Hazardous Materials Preambles

This introduction provides a framework for providers responding to an incident involving hazardous material (HAZMAT) release and chemical, biological, radiological, nuclear, and explosives (CBRNE) agents. All EMS providers are expected to have regular HAZMAT training at the awareness level – providers should be able to recognize a HAZMAT situation and not become part of the problem. Providers should begin their response with the following assumptions:

- There will <u>not</u> be advanced notification for most of these incidents.
- Information regarding the hazardous agent(s) may not be available immediately.
- There are a limited number of on-duty medical first responders and transport units available.
- Many patients will not necessarily have been decontaminated prior to departing from the scene of the incident and will self-refer to nearby healthcare facilities.

I. DEFINITIONS

- **"Hazardous Materials":** substances, such as chemicals, that endanger a person's health or life when ingested, inhaled, absorbed (through the skin or mucous membranes), or injected under skin (ex. by abrasion, cut, or shot), or absorbed. These substances shall be considered a threat to the health and life of EMS personnel. A hazardous material can be identified by its location, its use, and labels, placards, and signs attached to it.

- **"Weapons of Mass Destruction (WMD)":** includes any chemical, nuclear or biological agent used in terrorist activities to threaten or inflict intentional harm or death to a given population.

- **"Nerve agents":** extremely toxic organophosphate-type chemicals, including GA (tabun), GB (sarin), GD (soman), GF (cyclosarin), and VX, which attack the nervous system and interfere with chemicals that control nerves, muscles, and glands. G-series nerve agents are odorless and invisible and can be inhaled, absorbed through the skin, or swallowed. Traditionally classified as WMDs.

- **"Decontamination":** the process by which hazardous materials are removed from an exposed person. This process may involve removal of the patient's clothing, rinsing the patient with a high- volume water bath, washing the patient's body with a neutralizing agent, and/or irrigation of the eyes. Persons who have been decontaminated shall be considered safe for evaluation and treatment by responding personnel.

II. ROLES/RESPONSIBILITIES

The HAZMAT Team or Hazardous Materials Unit (HMU), under direction of the Incident Commander, assumes responsibility for control of a HAZMAT incident. EMS personnel should coordinate treatment/transport efforts with the HAZMAT Team so as not to jeopardize scene integrity or cause unnecessary spread of contamination to the ambulance, hospital personnel, or bystanders.

(1) **HAZMAT Team** – the HAZMAT team or unit (frequently associated with the fire department) is primarily responsible for identification, rescue, and decontamination. The HAZMAT team is frequently, but not always, associated with the fire department. The responsibilities of the HAZMAT team include:

   a. Identifying the hazard(s) and material(s),
   b. Determining the appropriate PPE requirements,
   c. Determining initial estimate of victims,
   d. Determining the control zones
      i. Staging area
      ii. Hot, Warm, Cold
      iii. Gross decontamination

The HAZMAT team/unit frequently is equipped to provide temporary disposable garments to decontaminated patients to prevent hypothermia and secondary contamination.

The HAZMAT team is often not first to a scene or hazardous incident; they should be requested as an additional resource via dispatch as soon as the need is identified.

(2) **Law Enforcement Officers (LEOs)** – LEOs are responsible for managing initial area isolation and extended evacuation, and egress control for EMS. LEOs will also identify additional explosive hazards associated with explosive events and determine the control zones and staging area to prevent injuries from secondary devices.

(3) **EMS** - the responding EMS personnel assume responsibility for patient care and transportation after decontamination and release by the HAZMAT team. Roles of EMS providers include:
   a. Patient triage
   b. Patient treatment
   c. Patient transport
   d. Provision of HAZMAT-specific medical care, including,
      i. Identifying intoxicating agent
      ii. Identifying antidote or mitigating agent
      iii. Treating signs and symptoms in effort to stabilize patient
      iv. Assessing for risk of organ impairment
   e. Communications with local healthcare facilities

Any EMS personnel not trained to the technician level of HAZMAT education <u>and</u> equipped with Level A or B PPE should not enter a potentially hazardous scene until the HAZMAT team arrives with further instruction. HAZMAT technician level EMS providers should consider the available and needed resources prior to entering a hazardous scene to ensure they have adequately trained back-up if needed.

III. SCENE SAFETY & SIZE-UP

When responding to a possible HAZMAT event the safety and security of first responders is a priority. It is important to stay upwind and uphill of all hazards when approaching the area and during staging prior to entering the cold zone established by Hazmat Team. Safe distances for specific chemical may be determined from the Department of Transportation's *North American Emergency Response Guidebook.*

Initial Notification

Providers should communicate with Dispatch prior to arrival to identify a safe route to the scene and staging location. Necessary information to facilitate safe entry includes:

a. Estimated number of victims or potential victims
b. Urgency of the incident
c. Approach to the incident (i.e. Ingress and egress)
d. Location of the staging area
e. Identification (radio designation) of the Incident Commander
f. Hazardous substance involved
g. Request for specialized equipment needed

Scene Arrival

Initial evaluation includes (1) establishment and activation of an incident command/management system, (2) confirmation of scene security via perimeter and crowd control, and (3) activation of the appropriate guidelines for treatment, including a possible MCI or terrorist response.

Responders First On-Scene

The first arriving paramedic on scene should act as EMS Incident Commander (IC) until relieved by a higher ranking personnel capable of assuming command. The EMS Incident Commander is expected to:

a. Confirm the location of the staging area with the Fire Department on scene and notify dispatch.
b. Confirm the following information from the HAZMAT Team IC:
    - Specific chemical involved
    - Chemical state (liquid, gas, solid) and amount
    - Type/level of PPE required
    - Number of victims involved - if there are > 5-10 Red (Immediate) and/or 10^{+} (Yellow) or Green (Minor) patients, providers should activate the Mass Casualty Incident (MCI) plan if they anticipate rapidly exhausting available EMS resources.
c. Notify EMS Dispatch of:
    - Description of hazard
    - Number of patients
    - Risks to providers en route (e.g. necessary PPE, concern for nerve agent exposure)
    - Any other pertinent information relative to hospital needs (e.g. concomitant trauma or burns, decontamination capability of receiving facility)

All Other Responders

If the scene has not been secured and a staging area has not been established, the ambulance unit should make radio contact with the Incident Commander for staging instructions. Once the scene has been secured, the first-in ambulance unit should enter the staging area and report to the Incident Commander for further instructions.

In addition to providing patient care, qualified EMS personnel may be asked to assume any of the following roles: Safety Officer, EMS Section Officer (e.g. Triage, Treatment, Transportation, Communications), Rehabilitation Officer, or Public Information Officer.

In the absence of an Incident Commander and/or a staging area, EMS personnel should avoid entering the contaminated area.

Levels of PPE[1]

Personal protective equipment is divided into four categories based on the degree of protection afforded. Level B protection is the minimum level recommended on initial site entries until the hazards have been further identified and defined. Most EMS providers without additional Hazmat/Rescue training are equipped with Level C or Level D protection.

- **Level A protection should be worn when the highest level of respiratory, skin, eye and mucous membrane protection is needed**. A typical Level A ensemble includes:
    - Positive pressure (pressure demand), self-contained breathing apparatus (SCBA) (NIOSH approved), or positive pressure supplied air respirator with escape SCBA.
    - Fully encapsulating chemical protective suit.
    - Gloves, inner, chemical resistant.
    - Gloves, outer, chemical resistant.
    - Boots, chemical resistant, steel toe and shank; (depending on suit boot construction, worn over or under suit boot.)

- **Level B protection should be selected when the highest level of respiratory protection is needed, but a lesser level of skin and eye protection is needed.** A typical Level B ensemble includes:
    - Positive-pressure (pressure-demand), self-contained breathing apparatus (NIOSH approved), or positive-pressure supplied air respirator with escape SCBA.
    - Chemical resistant clothing (overalls and long-sleeved jacket, coveralls, hooded two-piece chemical splash suit, disposable chemical resistant coveralls.)
    - Gloves, outer, chemical resistant.
    - Gloves, inner, chemical resistant.
    - Boots, outer, chemical resistant, steel toe and shank.

- **Level C protection should be selected when the type of airborne substance is known, concentration measured, criteria for using air-purifying respirators met, and skin and eye exposure is unlikely.** Level C provides the same skin protection as Level B but a lower level of respiratory protection. A typical Level C ensemble includes:
    - Full-face or half-mask, air-purifying respirator (NIOSH approved).
    - Chemical resistant clothing (one-piece coverall, hooded two-piece chemical splash suit, chemical resistant hood and apron, disposable chemical resistant coveralls.)
    - Gloves, outer, chemical resistant.

[1] US Department of Health & Human Services. https://chemm.nlm.nih.gov/ppe.htm#levels

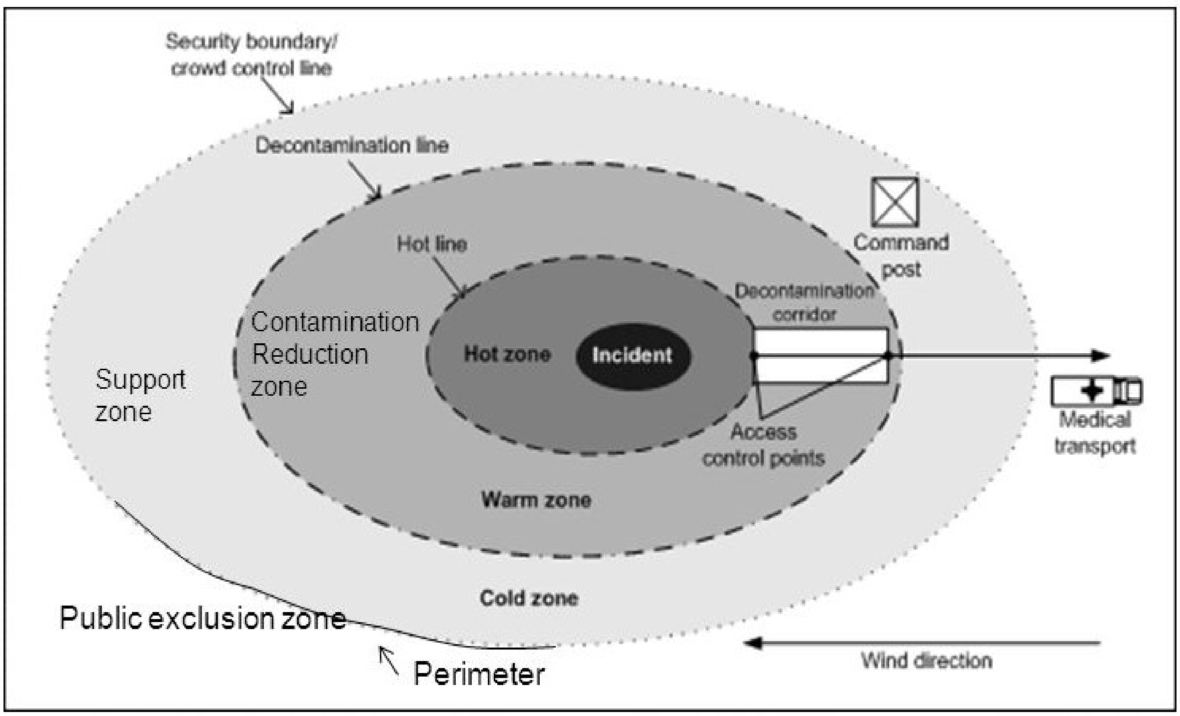
- Gloves, inner, chemical resistant.
- Boots, steel toe and shank, chemical resistant.

- **Level D protection is primarily a work uniform and is used for nuisance contamination only**. It requires only coveralls and safety shoes/boots. Level D provides no respiratory protection and minimal skin protection. Other PPE is based upon the situation (types of gloves, etc.). It should not be worn on any site where respiratory or skin hazards exist.

The EMS Incident Commander should confirm with the Hazmat IC what level of PPE is needed within each zone of care; this will vary based upon the situation and agent.

IV. ZONES OF CARE[2,3]

Zones of care delineate locations that require different levels of care and/or safety. Operationally, these zones help define the personnel and equipment that can and should be used depending on the type of incident. EMS zones are dynamic and fluid. Safety is paramount and the goal is to effectively transition the patients from the location of potential harm to definitive care.



Hot (Exclusion) Zone: The area of the EMS scene considered to be contaminated (actually or potentially) and having the highest potential for exposure. No responder should enter the hot zone without adequate PPE. The hot zone is maintained by a perimeter (aka "hot line") and should encompass all known or suspected hazardous materials.

Warm (Contamination Reduction) Zone: The area of the EMS scene that transitions between the hot and cold zone. This is the area where decontamination occurs, including decontamination of first responders entering

2 StatPearls [Internet]. www.ncbi.nlm.nih.gov/books/NBK436017/

3 EMRA EMS Essentials. www.emra.org/books/emra-ems-essentials/chapter-7-haz-mat/

and exiting the hot zone. Initial triage also takes place in the warm zone. This intermediate zone of protection is determined by the length of the decontamination corridor which contains all of the needed decontamination stations.

<u>Cold (Support) Zone:</u> The area of the EMS scene determined to be free of all hazardous materials and contamination, including discarded protective clothing and respiratory equipment. The command post, planning, and staging areas should be located in the cold zone, upwind and uphill of the red zone.

Ensure that personnel assigned to operate within each zone have the proper level of PPE and training.

V. PATIENT DECONTAMINATION

Victims contaminated by a hazardous substance or radiation must be appropriately decontaminated by the HAZMAT Team prior to being moved to the triage area for transportation. Decontamination consist of two phases[4]:

(1) The Gross Decontamination phase occurs in the “hot” zone and includes the medical provider’s primary assessment of ABCs, as well as the cutting away of clothing and jewelry once immediately life-threatening emergencies such as respiratory failure and hemorrhage are addressed. Open wounds should be cleaned and then covered with a water repellant dressing. The patient should then be rinsed with tepid water from head to toe.

(2) The Definitive Decontamination phase occurs in the “warm” zone and involves making the patient as clean as possible before transferring to the support zone and receiving facilities. Guidelines on duration of decontamination vary, but generally fall between 3-5 minutes, if not longer. If resources or time constraints do not allow for thorough cleansing, the patient should be cocooned in a blanket or sheet prior to transfer.

Transfer of the patient from the Hot Zone to the Cold Zone must be carefully coordinated to prevent the spread of contamination. <u>The urgency of the situation should not change the handling of the contaminated personnel or equipment.</u>

The removal of clothing and shoes will reduce external contamination by 70-90%. Thorough washing with soap and water will provide over 95% decontamination. Contaminated clothing and personal articles should be properly prepared for disposal by the HAZMAT Team. Double bagging removed clothing is ideal.

<u>Decontamination Procedure</u>

1. HAZMAT Team IC will establish hot, warm, and cold zones of operation.
2. HAZMAT and EMS Incident Commanders will ensure that personnel assigned to operate within each zone have proper PPE and training.
3. In coordination with other public safety personnel, EMS providers will ensure that each patient from the hot zone undergoes appropriate initial decontamination specific to the exposure. <u>Only immediate life threats (i.e. ABCs) should be addressed by hot/warm zone providers at the same time as the initial (i.e. gross, high volume rinse) decontamination is occurring.</u>

4. Further/repeat triage for treatment and transport may occur in the cold zone after secondary decontamination (i.e. thorough washing). In the event of an MCI, providers should place triage identification tags on each patient.
5. If patient personal belongings removed during decontamination are not disposed of by the Hazmat Team, providers should attempt to match patient belongings with the tag/triage information. Personal belongs should then be preserved for law enforcement. This should include all jewelry, cellular phones, clothing, etc.
6. EMS providers should ensure patient is grossly/initially decontaminated prior to being placed in an EMS unit for evaluation or transport.
7. EMS providers should monitor all patients for environmental illness (e.g. hypo- or hyperthermia)
8. Transport patients per JPASD Protocol – consider MCI activation for major incidents.
9. Notify receiving facility as early as possible to allow for emergency department preparations.

VI. PATIENT CARE[5,6]

General Care

EMS treatment of the Hazmat patient is no different from standard patients, with the exception of the provider protecting oneself from contamination. Some hazardous agents persist despite decontamination and require EMS providers to continue wearing PPE after patient decontamination and during patient transport. This should be clarified with the Hazmat IC prior to patient evaluation. Providers also should prepare for the potential of secondary contamination through body fluids, emesis, and/or belching in patients with a history of toxic ingestion.

As previously stated, life threats should be addressed during the primary survey concurrent to the initial decontamination process. The secondary survey occurs when time allows. Unless required by life threatening conditions, invasive procedures (e.g. IV injection, intubation) should be performed only in fully decontaminated areas because they may create a direct route for introducing hazardous material into the patient. Providers should remember to reassess the patient frequently because many chemicals have latent physiological effects.

Most contaminated patient can be handled with symptomatic care. However, antidote specific treatment is outlined in the following Hazmat protocols.

Toxidromes

Occasionally patients will display a constellation of signs and symptoms that aid in the identification of a hazardous agent. More common toxidromes are opioids, sedatives hypnotics, and the sympathomimetic syndrome seen after stimulant use. Other toxidromes that should be recognized and potentially treated in the prehospital setting include (1) Calcium channel and Beta blocker overdose, (2) Na-channel blockade and (3) Acetylcholinesterase inhibition.

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[5] EMRA EMS Essentials. www.emra.org/books/emra-ems-essentials/chapter-7-haz-mat/

[6] Centers for Disease Control and Prevention: Managing Hazardous Materials Incidents. https://www.atsdr.cdc.gov/mhmi-v1-3.pdf

Beta & Calcium-Channel Blocker Toxicity

Beta blockers and cardio selective calcium-channel blockers both block the heart's AV node and reduce the effects of adrenaline. Severe overdose can result in cardiovascular collapse. A single pill of either of these drugs can kill a toddler.

In therapeutic doses, beta and calcium-channel blocker reduce heart rate and blood pressure. Not surprisingly, early signs of their toxicity include bradycardia, AV heart block, and hypotension. Multiple drugs are frequently required for stabilization of these patients. Providers should give Crystalloid fluid boluses initially for hypotension. Atropine may be required if the patient is hypotensive and bradycardic, though it is likely to be less helpful in severe overdoses. In the case of calcium channel blocker overdose, the administration of IV Calcium can be used to treat fluid-resistant hypotension. Medical Control should be contacted for these orders. Glucagon use is controversial; its use for either overdose should be discussed in consultation with Medical Control.[7]

The presence of hyperglycemia (in a non-diabetic patient) can help differentiate calcium channel versus beta blocker toxicity. Calcium channel exist in the pancreas and become ineffective during overdose. There may be a relationship between the severity of the ingestion and the extent of the hyperglycemia. Seizures and coma are rare and usually signify the presence of a co-ingestant.

Propranolol is a unique beta-blocker whose toxicity presents more like a sodium channel blocker overdose and should be treated as such.

Sodium Channel Blocker Toxicity

Na-channel blockade may be seen with several prescription drugs (e.g. carbamazepine, lamotrigine, citalopram, flecainide) but is most attributed to tricyclic antidepressants. Cocaine also has Na-channel blocking effects. The **SALT** syndrome[8] is used to describe the common clinical features seen with Na-channel blockade:

Shock
Altered Mental Status
Long QRS (wide complex > 100ms)
Terminal R wave in lead aVR is prominent (other EKG findings include AV conduction blocks, VT, and VF)

If Na-channel blockade is suspected, EMS providers should anticipate the need for early airway management and treatment of shock, referring to those respective medical protocols. Sodium bicarbonate is the mainstay of treatment for severe Na-channel blockade toxicity. Sodium bicarbonate should be given if a wide QRS, ventricular arrythmia, or shock is present - Medical Control should be contacted for this order. Sodium Bicarbonate is ineffective for managing agitation or seizures; benzodiazepines may also be needed.

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[7] Life in the Fast Line. https://litfl.com/glucagon-as-an-antidote/
[8] Tarascon Adult Emergency Pocketbook, 4th Ed.

Cholinergic Crisis (Acetylcholinesterase Inhibitor – AChEi - Exposure)[9]

Organophosphate and carbamate insecticides inhibit acetylcholinesterase enzymes and increase acetylcholine concentration, leading to cholinergic crisis. **DUMBELS** is a common mnemonic used to describe the signs and symptoms of cholinergic crisis.

Patients can manifest any or all of the signs and symptoms based on the route of exposure, agent involved, and concentration of the agent:

Diarrhea
Urination
Miosis/**M**uscle weakness
Bronchospasm/**B**ronchorrhea/**B**radycardia (the killer B's)
Emesis
Lacrimation
Salivation/**S**weating

The ultimate cause of death with AChEi exposure is due to hypoxia/anoxia from pulmonary edema caused by profound bronchial secretions. The primary antidote for cholinergic crisis is atropine. Atropine should be administered liberally and repeatedly until the patient's secretions resolve and respiratory effort improves; ongoing treatment should not be based upon heart rate or pupillary response. Atropine doses over 20mg are sometimes necessary; the stock available to a single provider is usually not sufficient to fully treat the victim but it should be initiated and continued during transport.

Pralidoxime chloride (aka 2-PAM) is a secondary antidote that augments the effect of atropine. Pralidoxime should be used concurrently with atropine when available; generally, no more than 2-3 doses of pralidoxime is administered to an adult patient. Several commercially available antidote kits have autoinjectors that contain both atropine and pralidoxime. If using a dual antidote autoinjector, providers must calculate the amount pralidoxime administered each time to prevent pralidoxime overdoses while giving multiple rounds of atropine. Further guidance on treatment is outlined in the corresponding HAZMAT protocol.

Nerve Agents

Nerve agents also inhibit acetylcholinesterase enzymes and cause cholinergic crisis. However, unlike organophosphates and carbamates, nerve agents are not readily accessible to the general public, can be rapidly be fatal with any route of exposure, and are traditionally classified as weapons of mass destruction.

EMS providers should consider the confirmed or potential release of a nerve agent when responding to an unspecified incident or scene involving:

1. An unknown illness involving a potentially large number of patients
2. An explosion from an unknown source at an event where a large number of people are in attendance
3. An incident where the initial EMS responders on scene suddenly become symptomatic

[9] NAEMT. Nerve Agent Information for EMS and Hospitals. https://www.naemt.org/docs/default-source/ems-preparedness/nerve-agent-info-for-ems-hospitals_08-21-2018_final.pdf?sfvrsn=9710c892_0

A person potentially exposed to a nerve agent should be decontaminated whether they develop signs of acute illness or not. Nerve agents can persist in the environment and remain chemically toxic for a prolonged period.

In the event of a nerve agent release, mass medication distribution may be necessary for the treatment of illness. CHEMPACK is a federally owned cache of nerve agent antidotes managed by the Centers for Disease Control and Prevention (CDC) and reserved for larger events (where the nerve agent exposure will deplete the regional supply of antidotes). CHEMPACKS are placed in centralized locations for rapid deployment and usage[10] and contain enough antidote to treat over 500 patients. The use of CHEMPACK materials is for a life-saving measures only and should not be used prophylactically.

EMS providers should contact their IC and/or higher rank immediately if they suspect that a nerve agent is being used as a terrorist attack or for chemical warfare. Special operations and the FBI Field Office WMD Coordinator will be notified by the IC or Rank Command.

Asphyxia Agents[11]

Asphyxiants are any gas capable of causing death due to oxygen displacement. Asphyxiants are designated as either simple or chemical.

Simple Asphyxiants

Simple asphyxiants are gases that displace oxygen from the inspired air. Common simple asphyxiants are carbon dioxide (CO_2), nitrogen, helium, methane, ethane, and natural gas (e.g. propane, heptane). Simple asphyxiants are encountered when the environmental atmosphere becomes abnormally loaded with one of these gases at such high concentrations that they significantly or completely push the normal oxygen out. Simple asphyxiants have no inherent toxic or metabolic effects on the body's cells, other than causing hypoxia due to lack of oxygen.

The signs and symptoms of exposure to a simple asphyxiant depend on the specific agent involved and the relative concentration of the agent in the atmosphere (i.e., how severe the lack of atmospheric oxygen is). Patients will exhibit such classic signs of hypoxia as agitation, which may rapidly progress to unconsciousness and then cardiac arrest. If the simple asphyxiant is CO_2, patients may experience a narcotic-like sleepiness as the initial effect of exposure.

A key consideration concerning the effects of simple asphyxiants is water solubility. Materials with high water solubility react quickly with the moist membranes of the eyes and upper respiratory tract, causing irritation and burning in addition to coughing, wheezing and bronchospasm. Unless the patient has a pre-existing pulmonary condition (asthma, COPD), symptoms seen in mild to moderate exposure tend to improve with fresh air and good ventilation. Examples of highly water soluble asphyxiants include ammonia, hydrogen chloride, and formaldehyde.

Materials with low water solubility do not react readily with moist membranes of the upper respiratory tract and are able to pass more deeply into the lungs, causing direct lung injury. Patients exposed to low solubility asphyxiants often have mild or no upper respiratory symptoms for the first severe hours but slowly experience

[10] Medical Response to Terrorism. www.naemsp.org/medicalresponse/
[11] JEMS. https://www.jems.com/operations/ems-responds-toxic-inhalation/

lower respiratory complaints like dyspnea, wheezing, and hypoxia. In cases of severe exposure, non-cardiogenic pulmonary edema may develop up to 24 hours after the time of exposure. A patient may seem relatively stable then decompensate with respiratory failure due to acute lung injury. Examples of low water soluble asphyxiants are phosgene and fluorine.

Chlorine is a unique asphyxiant in that it has intermediate water solubility. Patents exposed to chlorine may have immediate irritation of the upper respiratory tract while also displaying signs and symptoms of respiratory distress, bronchial irritation, and pulmonary edema within 6-24 hours of higher exposures. In its gaseous form, chlorine is known as hydrogen chloride. When chlorine dissolves into water, hydrochloric acid is made. Liquified chlorine (aka hydrochloric acid) is a commonly used corrosive solution that can cause injuries similar to frostbite and severe burns with deep ulcerations. Providers exposed only to chlorine gas generally are not at great risk of secondary contamination; however, providers most recognize the significant risk involved in exposure to liquified chlorine.

The mainstay of simple asphyxiant management is gaining safe access to the patient, followed by high-concentration oxygen administration and cardiopulmonary support as indicated. Any significant exposure to a respiratory irritant needs to be evaluated at a medical facility.

Chemical Asphyxiants

Chemical asphyxiants are gases that interfere with oxygen delivery to the tissues or utilization of oxygen to produce energy. These include Carbon Monoxide (CO), Cyanide (HCN), and Hydrogen Sulfide (H_2S). Signs and symptoms of inhaled chemical asphyxiant exposure depend on which specific agent the patient has been exposed to. Symptoms can have a sudden or gradual, more insidious onset depending on the concentration and material to which a patient is exposed. HCN and H2S exposure tend to have a more rapid onset and progression of symptoms than CO.

Carbon monoxide affects oxygen delivery by displacing oxygen molecules bound to hemoglobin. The affinity of CO for hemoglobin is over 200x oxygen’s affinity; the more CO binds to hemoglobin, the easier it becomes for more CO to bind. Bound carboxyhemoglobin not only blocks unbound oxygen from binding but also inhibits the release of bound oxygen meant to be delivered to tissues. Patients exposed to CO may present with a spectrum of symptoms ranging from nausea and confusion with mild intoxication to seizures and cardiac arrest with severe poisoning. When available, providers should affix a CO detector on their equipment bag prior to entering a scene to assist with detection of occult toxicity.

Cyanide interferes with oxygen utilization by blocking an enzyme necessary for the aerobic metabolism and production of ATP. This leads to lactate accumulation as a by-product anaerobic metabolism and the development of metabolic acidosis. The seriously poisoned HCN patient classically presents with unresponsiveness, hyperventilation, and hypotension without evidence of cyanosis.

Hydrogen sulfide is a direct neurotoxin rapidly absorbed by the lungs that produces rapid systemic effects. Patients will often report a distinctive rotten egg odor, followed by eye and upper airway irritation progressing quickly to altered mentation with shortness of breath, hemoptysis, and ultimately pulmonary edema. H_2S can cause death after just a few breaths. It is commonly referred to as the "knock down" gas because it causes near immediate loss of consciousness with high concentrations.

Clinical protocol for treatment of CO and CN poisoning are outlined in subsequent pages. Treatment for H_2S includes supportive care with high-concentration oxygen and endotracheal intubation, if indicated.

Off-gassing of exhaled HCN and H_2S from the patient's lungs may be significant enough to cause some level of toxicity to EMS providers. Proper PPE in addition to following the procedures outlined in Section VII: Patient Transportation will help prevent secondary contamination.

Riot Control Agents[12]

Riot control agents (sometimes referred to as "tear gas") are chemical compounds that temporarily make people unable to function by causing irritation to the eyes, mouth, throat, lungs, and skin. Symptoms begin within seconds of exposure, are self-limited and are best treated by removing the patient from ongoing exposure. Symptoms frequently decrease over time (15-45 minutes) after the exposure ends.

Persons exposed to riot control agents may experience some or all the following symptoms:

- Eyes: excessive tearing, burning, blurred vision, redness
- Nose: runny nose, burning, swelling
- Mouth: burning, irritation, difficulty swallowing, drooling
- Lungs: chest tightness, coughing, choking sensation, wheezing, shortness of breath
- Skins: burns, rash
- GI: nausea, vomiting

Toxicity from riot control agents is related to is related to concentration of the agent used and the duration of exposure (especially in a non-ventilated space). EMS providers should move affected individuals from the contaminated environment and into fresh air as early as possible. Additional prehospital care should be symptom-specific: the most pertinent clinical guidelines for treatment will usually be (a) **Routine HAZMAT Care**, (b) **Wheezing/Bronchospasm**, and (c) **Burn Care**.

Patients with pre-existing pulmonary conditions (e.g. asthma, COPD) may be prone to more severe respiratory effects. Providers should also look for traumatic injury if exposed individuals were in proximity to the device used to disperse the riot control agent (e.g. host/stream under pressure, grenade).

VII. PATIENT TRANSPORTATION

No contaminated personnel, patient or equipment will depart the scene without first going through decontamination. EMS has limited staffing, equipment, and ambulance resources and they must be protected.

[12] https://emergency.cdc.gov/agent/riotcontrol/factsheet.asp#:~:text=Riot%20control%20agents%20(sometimes%20referred,throat%2C%20lungs%2C%20and%20skin.

Patient handling should be limited to personnel required in treatment and patient movement. When able, the driver of the ambulance should not be involved in patient treatment or handling to prevent contamination of the driver compartment of the ambulance. No PPE should be worn within the driver compartment.

The Routine HAZMAT Care protocol should be followed to prevent secondary contamination of EMS providers. This includes (a) wrapping the patient in a sheet, (b) sealing the window between the patient and driver compartment of the ambulance, and (c) ventilating the patient compartment of the ambulance.

Units found to have been exposed to and contaminated by a hazardous substance or material should be promptly decontaminated.

As early as possible (ideally, prior to transportation of patients), the EMS provider should notify the receiving hospital of the following and ask for instructions for entering the hospital with a contaminated patient.

a. Number of victims
b. Materials causing contamination
c. Extent of contamination and whether field decontamination occurred
d. Extent of injuries
e. ETA
f. Any other pertinent information

VIII. ARRIVAL AT THE EMERGENCY DEPARTMENT

Upon arrival at the hospital, emergency room personnel should meet the patient at the ambulance in order to determine if further decontamination is needed prior to delivery of patient(s) into the emergency room. All hospitals are expected to have a plan for receiving contaminated patients and mass contaminated casualties.

IX. EMERGENCY PERSONNEL DECONTAMINATION

All EMS providers who contact and care for a contaminated patient(s) or contaminated material(s) must take immediate measures to ensure proper decontamination after patient handoff is complete. Recommended secondary decontamination of EMS providers includes taking a shower and changing clothes. Follow-up monitoring of all personnel shall be conducted as deemed necessary by the ED Physician / Medical Director.