

Primary goals for emergency personnel in a hazardous materials incident or suspected nuclear, biological, or chemical terrorist (NBC) incident include: safety of rescue personnel, removal of the patient(s) from danger, patient decontamination, and providing definitive treatment.

Patients who are symptomatic due to a hazardous material or NBC exposure generally can be managed through our standard protocols and medication inventory. All personnel will adhere to this protocol up to the level of their training and capabilities. Hazmat units carry an expanded drug inventory provided for in this protocol. Special antidote therapy delineated by the prefix HMT will only be initiated by a department certified Hazmat Medic.

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A. Overview

1. When treating a patient suspected of being chemically contaminated, do not overlook the possibility that they may also be suffering from an underlying condition related to trauma, impaired consciousness, etc., that must be treated in accordance with other protocols.
2. If a hazardous material is involved and has been identified, responders should locate information concerning the substance(s) using available references.
 - a) North American Emergency Response Guidebook.
 - b) NIOSH Pocket Guide.
 - c) Emergency Care for Hazardous Materials Exposure.
 - d) Handbook of Poisoning.
 - e) Contact the **Poison Control Center at 1-800-222-1222** for consultation and then confirm guidance with receiving facility.

NOTE: The Hazardous Materials Response Unit will be notified of any incident involving a toxic chemical exposure.

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3. Separate victim from the causative agent.
 - a) Rescue of a victim from a hazardous environment should not be attempted by individuals who are not properly trained and equipped with appropriate Personnel Protective Equipment (PPE).
 - b) Rescue should not be delayed unnecessarily when only minimal risk is involved.

General Care

EMR/BLS

1. Initial Assessment/Care [Protocol 1P](#).
 - a) Primary assessment can be undertaken while simultaneously performing a gross decontamination of patient.
 - b) Rescue personnel must first address life-threatening emergencies before.
 - c) Decontamination and supportive measures.
2. Chemical specific ALS treatment modalities will only be utilized if either of the following exists:
 - a) Contact is with an identified contaminant.
 - b) Contact is with an unidentified contaminant, but symptoms are consistent with a known or recognized contaminant.

B. Carbon Monoxide (CO)

Carbon Monoxide is a colorless, odorless, and tasteless gas that is non-irritating to the respiratory tract. It is a common byproduct of the incomplete combustion from any organic material and is a major toxic component in smoke inhalation.

Carbon Monoxide binds readily with hemoglobin to create carboxyhemoglobin. This interferes with oxygen's ability to bind with hemoglobin, thus reducing the oxygen carrying capacity of the blood. Carbon Monoxide levels can be measured in a non-invasive manner using the RAD-57 [Procedure 44](#) Measurements are read as a percentage of carboxyhemoglobin (SpCO).

CO Exposure specific signs and symptoms in order of progression include: headache, dizziness, tinnitus, nausea, muscle weakness, chest pain, dyspnea, syncope, seizures, and coma. (Cherry red skin color is not an early sign of CO poisoning and is usually seen post-mortem).

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Pediatric Care
BLS

1. Remove patient from the contaminated environment.
2. Initial Assessment/Care [Protocol 1P](#).
3. Apply the RAD-57 [Procedure 44](#) and document a pre-oxygen SpCO reading in the "Narrative" section of ePCR.
4. Administer Oxygen 15 L/min via a NRB mask. If the patient is unresponsive, ventilate via BVM with 100% oxygen.

ALS

6. Initiate Airway Management **Protocol 7P**, perform endotracheal intubation and continue to hyperoxygenate.
 - a) If CO poisoning is due to a suicide attempt, and the patient shows signs of respiratory depression, administer **Narcan (Naloxone) 0.1 mg/kg** (max single dose 0.5 mg) IV/IM SLOWLY as needed.

NOTE: Narcan (Naloxone) should be administered only to patients showing signs of respiratory depression.

MCP

7. Transport to appropriate facility (refer to Hospital Compatibilities Chart and information below).

Transport considerations based upon SpCO levels using Pulse-CO Oximeter

SpCO %	Transportation Requirements per Protocol 25
0-3%	Transport NOT required unless patient has another medical/trauma complaint
3-12%	No signs/symptoms = No Transport required unless patient has another medical/trauma complaint
3-12%	WITH signs/symptoms = ALS Transport to closest appropriate facility
≥13%	ALS Transport REQUIRED to closest appropriate facility

Note: Readings outside of the normal range will be confirmed on the opposite extremity.

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C. Organophosphates & Carbamates

Organophosphate insecticides are absorbed by all routes, including the skin, G.I. tract, conjunctiva, and respiratory tract. The Carbamates are not appreciably absorbed through intact skin and typically do not cause toxicity by this route.

Organophosphates & Carbamates inhibit the enzyme cholinesterase, blocking the activity of the enzyme acetylcholinesterase from deactivating the neurotransmitter acetylcholine. Thus, allowing the excessive accumulation of acetylcholine. This overabundance of acetylcholine cannot be broken down, which results in a sustained stimulation of the autonomic nervous system, skeletal muscle, and CNS as the acetylcholine binds at the muscarinic receptors and the nicotinic receptors.

When the muscarinic and nicotinic receptors are over stimulated, there is a predictable response occurring in the body leading to the classic signs/symptoms of Organophosphate & Carbamate poisoning that can be remembered with the mnemonics "**SLUDGE**" or "**DUMBELS**" when associated with the overstimulation at the muscarinic receptors sites. The symptoms in the "Bs" of "DUMBELS" are recognized as the "Killer Bs" as they are serious signs of an organophosphate that can become fatal if left untreated.

S – Salivation	D – Diarrhea
L – Lacrimation	U – Urination
U – Urination	M – Muscle tremors, Miosis (pupillary constriction)
D – Defecation	B – Bradycardia, Bronchorrhea (excessive mucus), Bronchospasms
G – Gastrointestinal	E – Emesis
E – Emesis	L – Lacrimation
	S – Secretions, Salivation, Sweating

The mnemonic of the days of the week, "**MTWHF**" can be utilized to recognize the signs/symptoms associated with organophosphate poisoning primarily affecting the nicotinic receptor sites.

M – Mydriasis (pupillary dilation)
T – Tachycardia
W – Weakness
H – Hyperglycemia, Hypertension
F – Fasciculations (fine muscle twitches)

NOTE: Secondary symptoms after inhalation may be caused by the hydrocarbon-based solvent, such as xylene, mixed with the pesticide. These symptoms may include: upper respiratory irritation, dizziness, headaches, and nausea.

Pediatric Care

BLS

1. Administer Oxygen 15 L/min via a NRB mask.

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2. As pulmonary secretions may be severe, suction airway frequently.

ALS

3. If shortness of breath or muscle fasciculation's (tremors) are present, administer **Atropine 0.5-1 mg IM** [Procedure 17](#) or **0.02 mg/kg IV**.
4. Perform endotracheal intubation if needed.
5. If seizures develop, administer **Versed (Midazolam)** (0.1 mg/kg IV/IO/IM max total dose is 5 mg). **Versed** may be administered IN via the MAD (0.2 mg/kg maximum dose is 0.5 mL/nostril). This may be repeated once.
6. Repeat **Atropine every 5 minutes in 0.02 mg/kg IV or 0.5-1.0 mg IM** increments until the drying of secretions or "Atropinization" occurs. The desired end-point is the drying of all secretions. There is no maximum dose in this situation.

D. Cyanide (CN)

Cyanide is an extremely toxic and fast acting toxin. It is used to produce chemicals which are used to manufacture many plastics. Fires involving plastics, wool, and silk may yield significant amounts of cyanide gas, (hydrogen cyanide, HCN).

Cyanide produces toxicity by interfering with oxygen utilization at the cellular level. Death may occur within minutes of exposure. With inhalation, toxic effects are seen in minutes. If CN salts are ingested, effects may be delayed. Effects may first be seen in the following order: central nervous system, cardiovascular system, and respiratory systems.

*General Care***BLS**

1. Obtain and document a carboxyhemoglobin reading [Procedure 44](#).
2. Administer oxygen [Procedure 1](#).

*Pediatric Care***ALS**

3. Perform airway management, as indicated [Protocol 7P](#).
4. Establish vascular access.

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5. Prepare and mix **Hydroxocobalamin (CyanoKit)** as per [Appendix 09-7](#).
6. Administer **Hydroxocobalamin (CyanoKit) 70 mg/kg**. Run IV with vented tubing at 1 gtt/sec for a duration not to exceed 1 minute per kg.
 - a) If the CyanoKit is not available, mix Sodium Thiosulfate as per [Appendix 09-5](#).
 - b) Administer **Sodium Thiosulfate 1.2 mL/kg of a 25% solution (maximum of 50 mL)** slow IV over 10 minutes.

NOTE: The CyanoKit are only carried by EMS Captains, Battalion Chiefs and HazMat units.

E. Hydrogen Sulfides & Mercaptans

Hydrogen Sulfide (H₂S) is a colorless, irritating, and highly toxic gas with an odor similar to that of rotten eggs. H₂S, also known as sewer gas, can cause olfactory paralysis at high concentrations, making odor an unreliable sign. Mercaptans are extremely foul smelling sulfur containing compounds used as an odorant in natural and other gases. Although all of these compounds are irritants, their mechanism of poisoning is similar to that of cyanide.

Low level exposures may cause irritation of the eyes, nose, and throat, producing a cough, headache, nausea, and dizziness. Higher exposures may cause syncope, seizures, coma, tracheobronchitis, and pulmonary edema (which may not appear for 48 to 72 hours after exposure). Death may occur within minutes of a massive exposure.

General Care

BLS

1. Administer Oxygen 15 L/m via a NRB mask.

Pediatric Care

HMT

2. Administer Amyl Nitrite inhalants while the patient is on oxygen. Amyl Nitrite therapy should precede or coincide with step 3.
 - a) Break the inhalants and have the patient breath it for 30 seconds out of every minute.
 - b) Use a fresh inhalant every few minutes.

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- c) If assisting ventilations or the patient is intubated, place an inhalant in the oxygen reservoir of the BVM.
3. Administer **Sodium Nitrite 0.2 mL/kg IVP** (max dose of 10 mL of a 3% solution), over 2-4 minutes. **Discontinue Amyl Nitrite therapy after Sodium Nitrite administration has begun.**

NOTE: If symptoms worsen after Sodium Nitrite administration, consider Nitrite Toxicity, [Section F](#). DO NOT administer Sodium Thiosulfate.

F. Nitrogen Containing Compounds (Nitrites & Nitrates)

Nitrogen containing compounds and their derivatives are found in many household products such as inks, shoe polishes, paints, and varnishes. These compounds are also used to produce medical agents, i.e.: amyl nitrite, nitroglycerine, silver nitrate.

Nitrites are the chemicals that most frequently produce methemoglobinemia. When hemoglobin is changed into methemoglobin, oxygen can no longer be transported by the changed hemoglobin.

Patients with a methemoglobin greater than 15% will appear gray or cyanotic, and their blood will appear chocolate brown. With higher concentrations hypoxic signs and symptoms are present, such as headache, dizziness, nausea, dyspnea, syncope, seizures, and coma. Other signs and symptoms that may be present include: skin or respiratory irritation, vasodilatation, hypotension, and CNS depression.

General Care

BLS

1. Administer Oxygen 15 L/min via a NRB mask.

Pediatric Care

HMT

2. If the patient is exhibiting signs and/or symptoms of altered mental status:
 - b) Administer **Methylene Blue 1-2 mg/kg IVP** over 2-5 minutes. Observe for hypotension, nausea, and disorientation.

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G. Hydrofluoric Acid (HF)

Hydrofluoric acid is an inorganic acid that is widely used in the electronic, glass etching, and chemical industries. Fluoride salts mixed with acids may produce hydrogen fluoride, a toxic gas.

The trademark of HF acid exposure is that the pain outweighs the area of injury. The pain with this exposure is intense. HF acid bonds with calcium and magnesium and causes destruction of the cells.

Inhalation may cause eye, nose, and throat irritation, cough, tracheobronchitis, and pulmonary edema. Ingestion produces corrosive burns of the stomach and esophagus. Systemic absorption may cause cardiac arrest.

General Care

BLS

1. Administer Oxygen 15 L/min via NRB mask.

Pediatric Care

HMT

2. Don personal protective equipment utilizing gown, mask, eye protection and Nitrile gloves (two pairs). Remove all contaminated clothing and flood the affected skin area with copious amounts of water for at least one minute.
3. Apply Calcium Gluconate Gel liberally to the affected areas and continuously massaged into the skin until the pain has subsided and for at least 15 minutes afterwards. Apply more gel as necessary.
4. For patients in cardiac arrest secondary to HF exposure, administer **Calcium Chloride 20 mg/kg (0.2 mL/kg)** slow IV/IO.

H. Halogenated/Aromatic Hydrocarbons & Gasoline

Volatile substances such as aromatic hydrocarbons, halogenated solvents, and gasoline, when inhaled can sensitize myocardial tissue and cause sudden cardiac dysrhythmias, (V-Fib, V-tach, SVT).

Pediatric Care

ALS

1. Treat tachydysrhythmias secondary to inhaled cardiac muscle sensitizers [Protocol 9P.](#)
2. Treat bronchospasm or non-cardiogenic pulmonary edema produced by these respiratory irritants [Protocol 8P.](#)

NOTE: Because these hydrocarbons are cardiac sensitizers, DO NOT administer Epinephrine for bronchospasms.

HMT

3. Brevibloc is **NOT** indicated for the pediatric patient.

I. Acid Mist/Chlorine & Ammonia Gas Inhalations

These compounds act as direct irritants and corrosive agents to moist mucous membranes and to intact skin to a lesser extent. Fairly low concentration can produce rapid onset of eye, nose, and throat irritation. Higher concentrations can produce cough, stridor, wheezing, chemical pneumonia or non-cardiogenic pulmonary edema. Onset of pulmonary edema can be rapid or delayed up to 24 hours.

General Care

BLS

1. Administer Oxygen 15 L/min via NRB mask.

Pediatric Care

ALS

2. Treat bronchospasm or non-cardiogenic pulmonary edema produced by these respiratory irritants [Protocol 8P.](#)

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J. Chemical Nerve Agents (Organophosphates)

Chemical nerve agents in the Organophosphate family include: Tabun (GA), Sarin (GB), Soman (GD), GF and VX. These compounds are well absorbed through intact skin, and thus pose a serious hazard to rescuers. An exposure to these types of chemical nerve agents will present with symptoms similar to Organophosphates and Carbamates as defined in Section C of this protocol (SLUDGE or DUMBBELS).

HMT

Note: If fire department personnel are exposed or have symptoms of exposure to a chemical nerve agent, administer the DUODOTE™ Kit [Procedure 38](#). The DUODOTE auto-injector is indicated for the pediatric patient weighing more than 41 kg (90 pounds).

Note: DUODOTE is carried by Hazmat units, Battalion Chiefs and EMS Field Supervisor.

Pediatric Care

BLS

1. Administer Oxygen 15 L/min via a NRB mask.
2. As pulmonary secretions may be severe, suction airway frequently.

ALS

3. If shortness of breath or muscle fasciculation's (tremors) are present, administer **Atropine 0.5-1 mg IM** [Procedure 17](#).
4. If symptoms continue, administer **Atropine 0.02 mg/kg IV**.
5. Perform endotracheal intubation if needed. At least an initial dose of Atropine should be given prior to intubation.
6. If seizures develop, administer **Midazolam (Versed) 0.1 mg/kg slow IV/IO/IN**. Maximum dose 5 mg (0.5 mL/nosril IN).
7. Repeat **Atropine** every five minutes in 0.02 mg/kg IV or 0.5-1 mg IM increments until the drying of secretions (atropinization) occurs. The desired end-point is the drying of all secretions. There is no maximum dose in this situation.

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