Hydrocarbon Blends, Mixtures, and Related Compounds

SUBSTANCE IDENTIFICATION
Liquid hydrocarbons that are colorless or pale yellow, with a gasoline type odor. Used as cleaners and degreasers; fuels; solvents; vehicle for paints, thinners, enamels, and varnishes; and aerosol propellants. Components of various manufacturing processes.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

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

LIFE THREAT
CNS depression may lead to respiratory arrest. Seizures, cardiac arrhythmias, and pulmonary edema.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiac arrhythmias, tachycardia, hypotension, shock, and cardiovascular collapse.
Respiratory: Upper respiratory tract irritation and a burning sensation in the chest, dyspnea, tachypnea, and rales, which may progress rapidly to massive pulmonary edema.
CNS: Confusion, tinnitus, disorientation, headache, drowsiness, weakness. CNS depression, coma, and seizures.
Gastrointestinal: Pain and irritation of the GI mucous membranes, nausea, vomiting, and diarrhea.
Eye: Chemical conjunctivitis.
Skin: Minor erythema to irritant dermatitis. Cyanosis of the extremities in hypoperfusion states.
Renal: Kidney failure.
Hepatic: Liver injury.
SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Pulmonary edema symptoms possibly delayed

CO-EXPOSURE CONCERNS
Chlorinated hydrocarbons
Other hydrocarbon products

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Carbon dioxide
Carbon monoxide

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 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 m/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, is in respiratory arrest, or has severe pulmonary edema.
- Positive-pressure ventilation techniques with a bag-valve-mask device may be beneficial.
- Monitor cardiac rhythm and treat arrhythmias as necessary (refer to cardiac protocol in Section Three).
- Start an IV with D$_5$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. Watch for signs of pulmonary edema (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.
- 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

- Avoid epinephrine and related beta agonists (unless patient is in cardiac arrest or has reactive airways disease refractory to other treatment) because of the possible irritable condition of the myocardium. Use of these medications may lead to ventricular fibrillation.
Camphor and Related Compounds

SUBSTANCE IDENTIFICATION
Found in solid and liquid form. Extracted from the wood of the *Cinnamomum camphora* tree or synthesized from turpentine oil. Solids are usually a colorless, glassy, or white color with a penetrating, characteristic odor. Liquids are usually an oily consistency with a colorless to brown color. Products are commonly used in the manufacture of film, explosives, disinfectants, lacquers, and varnishes. Also used as moth and insect repellents and found in a variety of over-the-counter medicinal preparations.

ROUTE OF EXPOSURE
Skin and eye contact  
Inhalation  
Ingestion  
Skin absorption

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

LIFE THREAT
Status epilepticus and respiratory failure.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse, hypotension, arrhythmias, and asystole.
Respiratory: Feeling of coolness in respiratory tract and sore throat. Periods of apnea may follow seizures.
CNS: Headache, dizziness, confusion, irrational behavior, and excitement. coma, seizures, possibly becoming status epilepticus, and generalized CNS depression.
Gastrointestinal: Nausea, vomiting, diarrhea, and abdominal pain. Vomiting is sometimes projectile in nature. With ingestion a warm feeling is present in the stomach and breath will smell strongly of camphor.
Eye: Chemical conjunctivitis and pupillary dilation.
Skin: Paleness with cyanosis.
Hepatic: Liver damage.
Metabolism: Fever.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate  
Some symptoms possibly minimally delayed
THERMAL DECOMPOSITION PRODUCTS INCLUDE
Carbon dioxide
Carbon monoxide

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Cardiovascular disorders
Seizure disorders
Kidney disorders
Liver 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 as 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.
- Anticipate seizures and minimize all external stimuli. Treat seizures as necessary (refer to seizure protocol in Section Three).
- Monitor for shock and treat as 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).
- Do not use emetics (refer to ingestion protocol in Section Three).
ADVANCED TREATMENT
- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious.
- Monitor and treat cardiac arrhythmias as 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.
- Treat seizures with diazepam (Valium) (refer to diazepam protocol in Section Four).
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider vasopressors if patient is hypotensive 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.
- Observe for seizure activity.
- Obtain toxicological consultation as necessary.

SPECIAL CONSIDERATIONS
- Chronic ingestion in children may mimic Reye's syndrome with hepatic and neurological toxicity.
Esters and Related Compounds

SUBSTANCE IDENTIFICATION
Clear, colorless liquids with a fruity odor. Used as solvents, flavoring agents, fragrance additives, and chemical intermediates in the manufacture of pharmaceuticals and many other products. Produced by the reaction of an alcohol or phenol with organic acids.

ROUTE OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

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

LIFE THREAT
CNS depression, respiratory tract irritation, bronchitis, and pneumonitis.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Cardiovascular collapse, hypotension, and ventricular arrhythmias.
Respiratory: Mucous membrane irritation, dyspnea, and tachypnea, pharyngitis, bronchitis, pneumonitis, and pulmonary edema in massive exposures
CNS: Headache, drowsiness, dizziness, CNS depression, coma, neurobehavioral changes.
Gastrointestinal: Nausea, vomiting, diarrhea, and abdominal cramps.
Eye: Chemical conjunctivitis, lacrimation, and corneal damage.
Skin: Erythema, irritant dermatitis, or allergic dermatitis.
Hepatic: Liver damage.
Other: Some products are rapidly broken down to ethanol and acetic acid in the body.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Pulmonary edema symptoms possibly delayed

CO-EXPOSURE CONCERNS
Other petroleum products

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Carbon dioxide
Carbon monoxide

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Respiratory 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 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 as 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. 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 fluid overload.
- For hypotension with signs of hypovolemia, administer fluid cautiously. Consider va-
Esters and Related Compounds

- sopressors if patient is hypotensive with a normal fluid volume. Watch for signs of fluid overload (refer to shock protocol in Section Three).
- Consider drug therapy for pulmonary edema (refer to pulmonary edema 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.
- 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.
Ethers and Related Compounds

SUBSTANCE IDENTIFICATION
Colorless liquids or colorless, highly flammable gases with a sweet odor. Used as solvents for fats, oils, perfumes, alkaloids, and gums. Also found as starter fluid for gasoline and diesel engines, as additives, and as anesthetics. Used in a variety of manufacturing processes, including plastics and dyes.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion

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

LIFE THREAT
Predominant narcotic properties leading to anesthesia and respiratory arrest.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Hypotension, bradycardia, and cardiovascular collapse.
Respiratory: Respiratory tract irritation, cough, laryngeal spasms, irregular respirations, depression, pulmonary edema, and respiratory arrest.
CNS: Depression or excitation, headache, dizziness, weakness, seizures, and possible coma.
Gastrointestinal: Nausea, vomiting, and salivation.
Eye: Chemical conjunctivitis and possible corneal damage with blurred vision.
Skin: Mild skin irritation and irritant dermatitis. Expanding gases may cause frostbite.
Renal: Kidney damage and interstitial cystitis
Hepatic: Increased chance of liver damage when patient has preexisting liver disease.
Metabolism: Hyperglycemia and anion-gap metabolic acidosis.
Blood: Bone marrow toxicity. Certain products may easily cross the placental membrane.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Acidosis possibly delayed
Central nervous system depression possibly delayed
CO-EXPOSURE CONCERNS
Hydrocarbon solvents
Glycol ethers

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Carbon dioxide
Carbon monoxide
Peroxides may form on contact with air

MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE
Dermatitis

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.
- Provide a low-stimulus environment.
- 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 (refer to ingestion protocol in Section Three).
- Treat frostbite by rapid rewarming (refer to frostbite protocol in Section Three).
ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious or in respiratory arrest.
- 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.
- 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), calcium, phosphorus, and magnesium. Determination of anion and osmolar gaps may be helpful. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Products may cause anion gap acidosis; hyperventilation and sodium bicarbonate may be beneficial. Bicarbonate therapy should be guided by patient presentation. ABG determination, and serum electrolyte considerations.
- Hemodialysis may be beneficial in the severely poisoned patient with renal failure.
- Obtain toxicological consultation as necessary.
Dioxane and Related Compounds

SUBSTANCE IDENTIFICATION
Colorless liquids with a pleasant alcohol-like odor. Used as stabilizers for chlorinated solvents, as wetting and dispersing agents in textile processing, and as solvents for resins and oils. Found in dyes, cleaning agents, stains, and printing chemicals. Also used in the manufacture of adhesives, cosmetics, deodorants, fumigants, and polishing compositions.

ROUTES OF EXPOSURE
Skin and eye contact
Inhalation
Ingestion
Skin absorption

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

LIFE THREAT
Pulmonary irritant. Respiratory failure, pulmonary edema, and CNS depression.

SIGNS AND SYMPTOMS BY SYSTEM
Cardiovascular: Tachyarrhythmias.
Respiratory: Mucous membrane irritation, acute pulmonary edema, dyspnea, hyperpnea, coughing, tachypnea, and respiratory failure.
CNS: Headache, drowsiness, poor sense of balance (ataxia), seizures, CNS depression, and coma.
Gastrointestinal: Nausea, vomiting, loss of appetite, and stomach pain.
Eye: Conjunctival irritation and lacrimation.
Skin: Mild irritation and irritant dermatitis.
Renal: Kidney damage.
Hepatic: Liver damage.
Other: These products may cause olfactory fatigue and therefore not demonstrate adequate warning properties. Some products present a human carcinogenic and mutagenic risk.

SYMPTOM ONSET FOR ACUTE EXPOSURE
Immediate
Pulmonary edema symptoms possibly delayed
CO-EXPOSURE CONCERNS
Air (may form explosive peroxides on contact with air)

THERMAL DECOMPOSITION PRODUCTS INCLUDE
Carbon dioxide
Carbon monoxide

MEDICAL PROBLEMS POSSIBLY AGGRAVATED BY EXPOSURE
Skin disorders
Asthma and other pulmonary 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 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. 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 or 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. 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).
- 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 radiographs 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.
Ethylene Glycol, Glycols, and Related Compounds

**SUBSTANCE IDENTIFICATION**
Syrupy, colorless liquids with a faint etherlike or pleasant odor. Ethylene glycol has a sweet taste. Found as solvents, degreasers, wetting agents, agricultural chemicals, hydraulic fluids, and antifreezes. Also used in the application and manufacture of varnishes, lacquers, paints, and detergents.

**ROUTES OF EXPOSURE**
Skin and eye contact
Inhalation
Ingestion
Skin absorption

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

*Secondary*
Gastrointestinal system
Hepatic

**LIFE THREAT**
Respiratory failure, pulmonary edema, paralysis, cardiovascular collapse, and severe acidosis.

**SIGNS AND SYMPTOMS BY SYSTEM**

**Cardiovascular:** Cardiovascular collapse and tachyarrhythmias.

**Respiratory:** Respiratory tract irritation with dyspnea, hyperpnea, and tachypnea. Acute pulmonary edema and respiratory failure.

**CNS:** Headache, drowsiness, dizziness, weakness, muscle tenderness, tremors, seizures, CNS depression, and coma. Paralysis, disturbances in vision and hearing.

**Gastrointestinal:** Nausea, vomiting, and stomach pain.

**Eye:** Chemical conjunctivitis, photophobia, and lacrimation

**Skin:** Drying and cracking of the skin.

**Renal:** Nephropathy.

**Hepatic:** Liver damage.

**Metabolism:** Anion gap metabolic acidosis and hypocalcemia.

**Other:** Products may cause an inebriation-like effect similar to ethanol. Ethylene glycol symptoms show three stages of clinical effects:

- **Phase I:** 30 min to 12 hours after exposure; CNS and metabolic effects
- **Phase II:** 12 to 36 hours after exposure; cardiopulmonary effects and metabolic
Ethylene Glycol, Glycols, and Related Compounds

Acidosis; ethylene glycol metabolized to glycolic and oxalic acids.

Phase III: 2 to 3 days after exposure; nephropathy

**SYMPTOM ONSET FOR ACUTE EXPOSURE**

Immediate

Some symptoms possibly delayed (see above)

**CO-EXPOSURE CONCERNS**

Other glycol ethers
Hydrocarbon solvents

**THERMAL DECOMPOSITION PRODUCTS INCLUDE**

Carbon dioxide
Carbon monoxide

**MEDICAL CONDITIONS POSSIBLY AGGRAVATED BY EXPOSURE**

Respiratory system disorders
Kidney 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 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 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 or 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).
- Consider vasopressors to treat hypotension without signs of hypovolemia (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. Determination of anion and osmolar gaps may be helpful. Arterial blood gases (ABGs), chest radiograph, and electrocardiogram may be required.
- Determine ethylene glycol blood concentration. Look for oxalate or hippurate crystals in the 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.
- Products may cause anion gap metabolic acidosis and osmolar gap; hyperventilation and sodium bicarbonate may be beneficial. Bicarbonate therapy should be guided by patient presentation, ABG determination, and serum electrolyte considerations.
- Ethanol inhibition therapy of the alcohol dehydrogenase enzyme may be beneficial for severe poisoning with ethylene glycol and diethylene glycol. Ethanol therapy should be guided by severity of acidosis, patient presentation, and ethylene glycol/ethanol serum concentrations. Do not delay ethanol administration in symptomatic patients pending blood ethylene glycol results (refer to ethanol protocol in Section Four).
- 4-Methylpyrazole is an investigational physiological antagonist for ethylene glycol poisoning.
Ethylene Glycol, Glycols, and Related Compounds

- Hemodialysis is the treatment of choice in the severely poisoned patient with refractory acidosis, pulmonary edema or cerebral edema.
- Obtain toxicological consultation as necessary.

SPECIAL CONSIDERATIONS
- Co-ingestion of ethanol will delay onset of metabolic symptoms in cases of ethylene glycol poisoning.