 days.
Eye: Conjunctivitis after latent period.
Skin: Excessive sweating with cold, cyanotic, and moist hands and feet.
Other: Symptoms are generally nonfatal, but may take years to recover from and may leave permanent damage.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Delayed
CO-EXPOSURE CONCERNS
Carbamates
Organophosphates

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Phosphorus fumes

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Neurological 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 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.
- 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
- Use proparacaine hydrochloride to assist eye irrigation (refer to proparacaine hydrochloride protocol in Section Four).

INITIAL EMERGENCY DEPARTMENT CONSIDERATIONS
- Careful history and baseline neurological examination should be done.
- 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. Obtain baseline plasma and red blood cell cholinesterase levels. Baseline chest radiograph, and electrocardiogram may be required.

- Treatment is supportive.
- For additional information on organophosphate poisoning see guideline 49.
- Obtain toxicological consultation as necessary.

SPECIAL CONSIDERATIONS

- Since the only symptoms in the acute phase are GI in nature, treatment should be supportive and to ensure follow-up medical treatment.
- In 1930, during prohibition, an epidemic known as “ginger jake paralysis” occurred in over 15,000-20,000 individuals consuming Jamaica ginger extract contaminated with TOCP. Similar outbreaks have occurred with ingestion of similarly adulterated products.
- Tri-tolyl phosphate is made up of three isomers. Only the ortho isomer (TOCP) is responsible for the delayed neurotoxicity.