

FLORIDA SPECIAL INCIDENT HAZARDOUS MATERIALS MEDICAL PROTOCOLS

**Basic and Advanced Life Support
Hazardous Materials Medical Protocols
(Including Operational K9 Protocols)**

**Developed For:
Florida Training Task Force (TTF)
and the
Florida
State Emergency Response Commission (SERC)**
(Approval by SERC)

Florida Special Incident Hazardous Materials Medical Protocols.
Basic and Advanced Life Support Hazardous Materials Medical Protocols
(Including Operational K9 Protocols)

Developed through the East Central Florida Local Emergency Planning Committee

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INTRODUCTION

These Hazardous Materials Protocols are developed to guide EMS Personnel in the treatment of victims exposed to dangerous chemicals and environmental conditions specific to hazardous materials response. They are comprehensive in nature and are intended to be used by local medical directors in the development of protocols that are customized for each individual area/jurisdiction. Although, these protocols can be adopted in whole, it is typical for a committee working with their local medical control, to fine tune this document into a more customized protocol for their community.

The drug modalities placed within this protocol takes into consideration an agencies ability to provide such medications. In several areas of this protocol “OR” statements are provided to articulate the differences in local medical options and drug availability. It is up to the local medical director/control to provide the most cost-effective methods towards providing equipment and training for the delivery of service under this deployment discipline.

Although true hazardous material incidents do not happen every day, what is seen on a frequent bases are the personal misuse of chemicals both in the household and in the workplace setting causing exposures. These are typically not classified as a hazardous materials incident. In fact, most of the patient exposures that are treated by emergency responders do not come from a dispatched hazardous materials incident. Instead, the emergency response was dispatched as some kind of general medical call and it was not until the EMS providers arrived and found that an exposure was responsible for the resulting symptoms.

There are sections in this protocol dedicated to our canine (K9) emergency responders. Since 2001, the use of K9s by the military, law enforcement, and US&R has increased significantly. The increased use of these K9s to find accelerant and explosives compounds, live humans, human remains, drugs, and more is mostly related to increased efforts in improving domestic security. Over the past decade the skills of these K9s have increased allowing them to be utilized by even more specialized units. In many cases these K9s are dispatched to search and find people or hazards in damaged, dangerous, and sometimes contaminated areas. Unfortunately, at times, these Operational K9s (OpK9s) have become victims themselves. Frequently there have been questions, especially from the K9 handlers, regarding the use of the human hazmat medical protocols for their K9 partners. Understandably, a lot of funding, effort, and love has been put into these valuable K9 partners so efforts should be made to preserve their health and well-being. It was for this reason that K9 protocols have been placed into this SOP. Of note, it is understood that before any paramedic implements these protocols, they must have already received appropriate training in K9 first aid care from a licensed veterinarian. Establishing a working relationship with a veterinarian to develop training and to approve specific protocols is a necessary step if your agency plans to institute any of these K9 protocols.

This is a comprehensive guide towards the treatment of hazardous substance exposure with supportive treatments and modalities. It does not include any typical EMS BLS/ALS type protocol. Those should be consulted when this SOP refers the user to their own local EMS protocols. Although these protocols are backed by research and practical application, they do encompass invasive advanced life support skills. Any and all application of invasive skills/treatments must be approved and sanctioned by the physician serving as your agency’s medical control.

RESPONSIBILITY

It is the responsibility of all individuals involved in this type of response to take precautions to avoid primary exposure and reduce the occurrence of secondary exposure while, at the same time, rendering appropriate medical care. Responders who are specifically trained in hazardous materials (hazmat) medical response are defined as follows:

EMS/HazMat Operational Responder

A Basic Life Support trained provider certified at either a State or National level as an Emergency Medical Technician (EMT) and has successfully completed a hazmat operations level core curriculum (as identified in NFPA 470, Chapter 46 2022 edition), preferably with the mission specific competencies of Decontamination and Personal Protective Equipment.

Toxmedic

An Advanced Life Support (ALS) provider certified at either a State or National level as a Paramedic and has successfully completed a hazmat Operations level core identified in NFPA 472, 2017 edition, and a HazMat Medical course that identifies Toxidromes (toxic syndromes) with specific treatment modalities found in NFPA 470, Chapter 47, 2022 edition. Mission specific competencies at a minimum and should include decontamination and personal protective equipment.

HazMat Medic

An Advanced Life Support (ALS) provider certified at either a State or National level as a Paramedic and has completed the mandatory coursework and is recognized as a Hazmat Technician as identified in NFPA 470, 2022 edition. In addition, the paramedic has completed a HazMat Medical course that identifies Toxidromes (toxic syndromes) with specific treatment modalities found in NFPA 470, Chapter 47, 48, 2022 edition. Mission specific competencies at a minimum and should include decontamination and personal protective equipment.

OpK9 (Operational K9) HazMat Medic















A HazMat Medic with the added interest and training in the protection and care of working OpK9s. In addition, the Medic has facilitated a relationship with both the OpK9s he/she is responsible for and developed an understanding and written protocols through a veterinarian providing oversight. The program that provides OpsK9 must have a Veterinarian Medical Director for any issues that may arise during an incident.

Working OpK9

A Law Enforcement, US&R, or other force protection or search and rescue agency K9 that has been trained for a specific task such as human search and rescue, locating live human or human remains, explosive accelerant or narcotic detection, etc. An Operational K9 Unit – is a OpK9 with its human handler. Working OpsK9 must have a Veterinarian Medical Director for any issues that may arise during an incident.

Color Coding – To assist in both organization and physical use, these protocols include color coding that can be used for quick reference and for color coding the HazMat Drug Box. The color-coding system used in this document first appeared in 1987 with the institution of the first hazmat medic program within the Orlando Fire Department.

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SITUATIONAL ASSESSMENT

HAZMAT ALERT

In conjunction with these protocols, it is recommended that your EMS service enact a policy called “HazMat Alert”. HazMat Alert is used to provide early notification to the hospital that they are receiving a patient who has been injured by a chemical. In addition, a notification is made to the Regional Poison Center. Not so different than a “STEMI Alert”, or a “Trauma Alert” the HazMat Alert allows the hospital to prepare for a patient who may need additional specialized medical care providers, an isolation room, or may need to mobilize specialized equipment including additional decontamination equipment. The Alert should provide the hospital with key data points such as the number of patients involved, the overall signs and symptoms, the possible chemical involved, and any treatment provided. The Regional Poison Center can rapidly deploy pre-packaged toxic substance/antidotal therapy fact sheets through its emergency communication systems to the receiving medical facility or to multiple health care facilities, if needed. A sample HazMat Alert policy can be found under the policy section of this document.

SAFE PATIENT APPROACH

Because this manual focuses on human (and K9) exposures to toxic materials we would be remised to not talk about scene safety and personal protective equipment (PPE). Although this document reviews in depth assessment and treatment, it will not get into definitive scene safety, selection of PPE, and Decon unless it is related to treatment. It is expected that the scene is made safe and appropriate steps have been taken to keep the responders safe from initial and secondary exposure. Following the Gateway Protocol for Patient Approach/Evaluation on every patient involved in an exposure to a hazardous material will help to keep the responder safe during a response.

TOXIDROME EXAM

The toxidrome exam is different than a trauma or typical medical exam. Instead the hazmat medic is looking for specific, and sometimes subtle, signs and symptoms displayed from chemical exposures.

- Overall Assessment
 - Vital signs including temperature, Capnography and Masimo/Rainbow to assess Carboxyhemoglobin and Methemoglobin levels.
- Eyes
 - Pupil size, reaction to light, Corneal color (haziness), Epithelial exam (sloughing), Circulation (intact in sclera) blepharospasms, nystagmus reflexes, redness of the sclera.
- Mucous Membranes
 - Color and Moisture
- Respiratory Status
 - Rate, Lung Sounds, Capnography, Oximetry.
- Cardiac Status
 - Heart Rate, EKG to evaluate critical rhythms and QRS (sodium channel blockers) such as ST and PR interval widening (Slowed repolarization), Ectopy.
- Skin
 - Color, Moisture, Temperature, Burns, Irritation
- Musculoskeletal
 - Tremors and/or rigidity, hyperreflexia, fasciculation
- Mental Status
 - Confused, Obtunded, Aggressive, Alert
 - Odors present

GATEWAY PROTOCOL – INITIAL PROTOCOL

In these protocols it is assumed that the patient has been made safe for treatment. This may include removing the patient from the scene of the exposure, removing contaminated clothing, and decontamination. In addition, it is assumed that the EMS care provider is wearing appropriate Personal Protective Equipment (PPE).

At any point when decontamination is identified in the protocol it is highlighted to ensure the procedure was accomplished or there are special circumstances for the procedure.

Note: It is never appropriate to perform any ALS skills in the Hot Zone. Rapid rescue and decontamination is recommended prior to starting any ALS procedures.

Patient Approach/Evaluation:

- Approach the scene with caution.
- Ensure that the patient has been removed from the Hot Zone.
- Be aware of potential contamination hazards in both the terrain and on objects.
- The patient's clinical presentation and location may offer clues about the type of HAZMAT substance. (Situational Assessment Continuum [SAC])
- Don appropriate PPE.
- Ensure that the patient is safe to assess, treat, and transport.
- Monitor for respiratory compromise, cardiovascular abnormalities, shock, or other life-threatening conditions (simple vital signs).
- If in respiratory distress or arrest, follow the local Emergency Airway Procedure.
- Consider secondary system contamination (i.e. eye exposure may also cause a respiratory exposure)
- Low concentrations may take time to manifest or present signs and symptoms. (Conduct the toxidrome exam).
- High concentrations may have an immediate affect and, in addition, have latent symptoms appearing much later. These factors are dependent on the chemical, route of entry, and the target organ involved.
- Follow the appropriate and specific HAZMAT Toxidrome protocols if appropriate.

K9 Patient:

- **Maintain team safety by ensuring, when feasible, that the K9 handler is always involved when approaching and handling an injured K9.**
- **K9 Handling and Restraint:**
 - **Consider applying a muzzle prior to handling a conscious K9 when no contraindications to muzzling exist (e.g. upper airway obstruction, respiratory complications, severe facial trauma, heat-related injuries, vomiting, comatose, etc.)**
 - **Any injured or stressed K9 is considered unpredictable and may bite, even its own handler.**
 - **OpK9 HazMat Medics should always carry a quick application type muzzle in a known easily accessible location for expedient use when and if needed.**
 - **It is strongly urged to have at least two alternate team members trained on basic K9 handling techniques for situations when the handler is down. When feasible, these personnel should have a well-established and positive rapport with OpK9s they support.**

Assessment/Treatment

Basic Life Support

- Assess respiratory status and secure a patent airway.
- Take vital signs and record pulse oximetry prior to placing the patient on oxygen.
 - Provide supplemental oxygen at 100% via non-rebreather mask.
 - Auscultate lung sounds and assess oxygenation status.
 - If breathing is slow, suppressed, or absent secure an airway and support ventilations.
- Obtain vital signs and complete a head-to-toe survey of the body surface area.
- Avoid all body fluids/substances.
- Has Decontamination been provided (Type, Location and Dwell time)
- Obtain history of exposure.
 - Method/route of exposure (skin/eye exposure, respiratory, ingestion, penetrating injury).
 - Specific chemical involved.
 - Time of exposure.
 - Duration of exposure.
 - Substance or activity involved in the exposure.
 - Symptoms specific or those that occurred after the exposure.
 - Past medical history including preexisting medical conditions and current medications.
- If there is a known chemical exposure, contact Poison Control for additional guidance. (See “Policies and Further Guidance. III. “Poison Control Centers”

Advanced Life Support

- Provide advanced airway management as needed
- Begin advanced assessment
 - Monitor Pulse oximetry (Normal 96%-99% SaO₂). Both before and after oxygen administration.
 - Monitor Capnography (Normal 35-45 mmHg)
 - Monitor Carboxyhemoglobin (Normal 0.85-4%). Provide oxygenation NRB 15LPM if carboxyhemoglobin above 10%.
 - Monitor Methemoglobin (Normal 1-3%). Provide oxygenation NRB 15LPM if above 15% or if symptoms are seen or 10% in patients with a previous history of anemia, heart disease, or vascular disease.
 - Watch for reflex bradycardia (High BP with slow HR with clinical decompensation)
 - Cardiac monitoring including 12 lead EKG if warranted (cardiac irritability, EKG changes such as prolonged QT (QTc) interval or widened QRS complex).
- Treat any abnormalities in respirations and blood pressure per your local protocol.
- Provide advanced treatment as identified in the Toxidrome Protocols including specialized medications and antidotes.
- Contact receiving hospital and Regional Poison Control Center and provide **HazMat Alert**.

Pediatric

Pediatric patients breathe faster and have higher metabolisms. Both factors can produce more acute severe effects after an exposure. Keep in mind that a moderate exposure to an adult can be severe and life threatening to a pediatric patient.

Note: In this protocol, specific pediatric doses are identified when they are different from an adult's. Children over 110 pounds or 50 Kg are considered to be of an adult size and receive an adult dose unless the dosage is calculated in mg/Kg. In some cases, age is noted to determine appropriate dosage.

K9 Patient:

Depending on the type of exposure a K9 can develop symptoms quicker than their human counterparts exposed to the same toxins. In some cases, K9s actually tolerate exposures better and display fewer symptoms than humans. Initial assessment should immediately include monitoring the respiratory and cardiovascular status then supporting both of these. Follow toxidrome specific K9 protocols once the exposure has been identified.

TOXIDROMES

CORROSIVES AND IRRITANTS – HZT01

DESCRIPTION:

Corrosives and irritants are a group of chemicals that have the ability to cause inflammation or burns (of various degrees) to tissues. This can include eyes, skin, and/or respiratory system. These chemicals can be classified as highly water soluble, moderately water soluble, or primarily lipid soluble. They can also be classified as having a high pH (alkali) or a low pH (acid). Depending on these characteristics the damage suffered to the exposed tissue is predictable allowing treatment to begin even before many of the symptoms present themselves.

Patient Approach/Evaluation:

- Follow Gateway Protocol on the initial patient approach/evaluation.

SYSTEM EXPOSURE, CORROSIVES AND IRRITANTS

- Eyes
- Skin
- Respiratory

Eyes

Eye exposure to a corrosive/irritant chemical is a true emergency. Irrigation should not be delayed for any reason with the exception of immediate lifesaving efforts. Delay in initial irrigation may result in loss visual acuity, total loss of vision, or loss of globe. Immediate irrigation can be accomplished quickly from almost any water source (tap water, saline, sterile water, etc.)

Assessment/Treatment:

Basic Life Support (Adult and Child)

- Immediately start irrigation in both eyes by whatever means possible, as first priority.
- A rapid assessment of the eyes to determine the severity of the injury.
 - Sloughing of the epithelial tissue (Mild Injury)
 - Mild signs + Cloudiness of the cornea (Moderate Injury)
 - Mild and Moderate signs + Opaque cornea (Severe Injury)
 - Mild and Moderate signs + Porcelainization (completely white w/o blood vessels) of the sclera (Severe Injury)
- Continue irrigation in both eyes during transport

Note: *A nasal cannula can be used on the bridge of the nose as an apparatus to irrigate both eyes but, the eyes lids may have to be held open to facilitate adequate irrigation.*

- Ensure all particulate matter or contact lenses are out of the eyes by digitally opening the lids and pouring irrigation fluid across the globe.
- Consider in children to have the parents hold child in a shower while irrigating for at least 15 minutes allowing the water to flush over their heads/eyes.
- Contact the hospital and provide (**Hazmat Alert**)

Advanced Life Support (Adult and patient > 8 years old)

- If not contraindicated, prepare the Eye Irrigation Lens by attaching an IV solution of normal saline, ensure that fluid continues to flow at steady rate.
- Apply 2 drops of Tetracaine ophthalmic drops into each of the eyes. (In most cases both eyes are involved.) Before applying Tetracaine determine if the patient is allergic to “caine” derivatives.
- Insert the lens and secure the tubing.
- Adjust the flow so that a continuous solution is flowing from the eye.
- Continue irrigation until arrival at the emergency department.
- After 15-20 minutes of irrigation consider reapplication of ophthalmic drops to keep the patient comfortable during irrigation.
- Start IV of 1000cc Normal Saline at a KVO rate.
- Strongly consider sedation to reduce anxiety:
 - Diazepam (Valium) 2 – 10 mg IV/IO **or**
 - Midazolam (Versed) 2.5 mg IV/IO (systolic must be greater than 90 mmHg) (1.5 mg for elderly, debilitated or patients with other CNS depression) **or**
 - Lorazepam (Ativan) 2 mg IM/IV/IO and can be repeated after 5-10 minutes

Pediatric Considerations (eye exposure)

Adult Gateway Eye Protocols are applicable to pediatric patients.

- Do not use Morgan lenses in patients less than 8 years old.
- The use of ophthalmic drops is appropriate to relieve pain and discomfort in pediatric patients.
- Do not sedate pediatric patients.

K9 Patient (eyes)

- **Consider all the above without the use of the Eye Irrigation Lens**
- **The use of Tetracaine ophthalmic drops is appropriate and safe for K9s.**
- **Consider sedation to reduce injury to the K9 and personnel providing treatment: Refer to K9 anesthetic / analgesic protocol in appendix.**

Skin

Skin exposure is the most reported chemical injury in the U.S. pH and solubility must be taken into consideration when assessing the extent of the injury and developing a treatment strategy.

Assessment/Treatment:

Basic Life Support

- Ensure decontamination has occurred or is underway.
 - Immediately provide continuous irrigation of the exposure site by whatever means possible.
 - Depending on the solubility of the chemical an emulsifier may need to be used to remove the substance. (mild detergent, olive oil, mineral oil)

- Assess the body surface area affected. For large burns use the rule of nines to assess percentage of skin involvement.
- Assess vital signs, oxygenation, and end tidal CO₂ (Capnography).
- Contact the hospital and Poison Control Center and provide (**Hazmat Alert**)

Advanced Life Support

- In any irritant/corrosive injury always assess for secondary respiratory exposure.
- Provide advanced monitoring including oximetry, capnography, and Masimo/Rainbow.
- Once the chemical is known, access specific Toxidrome Protocols for further treatment options.

Pediatric Considerations (Skin Exposure)

All Adult Gateway Skin Protocols are applicable to pediatric patients.

K9 Patient (Skin)

General Concepts:

- **Skin pH:**
 - Human: more Acidic – 5.2 to 6.2
 - K9: more Alkaline – 5.5 to 8.0
- **Low pH Human Shampoos/soaps**
 - Human-based shampoos tend to be more acidic (pH<7)
 - May have adverse effects on the K9 skin
- **High pH (.8) Soaps / Detergents**
 - Safer for K9 eyes and skin; however, may compromise effectiveness
 - Most dish soaps (e.g. Dawn®) have neutral pH (7-8).

Basic Life Support (K9)

- Wear appropriate PPE to avoid secondary contamination.
- Remove contaminated outerwear (collars, clothing, harness, vest, other).
- Decontaminate the affected area with a neutral pH detergent / soap and water, making sure you don't spread the chemicals in the fur to other areas.
- If necessary to assess and treat the burned tissue, use clippers or scissors to cut hair from the area.
- If the chemical burn is in the mouth, lie the dog on his side and pour cool water through the mouth a cupful at a time or use a garden hose for a constant, cool flow.
- Once decontaminated, cover the burned skin with a non-adherent, sterile (or clean) bandage.
- Contact veterinarian services for further guidance. (See Policies and Further Guidance section IV, "On-Call K9 Veterinarian Services")

Advanced Life Support

- Support respirations.
- Maintain hydration and perfusion with IV 0.9% Sodium Chloride (Normal Saline).
- Maintain body temperature (Normal 100-102.5° F (37.7 – 39.2° C).

Respiratory

When an inhaled irritant/corrosive chemical is water soluble the upper airways are generally affected causing burns and irritation to those areas. These injuries produce wheezing and rhonchi upon auscultation. If the chemical is highly water soluble the resulting injury may occur above the vocal cords and produce stridor. When the chemical is more lipid soluble, the lower airways/alveoli are affected producing rales upon auscultation. Surfactant found in the alveoli is lipid soluble and is easily disrupted by chemicals that reach the alveoli. Injury to the alveoli causes chemically induced (non-cardiogenic) pulmonary edema. Loss of surfactant causes atelectasis. Both conditions are treated with Continuous Positive Airway Pressure (CPAP).

Note: In all cases the lungs may sound wet and rhonchorous as abundant production of secretions follow the airway irritation.

Assessment/Treatment:

Basic Life Support

- Ensure the patient is in a safe environment and, if needed, decontamination has occurred.
- Assess overall respiratory status:
 - Lung sounds
 - Oximetry (obtain before and after supplemental oxygen is given)
 - Capnography
- Give 100 % Oxygen by NRB
- If the chemical is water soluble, provide a nebulizer (updraft) of saline to dilute the chemical in the airways.

Advanced Life Support

- Provide advanced airway if needed.
- If wheezing is noted on auscultation:
 - Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) and/or Ipratropium Bromide (Atrovent).
 - Albuterol 2.5mg (0.5mL of 0.5% diluted to 3mL with sterile normal saline) give via nebulizer. May be repeated 3 times.
 - Ipratropium Bromide 0.5mg (500 mcg)/2.5 ml via nebulizer repeat at 20 minute intervals for a total of 3 doses (usually only one dose given in the field).
 - Administer methylprednisolone (Solu-Medrol) 125 mg, IVP slowly.
 - Monitor heart rate. Contact medical control if HR over 150 bpm.
 - Consider the administration of Brethine/Terbutaline Subcutaneous Injection.
 - Brethine (Terbutaline sulfate) 0.25 mg given subcutaneous injection. (0.25ml of a 1mg/ml solution) Especially if a rapid heartrate is a concern.
 - Repeated in 15-30 minutes if no improvement.
 - Maintain adequate ventilation and oxygenation
 - Assess:
 - Oximetry
 - Capnography
 - EKG

- Provide
 - CPAP and set the PEEP setting at or above 10 cm of H₂O and 100% Oxygen. (or select the high setting)
 - Provide advanced airway if needed.
 - Control seizures or anxiety with Valium or Versed
 - Diazepam (Valium) 2 – 10 mg IV/IO **or**
 - Midazolam (Versed) 2 – 2.5 mg IV/IO (Max 10 mg) **or**
 - Lorazepam (Ativan) 2 mg IM/IV/IO and can be repeated after 5-10 minutes
 - Consult specific Toxidrome Protocols for additional medical treatment guidance.
- Contact receiving hospital and the Poison Control Center and provide **HazMat Alert**.

Pediatric Considerations (Respiratory Exposure)

Pediatric patients may show more severe symptoms because they will receive a higher dose of a chemical if in the same environment as adult victims. Pediatric patients breathe and metabolize faster.

Note: Administration of a nebulized Inhalation Solution is not recommended for Pediatrics less than 2 years old.

- Albuterol - 2-12 years old less than 15 kg: give one 3 ml unit-dose vial of 1.25 mg by nebulizer (5-15 minutes)
 - 13 and older (or over 50kg) get adult dose
- Ipratropium Bromide (Atrovent) - Administered at an adult dose by nebulizer but the number of overall doses is reduced to 2. Only one should be given in the field.
- Solu-Medrol - 1.5mg/kg not to exceed 60 mg dose, IV. Give only one dose in the field.
- Brethine/Terbutaline is not recommended for pediatrics of less than 12 years of age. Above 12 years old receive adult dose.

Note: To provide CPAP to a pediatric patient the correct mask must be available. If the patient is not breathing, you must have a pediatric BVM with an integrated PEEP valve or an inline supplemental PEEP valve available.

- Provide CPAP
 - When providing CPAP to pediatric patients always start the PEEP setting at low pressures of 5 cm H₂O. (This setting may be signified by the “low” setting on some CPAP units. Then increase it in increments of 1 cm H₂O, as tolerated by the patient.
 - In patients less than 12 years old or less than 100 pounds (50 kg), the maximum PEEP should be 15 cm H₂O.
 - For patient 12 years old and more than 100 pounds (50 kg), the maximum PEEP should be 20 cm H₂O.

K9 Patient (Respiratory)

- **Ipratropium Bromide (Atrovent) is NOT recommended for dogs.**
- **Albuterol (Proventil, Ventolin) Is commonly prescribed by veterinarians as the drug of choice for bronchial constriction.**

- In dogs a conservative oral dose 0.020 - 0.050 mg/kg (20-50 micrograms/kg) PO every 8 – 12 hours. Oral absorption is rapid. May be repeated 4 times a day until symptoms subside.
- Brethine/Terbutaline – The dosage of Brethine SQ for canines is 0.01 mg/kg every 4 to 6 hours; may also nebulize 0.01 mg/kg diluted in 9 mL of 0.9% NaCl.

EXPOSURE TO SPECIFIC CHEMICAL CORROSIVE AND IRRITANTS

- **Chlorine & Chloramine**
- **Ammonia**
- **Phosgene**
- **Hydrofluoric Acid/Fluoride Products**
- **Phenol**
- **Lacrimators**

Chlorine

DESCRIPTION:

Chlorine gas easily becomes incorporated into water soluble mucous and creates hydrochloric acid and results in inflammation, swelling of the bronchioles, sloughing of tissue, and in high doses, pulmonary edema. Clinical effects may be delayed in onset and peak.

Chloramine

DESCRIPTION:

Accidental exposure to Chloramine is usually the result of mixing household ammonia (3-19% NH₃) and bleach (5% NaClO). In higher concentrations, the combination of hydrochloric acid, ammonia, and oxygen free radicals cause corrosive effects and cellular damage resulting in swelling and sloughing of upper respiratory tissue and damage to the alveoli resulting in pulmonary edema.

Patient Approach/Evaluation:

- Follow Gateway Protocol on the initial patient approach/evaluation.
- Patient should be decontaminated for liquid/irritant gas exposures (eyes/skin)
- Regardless of the level of decontamination, expect to smell the odor of chlorine or ammonia on the patient. Both have very low odor thresholds.

Assessment/Treatment for Chlorine and Chloramine:

Basic Life Support

Evaluate other systems for the possible effects of the chemical exposure (such as the eyes). Complete a rapid respiratory assessment and begin treatment:

- Ensure a patent airway
- Pulse Oximetry before and after oxygen administration
- 100% oxygen via NRB mask
- Assemble a nebulizer and administer 5 ml of sterile water

Advanced Life Support

- If airway or lung pain (burning) persists, mix 2.5 ml of 8.4% Sodium Bicarbonate solution with 2.5 ml of normal saline (rendering a 4.2% mixture) and administer the 5 ml mixture through a nebulizer.
- Administer Methylprednisolone (Solu-Medrol) 125 mg, IVP
- If wheezing is noted on auscultation:
 - Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) and/or Ipratropium Bromide (Atrovent).
 - Albuterol (Proventil) 2.5mg (0.5mL of 0.5% diluted to 3mL with sterile normal saline) give via nebulizer. May be repeated 3 times.
 - Ipratropium Bromide (Atrovent) 0.5mg (500 mcg)/2.5 ml via nebulizer repeat at 20 minute intervals for a total of 3 doses (usually only one dose given in the field).
 - Monitor heart rate. Contact medical control if HR over 150 bpm.
- Consider the administration of Brethine/Terbutaline Subcutaneous Injection.
 - Brethine (Terbutaline sulfate) 0.5 mg given subcutaneous injection. (0.5ml of a 1mg/ml solution).
- Maintain adequate ventilation and oxygenation
 - Assess:
 - Oximetry
 - Capnography
 - EKG
 - Provide
 - CPAP and set the PEEP setting at or above 10 cm of H₂O and 100% Oxygen. (or select the high setting)
 - Provide advanced airway if needed.
 - Control seizures or anxiety with Valium or Versed
 - Diazepam (Valium) 2 – 10 mg IV/IO **or**
 - Midazolam (Versed) 2 – 2.5 mg IV/IO (Max 10 mg) **or**
 - Lorazepam (Ativan) 2 mg IM/IV/IO and can be repeated after 5-10 minutes
 - Consult specific Toxidrome Protocols for additional medical treatment guidance.
- Contact receiving hospital and provide **HazMat Alert**.

Anhydrous Ammonia

DESCRIPTION:

Anhydrous ammonia is a colorless gas with a pungent suffocating odor. It is highly irritating when exposed to tissue including skin, eyes, and respiratory system. Ammonia dissolves into any mucous membranes to form ammonium hydroxide, a strong alkaline solution.

Patient Approach/Evaluation:

- Follow Gateway Protocol for Patient Approach/Evaluation.
- Consider secondary contamination (eye and skin exposure). Patient requires decontamination once stabilized.
- In low concentrations, because of the solubility, immediate upper airway injury can be expected and confirmed through lung sounds (wheezing).
- In high concentrations expect both upper and lower airway injury so bronchial swelling combined with chemically induced pulmonary edema may occur.

Assessment/Treatment for Anhydrous Ammonia

Basic Life Support

Ensure the patient is out of the contaminated area and has been made safe. Evaluate other systems for the possible effects of the chemical exposure (such as the eyes). Complete a rapid respiratory assessment and begin treatment:

- Pulse Oximetry before and after oxygen administration
- 100% oxygen via NRB mask
- Assemble a nebulizer and administer 5 ml of 0.9% Sodium Chloride.

Note: In cases of anhydrous ammonia inhalation, the patient's airway can be lost to swelling/edema in a matter of seconds to minutes. Any evidence of airway involvement (stridor, hoarse, wheezing, initial trouble breathing) should trigger immediate intubation. It is far better to gain rapid control of the airway while you can still see it rather than try to find it after it is lost through swelling/edema.

Advanced Life Support

- Administer methylprednisolone (Solu-Medrol) 125 mg, IVP
- Monitor heart rate. Contact medical control if HR over 150 bpm.
- If wheezing noted after the initial updraft of 0.9% Sodium Chloride, then:
 - Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) or/and Ipratropium bromide (Atrovent).
 - Albuterol 2.5 mg (0.5m or 0.5% diluted into 3ml normal saline) give via nebulizer. May repeat 3 times at 20-minute intervals.
 - Ipratropium Bromide 0.5mg (500 mcg) 2.5ml via nebulizer, repeat at 20-minute intervals for a total of 3 doses. May be repeated up to 3 times at 20-minute intervals
- Consider the administration of Brethine/Terbutaline Subcutaneous Injection.
 - Brethine (Terbutaline sulfate) 0.5 mg given subcutaneous injection. (0.5ml of a 1mg/ml solution).

- Maintain adequate ventilation and oxygenation
 - Assess:
 - Oximetry
 - Capnography
 - EKG
 - Provide:
 - CPAP and set the PEEP setting at or above 10 cm of H₂O (or select the high setting) and 100% Oxygen.
 - It is critical to provide an advanced airway if needed.
 - If seizures occur post exposure or the patient suffers from extreme anxiety, consider treating with:
 - Diazepam (Valium) 10mg IV/IO/IM. Maximum dosage 20mg **or**
 - Midazolam (Versed) 2.5 mg IV/IO. Repeat at 2-minute intervals to a maximum dosage of 10mg **or**
 - Lorazepam (Ativan) 2 mg IM/IV/IO and can be repeated after 5-10 minutes
 - If Rales or Rhonchi are noted on auscultation and the Oximetry or Capnography reflect negative changes.
 - Maintain Continuous Positive Airway Pressure (CPAP) and set the Positive End Expiratory Pressure (PEEP) setting above 10cm of H₂O.
 - Consider NTG, Morphine, or furosemide (Lasix) administration to reduce the pulmonary pressure and decrease the influx of fluid into the alveoli.
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**

Phosgene

DESCRIPTION:

Phosgene gas is either colorless or pale white and has an odor of newly mown hay. It is only slightly soluble in water, so it bypasses the mucous membranes of the upper respiratory system and enters the alveoli. It slowly hydrolyzed to form hydrochloric acid damaging the fine bronchioles and alveoli causing significant pulmonary edema. Phosgene also bonds with surfactant and removes the ability of surfactant to keep the alveoli open causing atelectasis. In most cases clinical effects may be delayed in onset and peak.

Patient Approach/Evaluation:

- Follow Gateway Protocol on the initial patient approach/evaluation.
- Because of the poor solubility of Phosgene monitor for impending pulmonary edema. Monitoring for pulmonary edema needs to continue for the next 12 – 24 hours.

Assessment/Treatment for Phosgene

Basic Life Support

Ensure the patient is out of the contaminated area and has been made safe. Evaluate other systems for the possible effects of the chemical exposure (such as the eyes). Complete a rapid respiratory assessment and begin treatment:

- Pulse Oximetry before and after oxygen administration

- 100% oxygen via NRB mask
- Assemble a nebulizer and administer 5 ml of sterile water

Advanced Life Support

- Due to the solubility of Phosgene expect that the result of the exposure will be the lower respiratory system and cause immediate or delayed chemically induced pulmonary edema and atelectasis.
 - Maintain adequate ventilation and oxygenation
 - Assess:
 - Oximetry
 - Capnography
 - EKG
 - Provide:
 - CPAP and set the PEEP setting at or above 10 cm of H₂O (or select the high setting) and 100% Oxygen.
 - Provide advanced airway if needed.
 - If seizures occur post exposure or the patient suffers from extreme anxiety give:
 - Diazepam (Valium) 10mg IV/IO/IM. Maximum dosage 20mg **or**
 - Midazolam (Versed) 2.5 mg IV/IO. Repeat at 2-minute intervals to a maximum dosage of 10mg **or**
 - Lorazepam (Ativan) 2 mg IM/IV/IO and can be repeated after 5-10 minutes
 - If Rales or Rhonchi are noted on auscultation and the Oximetry or Capnography reflect negative changes.
 - Maintain Continuous Positive Airway Pressure (CPAP) and set the Positive End Expiratory Pressure (PEEP) setting above 10cm of H₂O.
 - Consider NTG, Morphine, or furosemide (Lasix) administration to reduce the pulmonary pressure and decrease the influx of fluid into the alveoli.
 - If wheezing noted, then:
 - Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) or/and Ipratropium bromide (Atrovent).
 - Albuterol 2.5 mg (0.5ml or 0.5% diluted into 3ml normal saline) give via nebulizer. May repeat 3 times at 20-minute intervals.
 - Ipratropium Bromide 0.5mg (500 mcg) 2.5ml via nebulizer, repeat at 20-minute intervals for a total of 3 doses. May be repeated up to 3 times at 20-minute intervals
 - Consider the administration of Brethine/Terbutaline Subcutaneous Injection.
 - Brethine (Terbutaline sulfate) 0.5 mg given subcutaneous injection. (0.5ml of a 1mg/ml solution).
 - Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Pediatric Considerations (Chlorine, Chloramine, Ammonia, Phosgene)

A child's exposure can be much greater than an adult exposed to the same concentration. Children typically breathe much faster and their overall metabolism is higher making the exposure much more dramatic. All of the protocols stated above are applicable to a pediatric patient but expect more significant signs and symptoms.

If wheezing is noted or there is evidence of a shark fin pattern on the Capnogram, administer:
Note: If the offending chemical is ammonia/chlorine consider rapid intubation as stated in the prior Note.

Note: Nebulizer Inhalation Solution is not recommended for pediatric patients less than 2 years old.

- Albuterol - 2-12 years old less than 15 kg: give one 3 ml unit-dose vial of 1.25 mg by nebulizer (5-15 minutes)
 - 13 and older get adult dose
- Atrovent - Administered at an adult dose by nebulizer but the number of overall doses is reduced to 2. Only one should be given in the field.
- SoluMedrol - 1.5mg/kg not to exceed 60 mg dose, IV. Give only one dose in the field.
- Brethine/Terbutaline is not recommended for pediatrics 12 years old or younger.
- CPAP is used after exposure to chemical irritants.
- When providing CPAP to pediatric patients always start the PEEP setting at low pressures of 5 cm H₂O. Then increase it in increments of 1 cm H₂O, as tolerated by the patient.
- In patients less than 13 years old or less than 100 pounds, the maximum PEEP should be 15 cm H₂O but should not be given above 10 cm H₂O in the field.

K9 Patient (Chlorine)

- Chemical gases and vapors that are heavier than air will have higher concentrations closer to the ground level causing most canines to have a greater exposure.
- Ipratropium Bromide (Atrovent) is NOT recommended for dogs. Research has found that bronchiole constriction can occur after administration.
- Albuterol (Proventil, Ventolin) is commonly prescribed by veterinarians as the drug of choice for bronchial constriction.
 - In dogs a conservative oral dose 0.020 - 0.050 mg/kg (20-50 micrograms/kg) PO every 8 – 12 hours. Oral absorption is rapid. May be repeated 4 times a day until symptoms subside.
- Brethine/Terbutaline – The dosage of Brethine SQ for canines is 0.005mg/lb (0.01 mg/kg) every 4 to 6 hours; may also nebulize 0.01 mg/kg diluted in 9 mL of 0.9% NaCl.

Hydrofluoric Acid and Fluorine Based Chemicals

DESCRIPTION:

Hydrofluoric Acid (HF) is an inorganic acid which is classified as a weak acid when compared to other inorganic acids. The hazardous nature of HF is not in the corrosivity but rather the toxicity. Injury is twofold. First, it causes damage to the skin and underlying tissue and the fluoride binds with calcium and magnesium from the nerve pathways, bone, and blood stream. Exposure causes minor burns (with pain out of proportion to burn appearance) to tissue with severe systemic effects manifesting as signs of hypocalcemia and other electrolyte disturbances, multi-organ system failure, tetany, seizures and cardiac effects characterized

by elongating QT (QTc) interval leading to cardiac arrest. In addition to hypocalcemia HF also causes hypomagnesemia and the release of intracellular potassium causing hyperkalemia.

Patient Approach/Evaluation:

- Follow Gateway Protocol for Patient Approach/Evaluation.
 - The most common exposure to Hydrofluoric Acid is to the skin but the rapid vaporization of this acid may also cause a secondary exposure to the eyes and the respiratory system.
 - Immediate decontamination is warranted.

Assessment/Treatment Hydrofluoric Acid chemicals:

Assessment and treatment for Hydrofluoric acid exposure is highly dependent on the concentration and contact time External exposures involving the eyes, skin, and respiratory system are usually followed by internal/systemic injury. All must be evaluated and, if necessary, aggressively treated.

Eye Injuries (hydrofluoric acid)

Basic Life Support

- Immediately flush eyes with any means possible
- Once irrigation has been initiated a nasal cannula can be used on the bridge of the nose to facilitate irrigation of both eyes. The eyelids may still need to be held open to ensure adequate irrigation.
- Ensure that all foreign materials or contact lenses are removed from the eye.

Advanced Life Support

- Eye irrigation should use normal saline and NOT a solution of calcium gluconate.
- Connect the saline bag and tubing to a Morgan Lens and bleed out any air.
- Insert two drops of Tetracaine ophthalmic analgesic solution into the eye. Before applying Tetracaine determine if the patient is allergic to “caine” derivatives.
- Insert the Morgan lens(es) into the affected eye(s) and adjust the rate to ensure a continuous flow of solution out of the eye.
- Irrigate the eyes using the calcium gluconate that was prepared.
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Skin Burns (hydrofluoric acid):

Basic Life Support

- Immediately flush exposed area with large amounts of water

Advanced Life Support

- Prepare Calcium Gluconate Gel by mixing 10 cc of a 10% Calcium Gluconate into 2 ounces of water-based lubricant (such as KY Jelly) and mix completely. This can be done by pouring both into an exam glove and mixed.
- Apply calcium gluconate Gel over burned area and massage into exposure using a gloved hand. (i.e Rescuer PPE must have gloves that are chemical resistant Neoprene or 22 mil Nitrile gloves).

Advanced Life Support

If pain continues:

- Reduction or cessation of pain is an indication that the calcium is bonding with the Fluoride.
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Note: Tums mixed with water, saline or water-based lubricant (K-Y Jelly), Maalox, or Mylanta (Calcium blend) can be used in the absence of Calcium Gluconate or Calcium Chloride for topical treatment of Hydrofluoric Acid burns. An Epsom Salt bath solution (Magnesium Sulfate) may also be used as a skin surface treatment. Both Calcium and Magnesium bond with the free Fluoride ions to prevent further injury.

Respiratory Injury (hydrofluoric acid):

Basic Life Support

- If a respiratory exposure is suspected or if signs and symptoms are present immediately begin humidified oxygen therapy using a NRB mask.

Advanced Life Support

- Mix 6 ml of sterile water into 3 ml of 10% calcium gluconate
- Place solution in nebulizer and connect to oxygen to provide effective fog.
- 9 ml is enough solution to provide 2-3 nebulizer treatments.
- If wheezing continues after treatment with calcium gluconate administer:
 - Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) and/or Ipratropium Bromide (Atrovent).
 - Albuterol 2.5mg (0.5mL of 0.5% diluted to 3mL with sterile normal saline) give via nebulizer. May be repeated 3 times.
 - Ipratropium Bromide 0.5mg (500 mcg)/2.5 ml via nebulizer repeat at 20 minute intervals for a total of 3 doses (usually only one dose given in the field).
 - Administer methylprednisolone (Solu-Medrol) 125 mg, IVP slowly.
 - Monitor heart rate. Contact medical control if HR over 150 bpm.
 - Consider the administration of Brethine (Terbutaline sulfate) 0.5 mg given subcutaneous injection. (0.5ml of a 1mg/ml solution).
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Systemic Injury from hydrofluoric acid (hypocalcemia):

- Continuously monitor VS and pay close attention to the EKG.
- Systemic injury is characterized by the presence of one or several of the below signs:
 - Cardiac dysrhythmias
 - Conduction disturbances
 - QT (QTc) Segment elongation on EKG (hypocalcemia)
 - Peaked T waves (indicating hyperkalemia)
 - Tetany
 - Seizures
- If the above symptoms are present give:
 - 10 ml of Calcium Gluconate 10% IV

- Repeat every 3-5 minutes to a maximum dose of 30 ml if the signs of systemic fluoride toxicity persist.

Note: Patients may be given larger doses of IV calcium for systemic toxicity; even large doses rarely cause hypercalcemia. Correction of acid-base status is paramount but never give sodium bicarbonate and calcium through the same I/V line.

- If Calcium Gluconate not available give Calcium Chloride 10% (9.3%) solution, 10 ml IV push slowly (very irritating to the vein).
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Pediatric Considerations

- All topical and nebulized treatments remain the same for pediatric patients
- Pediatric dose of 10% Calcium Gluconate IV is:
 - Give 0.2 ml/kg IV or IO
 - Repeat half the initial dose in 3-5 minutes if signs of systemic fluoride toxicity persist.
 - If Calcium Gluconate not available give Calcium Chloride 10% solution, 0.1 – 0.2 ml IV push slowly

K9 Patient

Toxicity studies involving dogs who were exposed topically and by inhalation revealed that relatively small dosages of HF cause severe injury including ulcerations of the skin, complete opaqueness and loss of circulation to the globe of the eye, and destruction of airway and lung tissue. There have been no reports of cardiac issues following the exposures but it is reasonable to expect both hypocalcemia and hyperkalemia.

Calcium Gluconate has been used successfully on K9s exposed to Hydrofluoric Acid. Therefore:

- Skin Exposures - Follow adult.
 - It is generally better to decontaminate the coat rather than clipping or shaving the fur. If efforts are made to clip the fur of a K9 to gain full exposure to skin lesion; do so with great care to avoid causing further dermal injury (aka. 'clipper burn').
 - Decontaminate affected area by irrigation with copious amounts of water.
 - Consider applying ice packs to the affected area; may provide pain relief and retard diffusion of the HF ion further into the skin layers.
 - Mix 10 cc of a 10% Calcium Gluconate into 2 ounces of water-based lubricant (such as KY Jelly). Apply topically to exposed skin.
 - May also consider soaking /coating HF chemical burns with magnesium hydroxide – containing antacid preparations (e.g. Mylanta).
- Respiratory / inhalation exposures; Follow adult procedures:
 - Administer oxygen supplementation.
 - Monitor pulse oximetry (maintain > 94%)
 - Consider 2.5% Calcium gluconate nebulization treatment. Mix 6 ml of sterile water into 3 mL of 10% calcium gluconate.

- Provide 2 nebulizer treatments
- Treat systemic clinical manifestations (e.g. hypocalcemia, hyperkalemia-induced cardiotoxicity) with the following:
 - Gain and IV or IO access.
 - Give 10% Calcium Gluconate at a dose of 0.2 ml/kg IV or IO.

Note: IV calcium treatment antagonizes the cardiotoxic effects of hyperkalemia, but does not reduce serum potassium concentrations.

- Start IV 0.9% NaCl fluid resuscitation at 3 mL/kg/hr to maintain perfusion, dilute serum potassium concentrations, and promote renal potassium excretion.
- Administer appropriate analgesia for pain management. See recommended K9 analgesic protocols in appendix.

Phenol (Carbolic Acid)

DESCRIPTION:

Phenol is found in many household items and is commonly used as a disinfectant, germicide, antiseptic, and as a wood preservative. It causes injury much the same as other acids by causing coagulation necrosis. But the true danger is related to its ability to depress the CNS. Low BP, slowed respirations, decrease in core temperature, and eventually cardiac arrest have all occurred.

Patient Approach/Evaluation:

- Follow Gateway Protocol for Patient Approach/Evaluation.

Assessment/Treatment of Phenol:

Basic Life Support

- Decontaminate initially with soap and water. If evidence of Phenol is present after first decontamination, use PEG 300 or 400 (polyethylene glycol) diluted to 50% area rinsed off until no detectable odor of phenol. (Not advised for pediatrics)
- Repeat a second soap and water wash. Phenol maybe difficult to fully decontaminate on scene.

Note: There is no antidote to this exposure, but detailed decontamination will reduce the exposure and reduce the ongoing symptoms. Caution: using only small volumes of water increase absorption by expanding the surface area of exposure.

Advanced Life Support

- Support respiration, control seizures, and ventricular ectopy following the local medical protocols.
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Pediatric Considerations (Phenol)

The same protocols used for adults are appropriate for pediatric patient exposures.

K9 Patient (Phenol)

- Decontamination protocols used for adults and pediatrics are applicable to K9s.
- Decon in a well-ventilated area with all attending personnel wearing appropriate PPE.
- Dermal exposure:
 - Initially, blott the chemical off contaminated skin and hair coat with paper towels or other disposable absorbent materials before washing.
 - Use a neutral pH liquid dish detergent (e.g. Dawn) with copious amounts of water, perform alternating rinse-wash cycles until the odor of phenol is no longer detected on the K9.
- Ingestion:
 - Avoid inducing emesis; Phenol is corrosive and may cause further damage to the esophageal and oral cavity lining if vomited back up, additionally, aspiration of phenol may significantly increase the risk of chemical pneumonitis and acute lung injury.
 - Dilute ingested phenols by administering small amounts of a demulcent agent (egg whites or milk).
 - If available, gastric lavage and administration of activated charcoal are recommended.

Lacrimator

OC (Oleoresin Capsicum), Pepper Spray, and other Lacrimators

DESCRIPTION:

This is not a life-threatening chemical. Pepper spray is a fine solid material that is not water soluble. Secondary contamination to the health care provider is a concern and care needs to be taken to avoid effects to the care provider. Patients with pre-existing reactive airway disease (e.g. asthma) or who are allergic may present with more severe symptoms requiring immediate intervention.

Patient Approach/Evaluation:

- Follow Gateway Protocol for Patient Approach/Evaluation.
- Secondary contamination is a likely issue. Although not life threatening it will hinder the EMS responder's ability to render aid.
- Keep Tetracaine available to treat the eyes and soap and water available for skin decontamination of both the patient and the emergency responder.

Assessment/Treatment:

Since the agent does not cause significant tissue damage the treatment is aimed at decontamination and relieving the pain caused by nerve stimulation.

Basic Life Support

- Immediate eye irrigation to reduce the effects of the chemical and decrease pain.
- Eye irrigation (decontamination) can include the use of whole milk to mix with the oleoresin capsicum and allow it to be washed from the eyes.
- Sudecon Wipes can be used to remove additional irritant spray from surface skin.

Advanced Life Support

- Before applying Tetracaine determine if the patient is allergic to “caine” derivatives
- Apply 2 drops of Tetracaine into each eye.
- When the blepharospasm is relieved, a detailed visual exam can be performed to evaluate for eye trauma.
- Assess for clear lung sounds and blood pressure changes to ensure that sensitivity has not occurred.
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Pediatric Considerations (Lacrimants)

The same protocols used for adults are appropriate for pediatric patient exposures.

K9 Patient (Lacrimants)

- Expose the K9 to fresh air.
- Anesthetize the eyes utilizing topical, ocular anesthetic (Tetracaine).
- Flush eyes copiously with cool water or milk (if available).
- Do not let the K9 rub or scratch at the eyes.

Note: Oil-based residues may persist on the K9s hair coat for long durations; agitation of the residue can cause it to aerosolize and activate, re-exposing and contaminating those around the K9 as well as the K9 itself. In these cases, use a neutral pH liquid dish detergent (i.e. Dawn) with copious amounts of water, until the residues have been “cleaned” from the hair and skin.

ASPHYXIANTS – HZT02

SIMPLE ASPHYXIANTS

DESCRIPTION:

Simple Asphyxiant gases displace oxygen and cause injury and death through suffocation and not by other toxic effects. Examples of common simple asphyxiants are Methane, Nitrogen, and Carbon Dioxide.

Patient Approach/Evaluation:

- Follow Gateway Protocol for Patient Approach/Evaluation.

Assessment/Treatment for simple asphyxiants:

Basic Life Support

- Remove patient from the environment
- Immediately administer 100% oxygen, if unconscious secure airway and deliver 100% oxygen.

Advanced Life Support

- If conscious apply CPAP with a PEEP setting of ≥ 10 cm of H₂O
- If unconscious, apply PPV using a PEEP valve set at greater than 10 cm of H₂O
- Secure an advanced airway if needed.
- Start IV of 1000cc Normal Saline at a KVO rate.
- Follow general medical protocol - treat symptoms.
- Goal is to maintain Oximetry >94% and Capnography between 35-45mm/Hg.
- Contact receiving hospital and provide **HazMat Alert**.

Pediatric Considerations (simple asphyxiants)

The same protocols used for adults are appropriate for pediatric patient exposures.

K9 Patient

- Remove the K9 from the environment and into a well-ventilated area.
- Immediately administer 100% oxygen via face mask or muzzle-based oxygen using nasal cannulas (see photo). If unconscious, place and secure an advanced airway (endotracheal tube) and deliver 100% oxygen via BVM.



Nasal Cannula affixed to open basket muzzle (Photo courtesy of Dr. Lee Palmer)



Endotracheal tube with open basket muzzle (Photo courtesy of Dr. Lee Palmer)

CHEMICAL ASPHYXIANTS

- **Carbon Monoxide**
- **Cyanide**
- **Hydrogen Sulfide**
- **Nitrate/Nitrite**

Chemical asphyxiants interfere with either the movement of oxygen within the blood or the use of oxygen in the cells to produce energy. The end results of an exposure to a chemical asphyxiate is cellular hypoxia, anaerobic metabolism, metabolic acidosis, and death. Some chemical asphyxiates can be ingested, absorbed through the skin and eye, or inhaled to cause hypoxia.

Carbon Monoxide

Carbon monoxide is generated when organic compounds burn. This includes smoke from fires, internal combustion engine exhaust, and fuel powered heaters. It is often associated with malfunctioning or obstructed exhaust systems.

DESCRIPTION:

Colorless, odorless, tasteless, non-irritating gas. Has a much greater affinity to hemoglobin than oxygen and blocks future bonding of oxygen. The bond between carbon monoxide and hemoglobin forms a compound called carboxyhemoglobin. Carboxyhemoglobin is a non-oxygen carrying compound causing chemical asphyxiation. Because carboxyhemoglobin is bright red in color and the patient may not look cyanotic. The pulse oximeter will not accurately indicate the presence of CO (e.g. indicates a false high oxygen saturation) due to the inability of the pulse oximetry sensors to distinguish hemoglobin from carboxyhemoglobin.

Patient Approach/Evaluation:

- **Remove the patient from the environment.**
- Follow Gateway Protocol on the initial patient approach/evaluation.

Assessment/Treatment:

Basic Life Support

- Immediately administer 100% oxygen if intubated or as high a concentration of oxygen as possible with a non-rebreather mask if conscious, if unconscious secure airway to deliver 100% oxygen.
- Capnography to determine appropriate cellular metabolism (between 35 and 45 mm/Hg)

Advanced Life Support

- If the patient is unconscious secure an advanced airway.
- Provide CPAP if conscious and PPV if unconscious utilizing a Positive End Expiratory Valve (PEEP) set at ≥ 10 cm of H₂O.
- Start IV to KVO.
- Treat unconscious patients by evaluating Glucose levels and administration of naloxone (Narcan) 2 mg IVP, IO, IM, or intranasal every 3-5 minutes up to 8mg.

- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Note: *A carboxyhemoglobin of 9% in a pregnant female can be enough to cause fetal hypoxia. Although the patient may not display critical signs, the fetus may be in critical condition. Immediate transport to a medical facility is necessary.*

Pediatric Considerations (Carbon Monoxide)

Note: Pediatric patients will always have more severe effect compared to adults in the same environment due to their higher metabolism.

- Apply CPAP after exposure to carbon monoxide to reduce the half-life of carboxyhemoglobin.
- When providing CPAP to pediatric patients always start the PEEP setting at low pressures of 5 cm H₂O. Then increase it in increments of 1 cm H₂O, as tolerated by the patient.
- In patients less than 12 years old the maximum PEEP should be 15 cm H₂O.
- For patient 12 years old and above the maximum PEEP could be increased to as high as 20 cm H₂O if tolerated.

K9 Patient:

- **Administer high-flow oxygen if exposure is suspected. Oxygen can be administered via a canine oxygen face mask, nasal cannula, or delivered via endotracheal tube and BVM.**
 - **Place an advanced airway (ET Tube) if unconscious: Positive end-expiratory pressure should be initiated at 3-5mmHg, not exceed 10mmHg.**
- **Start CPR if the K9 stops breathing.**
- **Obtain IV/IO access and start IV/IO fluid therapy with 0.9% NaCl or Lactated Ringers Solution at 2-3 mL/kg/h. Fluid therapy is required to maintain adequate tissue perfusion and to avoid drying and thickening of airway secretions. Avoid overhydrating: this may lead to increased pulmonary pressure and pulmonary vascular leakage (pulmonary edema).**
- **Consider bronchodilator therapy to control bronchoconstriction and spasms. Options include:**
 - **Terbutaline 0.01 mg/kg SC, IM, IV q 6-12 hours.**
 - **Albuterol (0.83 mg/mL or 2.5 mg/3 ml) nebulize 2.5 mg or 3mL.**

CYANIDE AND HYDROGEN SULFIDE

Both of these chemicals bond with the enzyme Cytochrome C Oxidase found in the mitochondria of each cell. This enzyme is necessary for cellular combustion (respiration). Without the use of this enzyme the cell is not able to undergo aerobic cellular metabolism.

Cyanide

DESCRIPTION:

Cyanide is one of the most rapidly acting poisons. It is reported that patients exposed to Cyanide smell like “bitter almonds” (benzaldehyde) to those that are genetically capable of detecting the odor. Pulse oximetry will accurately indicate an unusually high saturation of oxygen due to the cell’s inability to pick up oxygen from the blood stream. Causes cellular hypoxia by interfering with the cellular enzyme, Cytochrome C Oxidase.

Hydrogen Sulfide

DESCRIPTION:

Hydrogen Sulfide is also known as Sewer Gas. It has a distinctive smell of rotten eggs but may quickly exceed its odor threshold causing olfactory fatigue (loss of the ability to smell). Formed naturally from the decomposition of organic substances. It is slightly heavier than air and tends to gather in low lying areas and confined spaces. Causes cellular hypoxia and decreased cellular metabolism by interfering with the cellular enzyme, Cytochrome C Oxidase.

Patient Approach/Evaluation:

- Follow Gateway Protocol for Patient Approach/Evaluation.
- Cyanide and Hydrogen Sulfide are the fastest and some of the most toxic chemicals. Exercise extreme caution when evaluating patients exposed to either of these chemicals.
- Respiratory protection is warranted when intubation is required.
- With ingestion of cyanide respiratory protection may be required as “toxic burps” may ensue during emergency medical procedures.

Assessment and Treatment:

Basic Life Support

- Support respirations and provide 100% oxygen via non-rebreather (NRB) mask.
- If the patient is not breathing immediately begin CPR and other supportive measures.

Advanced Life Support

- If the patient is conscious with hypoxia consider CPAP at 100% oxygen with the PEEP setting $\geq 10\text{cm}/\text{H}_2\text{O}$.
- If unconscious or not breathing, provide an advanced airway and positive pressure ventilations. Consider the use of a PEEP valve on the BVM with a setting of 10-15 $\text{cm}/\text{H}_2\text{O}$.
- Prepare to give one of the two available cyanide antidotes.
 - The CyanoKit is preferred for confirmed Cyanide poisoning or smoke inhalation:
 - CyanoKit (Hydroxocobalamin 5 Gm)

- The CyanoKit will **NOT** work on a patient poisoned with Hydrogen Sulfide.
- For Hydrogen Sulfide or Cyanide:
 - (Lily or Pasadena) *Nitrite-based Cyanide Antidote Kit*.

Note: Never give the Nitrite based Cyanide Antidote Kit for smoke inhalation patients who may be compromised with elevated levels of carboxyhemoglobin and methemoglobin.

CyanoKit – Hydroxocobalamin (preferred treatment for Cyanide Poisoning)

Give 5 grams Hydroxocobalamin IV infusion over 15 minutes.

- Start a dedicated IV line.
- Reconstitute the 5 gram vial with 200 ml of 0.9% Sodium Chloride. (Lactated Ringers and D5W can also be used if Sodium Chloride is not available). Renders 25mg/ml.
- Invert or rock the vial. Do not shake.
- Administer 5 grams over 15 minutes (~15 ml/min). An additional 5 gm dose may be administered if necessary

(Lilly or Pasadena) Nitrite-based Cyanide Antidote Kit (used for Hydrogen Sulfide or Cyanide if the Cyanokit is not available)

- Cyanide Antidote Kit (3 Step Process)
 - Step 1 – Amyl Nitrite Pearls ($C_5H_{11}NO_2$) – Broken and held under the patient's nose (may not be available).

Note: Amyl Nitrite is being removed from the market and may not be available in the near future. If this occurs go directly to Step 2.

- Allow the patient to breathe the vapors for 15-30 seconds of every minute.
- Between the breathing of Amyl Nitrite provide patient with 100% oxygen.
- If the patient is not breathing place the pearls in a Bag Valve Mask to be used during ventilation.
- Do not allow the use of this step to delay IV access.
- Amyl Nitrite converts about 5% of the hemoglobin to methemoglobin.
- Step 2 – establish an IV of normal saline and immediately give:
 - IV Sodium nitrite ($NaNO_2$) 10 ml of a 3% solution over 2 minutes while closely monitoring the patient's blood pressure.
 - Sodium Nitrite converts approximately 20% of the circulating hemoglobin to Methemoglobin. Methemoglobin bonds with both Cyanide and Sulfide and is excreted in the urine.
- Step 3
 - IV Sodium Thiosulfate ($Na_2S_2O_3$): 50 ml of a 25% solution over 10 minutes.
 - Do not complete this step for Hydrogen Sulfide. There is NO benefit to providing Sodium Thiosulfate.

Note: The use of Amyl Nitrite and Sodium Nitrite cause approximately 25% of the hemoglobin to be converted to methemoglobin. Therefore, 25% of the hemoglobin will not carry oxygen. Securing an advanced airway and providing 100% oxygen is critically important.

- Contact receiving hospital and Regional Poison Control Center and provide **HazMat Alert**.

Pediatric Consideration (Cyanide/Hydrogen Sulfide)

CyanoKit – Hydroxocobalamin

- The safety and effectiveness of the Cyanokit have not been established in the pediatric population (per package insert). The CyanoKit has been successfully used in the non-US market at a dose of 70 mg/kg to treat pediatric patients.

Cyanide Antidote Kit – Lilly or Pasadena Kit

- Use with great caution in Children— Sodium nitrite (NaNO_2) 10ml of a 3% solution administer 0.33 ml / kg of a 3% solution over 10 minutes.
- Sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) 50 ml of a 25% solution over 10 minutes. Monitor BP
- Children— Administer 1.65 ml / kg up to 50 ml over 10 minutes.

K9 Patient

Just like an adult or child, treatment of a Canine must begin immediately. It is vitally important to stop the bonding of cyanide to cytochrome c oxidase. This will reestablish cellular metabolism. Treatment options include:

- **Option 1: (preferred)**
 - **Hydroxocobalamin 150 mg/kg over 10-15 minutes.**

OR

- **Option 2:**
 - **3% Sodium Nitrite (NaNO_2): 16-22 mg/kg IV; followed by:**
 - **20-25% Sodium Thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3$): 500 mg/kg IV (Oruc1HH, et al., 2006) or 1.65 mL of a 25% solution administered IV over 10-15 minutes.**
 - **Repeat NaNO_2 and $\text{Na}_2\text{S}_2\text{O}_3$ at $\frac{1}{2}$ the initial dose listed above 30 minutes after initial dose if clinical response is not observed.**

Note: Supplemental oxygen in combination with sodium thiosulfate alone, has been shown to be effective for treating combined CO + CN exposures. (P H Breen et al., 1995; C J Vesey et al., 1985).

METHEMOGLOBIN GENERATORS

Aniline Dyes, Nitrates, Nitrites, and Nitrobenzene

DESCRIPTION:

Both accidental and intentional exposures occur. Nitrates/Nitrites are found in fertilizers, paints, inks, medication, dyes and chemicals abused for inhalation. Changes hemoglobin into a non-oxygen carrying compound; methemoglobin. Masimo, Rainbow should be used when possible to ascertain the percentage of Methemoglobin in the circulating blood.

Patient Approach/Evaluation:

- Follow the gateway protocols for the patient approach and evaluation.
- Expect a false low reading of Oxygen Saturation on the Pulse Oximetry

Assessment/Treatment of methemoglobinemia:

Basic Life Support

- Immediately administer 100% oxygen if conscious, if unconscious secure airway to deliver 100% oxygen.
- Do not rely on the pulse oximeter as the darker colored methemoglobin will create a false low reading.

Advanced Life Support

- Masimo/Rainbow technology can assess the level of Methemoglobin and provide guidance for further treatment
- If conscious place the patient on Continuous Positive Airway Pressure (CPAP) with the PEEP setting at or above 10 cm of H₂O.
- Assess cellular respiration by evaluating the end tidal CO₂ (Capnography).
- If unconscious or not breathing secure an advanced airway and use PPV with a PEEP valve set above 10 cm of H₂O.
- Start 2 - IVs of 1000cc normal saline utilizing large bore catheters.
- If hypotensive, position patient and reassess the blood pressure.
- If needed provide a fluid challenge.
- If still unable to maintain BP administer
Epinephrine **or** Dopamine **or** Norepinephrine to maintain a systolic pressure of greater than 70 - 90mm/Hg.
 - Epinephrine
 - Push Dose epinephrine 1:100,000 (10mcg/mL).
 - Dilute: Discard 9 mL of Epi 1:10,000 and draw up 9 mL of Normal Saline to create Epi (1:100,000) in 10 mL solution for 10 mcg/mL.
 - Administer: 1mL slowly over 30 seconds IV/IO.
 - May repeat every 1-2min for a max 3 doses.
 - Max total dose 30mcg (3mL).
 - Titrate to MAP at least 70 mmHg.

Or

- Dopamine:
 - Mix 400mg in a 250ml bag of 0.9% D5W = 1600 mcg/ml.
 - Provide an IV infusion rate of 5mcg/Kg/min.
 - If this does not improve the BP the infusion rate can be increased to

10mcg/Kg/min.

Or

- Levophed (norepinephrine):
 - 8-12 mcg/min titrated to maintain systolic BP higher than 90 mm/Hg.
- If symptomatic and methemoglobinemia can be confirmed, then:
- Administer methylene blue, 1 to 2mg / kg IVP over 5 minutes. (methylene blue may momentarily affect the pulse oximeter because of the opaqueness of the drug). Dose may be repeated once not to exceed 7 mg/kg. Must be used with caution or not used in patients with G6PD deficiency.

Note: Methylene blue will turn sweat, secretions and urine green in color.

Note: methylene blue must be used with caution or not considered at all in patients with G6PD deficiency. G6PD deficiency is a genetic abnormality that results in an inadequate amount of glucose-6-phosphate dehydrogenase (G6PD) in the blood. Hemolytic anemia develops when red blood cells are destroyed faster than the body can replace them, resulting in reduced oxygen flow to the organs and tissues.

- Contact receiving hospital and Regional Poison Control Center and provide **HazMat Alert**.

Pediatric Consideration (Methemoglobin)

The same protocols used for adults are appropriate for pediatric patient exposures.

- Provide 1-2mg of 1% Methylene Blue IV push over 5 minutes.

K9 Patient

- **Treatment:**
 - **Methylene Blue can be administered using careful dosing, additional fluid therapy, and post treatment monitoring.**
 - **If exposure to a nitrate/nitrite can be confirmed and there is significant evidence of exposure/methemoglobinemia give:**
 - **1% Methylene Blue - Slow IV injection (over several minutes) at 1 – 4 mg/kg once.**
 - **Improvement in clinical parameters should be noted within 30 minutes of administration.**
 - **Provide oxygen supplementation to maximize oxygenation of remaining normal hemoglobin.**
 - **Provide IV fluid to maintain cardiovascular support, correct electrolyte and acid/base abnormalities, and protect the kidneys if hemolysis is present.**

CHOLINERGIC – HZT03

ORGANOPHOSPHATE (OP) AND CARBAMATE POISONING

DESCRIPTION:

These insecticides can enter through all routes. They bind with the enzyme acetylcholinesterase that is necessary to remove acetylcholine (neurotransmitter) from the synapse. The chronic presence of acetylcholine in the neuropathway causes overstimulation of primarily the parasympathetic nervous system (although the CNS and Somatic Systems are affected to a lesser degree).

Patient Approach/Evaluation:

- Follow the Gateway Protocols for patient approach and evaluation.

Assessment/Treatment:

Basic Life Support

- Immediately provide 100% oxygen using a non-rebreather mask.
- Be aware of excessive mucous production and suction as needed.
- Assess vital signs paying particular attention to both blood pressure and respirations.
- Ensure the use of PPE to avoid secondary contamination from vomit, urine, or feces.
- Significant secondary exposure from airborne organophosphates is rare unless the exposure is from a weaponized form of the chemical.
- If dermally exposed start immediate decontamination to terminate the exposure

Advanced Life Support

- Start IV with normal saline and give:
 - If symptomatic give atropine 2-6mg IVP until Atropinization (drying pulmonary secretions, relieve bronchoconstriction, normalize heart rate/BP) occurs.
 - There is not a maximum dose; use what it takes to dry pulmonary secretions, relieve bronchoconstriction and reverse hemodynamically significant bradycardia. Use extreme caution in a hypoxic patient (giving atropine to hypoxic heart may stimulate critical arrhythmias).
 - Atropine should ONLY be given if muscarinic (DUMBELS or SLUDGE) effects are seen. It is NOT effective for nicotinic effects (muscle fasciculation/ weakness/ paralysis) .
 - Pralidoxime (2-PAM, Protopam Chloride) IVP 1Gm over no less than 5 minutes to remove insecticide from acetylcholinesterase and treat nicotinic symptoms
 - Pralidoxime may also be given IM as well (300mg/ml – give 600mg in 2 ml. May give a second dose after 15 minutes. (NOT USED IN CARBAMATE POISONING)
 - If seizures occur post exposure or the patient experiences excessive anxiety give:
 - Diazepam (Valium) 10mg IV/IO/IM. Maximum dosage 20mg.
 - Midazolam (Versed) 2.5 mg IV/IO. Repeat at 2 minute intervals to a maximum dosage of 10mg.
- If Atropine and Pralidoxime are given via a Mark 1 kit or DuoDote kit:

- 1 Mark 1 = 1 DuoDote
- For mild symptoms (eye pain, miosis) no dosing needed
- For moderate symptoms (sweating, systemic symptoms without intubation (twitching vomiting, weakness) give 2 kits and repeat in 5 minutes.
- For severe systemic symptoms with intubation (unconscious, seizures, apnea, flaccid paralysis, significant bronchorrhea,) give 3 kits.
- If seizures follow the exposure give:
 - Midazolam (Versed) IV/IO 2.5 mg. Repeat at 2 minute intervals to a maximum dosage of 10mg **or**
 - Lorazepam (Ativan) 4 mg IV at a rate of 2 mg/min. May repeat in 5-10 minutes.
- If the patient is wheezing or if Capnogram indicates a shark fin pattern:
 - Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) and/or Ipratropium Bromide (Atrovent).
 - Albuterol 2.5mg (0.5mL of 0.5% diluted to 3mL with sterile normal saline) give via nebulizer. May be repeated 3 times.
 - Ipratropium Bromide 0.5mg (500 mcg)/2.5 ml via nebulizer repeat at 20 minute intervals for a total of 3 doses (usually only one dose given in the field).
 - Administer methylprednisolone (Solu-Medrol) 125 mg, IVP slowly.
 - Monitor heart rate. Contact medical control if HR over 150 bpm.
- Consider the administration of Brethine/Terbutaline Subcutaneous Injection.
 - Brethine (Terbutaline sulfate) 0.5 mg given subcutaneous injection. (0.5ml of a 1mg/ml solution).
- Contact receiving hospital, Poison Control Center, and provide **HazMat Alert**.

Note: Although the symptoms presented by Carbamate toxicity are similar to Organophosphate, the amount of Atropine needed for treatment is usually reduced to 0.4 – 1 mg every 15-20 minutes and Pralidoxime is not used unless muscle weakness/paralysis is evident.

Pediatric Considerations

Pediatric dose:

- Atropine 0.05 mg/kg IV/IO push or IM, min 0.1 mg, max 5 mg. initial dosing should be given as soon as possible. (1 Gm mixed in 20 ml N.S. = 50 mg/ml solution)
- Pralidoxime (2-PAM), 25 mg/kg IV or IM (max 1 gm IV, 2 gm IM) over 5 – 10 minutes. Dose may be repeated in 30 – 60 minutes (1 – 2 doses) for weakness or high Atropine requirements. (NOT USED IN CARBAMATE POISONING)
- If seizures occur post exposure or the patient suffers from extreme anxiety, consider the administration of:
 - Diazepam (Valium) 0.2mg/Kg. IV/IO/IM
 - or**
 - Midazolam (Versed) 0.1 mg/Kg IV/IO. Repeat at 2-minute intervals to a maximum dosage of 0.6 mg/Kg.
 - or**
 - Lorazepam (Ativan) 0.05mg/kg IV, can be repeated after 10-15 minutes

Mark 1/DuoDote

- Mark 1 and DuoDote should probably NOT be used in children as the Atropine dose is too high. The Pralidoxime 600 mg (Mark 1 kit) can be used. Use AtroPen for pediatrics.

AtroPen

- Give one dose of 1mg and repeat to control symptoms.

K9 Patient

- Decontaminate for NERVE AGENT EXPOSURE, to include organophosphate and carbamate insecticide toxicity.
 - Recognize the signs of nerve agent, organophosphate, and carbamate toxicity. Common signs are easily remembered using the mnemonic, SLUDDE.
 - (1) Excessive *salivation* and drooling.
 - (2) Uncontrolled *lacrimation* (tearing).
 - (3) Uncontrolled *urination*.
 - (4) Uncontrolled *defecation or diarrhea*.
 - (5) Uncontrolled *emesis*
 - (6) Rapid breathing, panting, or severe respiratory distress.
 - (7) Muscle twitching.
 - i. Muscle twitching usually begins with the face and progresses over the entire body and becomes much more severe.
 - ii. Attempted walking becomes stiff and jerky.
 - (8) Convulsions, seizures, or collapse.
 - (9) Odor of pesticides on the hair coat.
 - Decontaminate the skin and hair coat immediately following nerve agent contamination to slow penetration of liquid agents through the skin.
 - (1) Decontaminate the skin and hair coat using the *Reactive Skin Decontaminant Lotion (RSDL)* skin decontamination kit first.
 - (2) Wipe down the entire dog avoiding the area around the eyes. Follow with soap and water bath.
 - (3) If a RSDL not available, bathe the K9 with soap and water.
 - (i) If soap is not available, rinse the dog with copious amounts of water.
 - Decontaminate the eyes by rinsing with generous amounts of water or crystalloid fluid until the agent has been removed.
 - Consider a dilute bleach (0.5% hypochlorite) paw +/- body rinse/bathe, waiting 10 minutes, and then a water rinse to further reduce or destroy the level of any remaining nerve agent contaminant.
 - Properly dispose of and replace all contaminated collars, leashes, muzzles, cages, bowls, and other contaminated items. If items cannot be replaced, disinfect all contaminated inanimate objects in 0.5% hypochlorite (10-minute contact time) and thoroughly rinse with water.
 - Administer drugs to control nerve agent toxicity, if signs described above are noted.
 - (1) Using the Mark 1 Nerve Agent Antidote Kit

- i. Administer atropine AND 2 pralidoxime (2-PAM) auto-injectors intramuscularly into the K9;s back (epaxial) muscles (the band of muscles on either side of the lumbar spinal cord)
- ii. Hold the injector firmly in place for at least 10 seconds; massage the injection sites after administration, if time permits
- iii. Mark 1 auto-injector contains an Atropine injector alongside a 2-PAM injector. Each auto-injector contains:
 - (i) 2 mg Atropine
 - (ii) 600 mg 2-PAM
- iv. K9 dosing for cholinergic (nerve agent) toxicity:
 - (i) Atropine: 0.2 – 0.5 mg/kg IM every 3 to 4 hours as needed
 - i. When feasible, repeated doses should be lower (0.1 mg/kg) and given as needed based on a combination of signs
 - (ii) 2-PAM: 10 – 20 mg/kg IM every 8 to 12 hours as needed
 - i. 2-PAM is only effective if used within the first 24 to 36 hours of exposure
 - (iii) Always consider using the lower end of the dose, and repeat as necessary if clinical signs persist

Alternate Atropine + 2 pralidoxime (2-PAM) Auto-injectors

- ATNAA “Antidote Treatment, Nerve Agent Auto-injector”
- DuoDote® Auto-injector
- Atropen® Auto-injector (Atropine only)

NOTE: Mark I is being replaced with Antidote Treatment, Nerve Agent Auto-injector (ATNAA) as supplies of the Mark 1 are expended. The Antidote Treatment-Nerve Agent Auto-Injector (ATNAA) contains 2.1 mg of atropine and 600 mg of pralidoxime chloride in a single injector. If this new kit is the kit you are carrying for your K9, inject the contents of the auto-injectors into your K9 as described above for the Mark I.

K9 ATROPINE DOSING CHART

Weight (lb)	Weight (kg)	Dose range (mg)	Min. # Injectors
40	18	3.6 – 9.0	2
50	22.7	4.5 – 11.4	2
60	27	5.4 – 13.5	2
70	32	6.4 – 16	3
80	36	7.2 – 18	3
90	41	8.2 – 20.5	4

K9 2-PAM CL DOSING CHART

Weight (lb)	Weight (kg)	Dose range (mg)	Min. # Injectors
40	18	180 – 360	2
50	22.7	227 – 450	2
60	27	270 – 540	2
70	32	320 – 640	3
80	36	360 – 720	3
90	41	410 – 820	

(Tables provided by Dr. Lee Palmer)

- Monitor the K9's response to administration of the atropine and pralidoxime.
 - (1) If the K9 continues to show severe signs of intoxication, or signs return, then give another intramuscular injection of atropine AND pralidoxime every 10-20 minutes.

OP- NERVE AGENT-INDUCED SEIZURES

- a. Convulsant Antidote for Nerve Agent (CANA) auto-injector:
 - (1) Contains 10mg diazepam for intramuscular administration to control nerve agent induced seizures
 - (2) Indication: Administer to OpK9s that are having convulsions or seizing
 - (3) Dose:
 - i. Administer Convulsant Antidote for Nerve Agent (CANA) auto-injector intramuscularly into the dog's back (epaxial) muscles (the band of muscles on either side of the lumbar spinal cord).
 - ii. If seizures continue, administer one CANA every 5-10 minutes until seizures have ceased.

Note: If available, Intravenous administration of diazepam is the preferable route for treatment of seizures

- Dose: 0.25 – 0.5 mg/kg IV or IO (Do not give IM)
 - Repeat every 5- 10 minutes as needed up to a max of 3 doses
- Midazolan (Versed) IV/IM/IO/IN is considered a more effective benzodiazepine as compared to diazepam (Valium).
 - Dose: 0.25 – 0.5 mg/kg IV or IO.
 - Repeat every 5- 10 minutes as needed up to a max of 3 doses.

HYDROCARBONS AND DERIVATIVES – HZT04

HYDROCARBON AND HALOGENATED HYDROCARBONS

DESCRIPTION:

Hydrocarbons exist in all states of matter. Hydrocarbon gases have the ability to displace oxygen causing an asphyxiating atmosphere. Non-halogenated hydrocarbons are also flammable or combustible some creating an explosive atmosphere. Exposures to these hydrocarbons cause Central Nervous System depression and an anesthetic state. In addition, hydrocarbons can cause myocardial excitation and sensitization. Epinephrine and other catecholamines should be avoided post exposure as the heart is sensitized to these chemicals by the hydrocarbons.

Patient Approach/Evaluation:

- Follow the Gateway Protocols for the patient approach and evaluation.
- Most of these hydrocarbons are flammable or combustible so exercise great care with any equipment that may generate a spark or flame.
- Expect delayed pulmonary involvement.

Assessment/Treatment:

Basic Life Support

- Provide a complete assessment including cardiac monitoring and respiratory status.
- If an inhalation injury has taken place provide 100% oxygen utilizing a non-rebreather mask.
- Decontamination of the patient should be performed for dermal exposures.
- Position patient to prevent aspiration in case of vomiting.

Advanced Life Support

- Maintain adequate ventilation and oxygenation
 - Assess:
 - Oximetry
 - Capnography
 - EKG
- If Acute Bronchoconstriction (wheezing):
 - Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) or/and Ipratropium bromide (Atrovent).
 - Albuterol 2.5 mg (0.5ml or 0.5% diluted into 3ml normal saline) give via nebulizer. May repeat 3 times at 20-minute intervals.
 - Ipratropium Bromide 0.5mg (500 mcg) 2.5ml via nebulizer, repeat at 20-minute intervals for a total of 3 doses. May be repeated up to 3 times at 20-minute intervals.

Note: Albuterol should be used with great caution as it can exacerbate myocardial irritability.

- Administer methylprednisolone (Solu-Medrol) 125mg, IVP slowly.
 - Monitor heart rate. Contact medical control if HR over 150 bpm.
- Consider the administration of Brethine/Terbutaline Subcutaneous Injection, if cardiac rate or irritability is of concern
 - Brethine (Terbutaline sulfate) 0.5 mg given subcutaneous injection. (0.5ml of a 1mg/ml solution).
- If oxygen saturation is below 92% provide oxygen via Continuous Positive Airway Pressure (CPAP).
- Provide advanced monitoring evaluating End Tidal CO₂ ensuring a reading of between 35-45mm/Hg and monitoring the wave form for the occurrence of a shark fin pattern.
- If Rales or Rhonchi are noted on auscultation and the Oximetry or Capnography reflect negative changes.
 - Maintain Continuous Positive Airway Pressure (CPAP) and set the Positive End Expiratory Pressure (PEEP) setting above 10cm of H₂O.
 - Consider NTG, Morphine, or Lasix administration to reduce the pulmonary pressure and decrease the influx of fluid into the alveoli.
- Provide advanced airway if needed.
- If Supraventricular Tachycardia occurs secondary to hydrocarbon exposure:
 - Administer Adenocard (adenosine)
 - 6 mg of adenosine is given rapid IV push followed by a 20 ml syringe bolus of 0.9% normal saline.
 - If no conversion within 1-2 minutes give 12 mg IVP, repeat second time if necessary (30 mg total).
 - Consider Diltiazem (Cartizem) 0.25 mg/kg IV/IO bolus over 2 minutes.
 - A second bolus of 0.35 mg/kg may be used if necessary.
 - If Supraventricular Tachycardia occurs give:
 - Esmolol (Brevibloc) 0.2-0.5 mg/kg IVP q5 minutes PRN **or**
 - Procainamide 5-15 mg/kg IVP with maintenance drip of 20-50 mcg/kg/min. (Loading dose: 15-18 mg/kg administered as a slow infusion over 25-30 minutes or 100 mg/dose at a rate not to exceed 50 mg/minute repeated every 5 minutes as needed to a total dose of 1 gram)
- If seizures occur post exposure or the patient suffers from extreme anxiety administer:
 - Diazepam (Valium) 10mg IV/IO/IM. Maximum dosage 20mg **or**
 - Midazolam (Versed) 2.5 mg IV/IO. Repeat at 2-minute intervals to a maximum dosage of 10mg **or**
 - Lorazepam (Ativan) 2 mg IM/IV/IO and can be repeated after 5-10 minutes
- If evidence of suicide attempt, overdose, and/or respiratory depression in the setting of a decreased level of consciousness administer (with suspect opioid history):
 - Naloxone (Narcan)
 - Adult dose: 2mg IVP, IO, IM, or intranasal every 3-5 minutes up to 8mg.
- Contact receiving hospital, Poison Control, and provide **HazMat Alert**.

Pediatric Considerations

- Monitor both cardiac and respiratory status.
- If bronchiole construction (wheezing) occurs administer:

Note: Administration of a nebulized Inhalation Solution is not recommended for Pediatrics less than 2 years old.

- Albuterol (Proventil or Ventolin) - 2-12 years old less than 15 kg: give one 3 ml unit-dose vial of 1.25 mg by nebulizer (5-15 minutes)
 - 13 and older get adult dose
- Ipratropium Bromide 0.02% (Atrovent) - Administered at an adult dose by nebulizer but the number of overall doses is reduced to 2. Only one should be given in the field.
- Monitor the EKG closely for cardiac irritability (ectopy).
- Solu-Medrol (methylprednisolone) – 2 mg/kg not to exceed 60 mg dose, IV. Give only one dose in the field.

Note: to provide CPAP to a pediatric patient the correct mask must be available. If the patient is not breathing, you must have a pediatric BVM with an integrated PEEP valve or an inline supplemental PEEP valve available.

K9 Patient

In K9s, the most acute life-threatening sequel of petroleum intoxication is the risk of aspiration pneumonia.

- **DO NOT INDUCE VOMITING.**
- **Copiously flush the mouth with water to remove the petroleum residue.**
- **Dermal decontamination consists of copiously washing hair coat and skin with warm water and a neutral pH or mild liquid dish detergent (e.g. Dawn) or shampoo. Monitor respiratory and cardiovascular vital signs and provide supportive treatment.**
- **Provide oxygen as needed based on clinical signs.**

HYDROCARBON DERIVATIVES/ ALCOHOLS

- **Ethylene Glycol**
- **Propylene Glycol**
- **Methanol & Isopropyl Alcohol**

DESCRIPTION:

This group includes the ingestion of these alcohols for the purposes of intoxication or suicide. In the case of ingestion of ethylene glycol the body forms glycolic acid and oxalic acid causing acidosis and forming calcium oxalate crystals in the urine leading to kidney injury or stroke resulting in systems failure. Crystal formation in tissues and severe metabolic effects may result in irreversible brain damage. The formation of these crystals depletes the calcium found in the blood and affects the repolarization of the heart muscle. Hypocalcemia can be worsened by the administration of Sodium Bicarbonate. Methanol causes the formation of formic acid which leads to severe acidosis and permanent damage to the retina. All produce CNS depression, with isopropyl producing the most. Isopropyl alcohol will cause the production of acetone in the body and can result in severe CNS depression and hypotension with significant ingestions. Actions of methanol and ethylene glycol will be delayed 4-12 hours with exception of its CNS depression which will onset quickly.

Patient Approach/Evaluation:

- Follow Gateway Protocol for Patient Approach/Evaluation.
- These poisonings are usually the result of intentionally drinking these alcohols for the purpose of getting intoxicated. Use caution and protect yourself from projectile vomiting.

Assessment and Treatment:

Basic Life Support

- Support respirations and provide 100% oxygen via non-rebreather (NRB) mask.
- If the patient is not breathing immediately begin CPR and other supportive measures.

Advanced Life Support

- Assess and treat any cardiac dysrhythmia.
- Administer 50 mEq of 8.4% Sodium Bicarbonate (50ml) IV.
- Administer Thiamine 100mg IV for ethylene glycol exposures
- Administer Pyridoxine 1mg/Kg IV for ethylene glycol exposures
- Administer folic acid 50 mg for methanol exposures
- If an elongated QT (QTc) interval is noted on the EKG (indicating hypocalcemia), administer 10ml/10% Calcium Chloride or 10ml/10% Calcium Gluconate IV.
- Antidote is fomepizole (Antizole) or if unavailable, Ethanol 10% 8ml/kg IV or Ethanol 20% 4ml/Kg PO if available (Whisky, Vodka, or Gin may be substituted in an emergency situation) can be used. If transport time is short, this therapy should be reserved for health

care facility. In cases of severe acidosis, renal failure, etc. from late presenting patients, this modality will not be of much help.

- Activate a HazMat Alert to the receiving facility.

K9 Patient:

- Consider inducing emesis, if exposure was recent (< 15 minutes) AND no clinical signs of intoxication are apparent; avoid emesis if clinical signs are present to avoid the risk of aspiration.
- Provide IV fluid therapy for diuresis, maintenance of hydration, and correction of acid-base and electrolyte disorders.

Ethylene Glycol (EG) Treatment:

- Option 1: Ethanol: Ethanol has a high affinity for alcohol dehydrogenase and competes with EG and slows the metabolism of EG. Of note, ethanol enhances many of the alcohol-related clinical signs associated with EG toxicosis (e.g. nausea, vomiting, CNS depression, and metabolic acidosis).
 - **Intravenous Ethanol:** Because of its short half-life, it is better to administer ethanol IV q 4 h or as an infusion. The following are different IV protocols for ethanol administration:
 - Ethanol 7% solution with 5% dextrose in 0.9% NaCl: Administer 8.6 mL/kg slowly IV followed by 1.43 mL/kg/h IV for at least 36 – 48 hrs.

OR

 - Ethanol 20% solution: Administer 5.5 mL/kg IV q 4 h for 5 treatments, then q 6 h for 4 treatments.

OR

 - Ethanol 30% solution: Administer 1.3 mL/kg IV as a bolus, followed by 0.42 mL/kg/h IV for 48 hrs. (Ref: Thrall MA, Connally HE, Grauer GF, et al: Ethylene glycol. Small Animal Toxicology, 3rd ed. St. Louis, MO: Elsevier/Saunders 2013 pp. 551–567). (Adapted from Veterinary Information Network, Ethylene Glycol Toxicosis Canine Associate, February 2016. Sharon Gwaltney-Brant available at: <https://www.vin.com/Members/Associate/Associate.plx?DiseaseId=1216>)
- **Oral Ethanol:** Administer ethanol orally when IV administration is not feasible; gastric irritation and gagging during administration may result in vomiting.
 - Dose: 1-1.4 mL/kg of an 80-proof (40% ethanol) alcoholic beverage.

Note: To determine how much ethanol to add to a bag of IV fluid (5% dextrose in 0.9% NaCl) to make a X% solution, use this formula: (Adapted from Veterinary Information Network, Ethylene Glycol Toxicosis Canine Associate, February 2016. Sharon Gwaltney-Brant, available at: <https://www.vin.com/Members/Associate/Associate.plx?DiseaseId=1216>)

1. *X% divided by the % ethanol in stock solution(S) x the number (N) of mL of final stock solution= mL of stock ethanol to use (Y), i.e. $X\% / S\% \times N = Y$*
2. *Remove the above calculated volume of fluid from the IV fluid bag and replace it with the same volume of vodka or other alcohol solution.*
3. *Remember to divide "proof" by 2 to get % ethanol (e.g. 80-proof vodka is 40% ethanol).*

To make 1L of 7% ethanol solution out of a 40% (80 proof) vodka solution:

- a. $(7\% / 40\%) \times 1000 \text{ mL} = 175 \text{ mL}$*
- b. Remove 175 mL of the fluid from the 1L bag and replace it with 175 mL of the vodka.*
- 4. If using 80-proof vodka (40% ethanol), the formula for different sizes of fluid bags is as follows:*
 - a. $7\%/40\% \times 1000 \text{ mL} = 175 \text{ mL of vodka}$*
 - b. $7\%/40\% \times 500 \text{ mL} = 87.5 \text{ mL of vodka}$*
 - c. $7\%/40\% \times 250 \text{ mL} = 43.75 \text{ mL of vodka}$*
- 5. If using Everclear 190-proof, the formula for different sizes of fluid bags is as follows:*
 - a. $7\%/95\% \times 1000 \text{ mL} = 74 \text{ mL of Ever Clear}$*
 - b. $7\%/95\% \times 500 \text{ mL} = 37 \text{ mL of Ever Clear}$*
 - c. $7\%/95\% \times 250 \text{ mL} = 18.4 \text{ mL of Ever Clear}$*

DESCRIPTION

The use of biological agents to create illness and death has been practiced for centuries. Biological terrorism involves the intentional release of biological agents including bacteria, viruses, or biotoxins. These agents may be naturally occurring or been modified in the laboratory to create even faster or more severe injury. These include:

Virus

Ebola
Smallpox
Venezuelan Equine Encephalitis (VEE)

Bacteria

Anthrax
Botulism
Cholera
Plaque
Tularemia

Biological Toxin

Botulinum Toxin
Mycotoxin
Staphylococcal Enterotoxin B (SEB)
Ricin

Patient Approach/Evaluation:

- Approach the scene with caution
- In the case of bioterrorism, be aware of potential contaminated terrain and contaminated objects.
- The patient's clinical presentation and location may offer clues about the type of biological agent.
- Don appropriate PPE.
- Ensure that the patient is safe to assess, treat, and transport.
- Monitor for respiratory compromise, cardiovascular abnormalities, shock, or other life-threatening conditions (simple vital signs).
- If in respiratory distress or arrest, follow the local Emergency Airway Procedure.

Assessment/Treatment:

All these exposures must be treated with great caution. Although not all of these are airborne, standard and transmission precautions must be strictly followed. This includes respiratory precautions (N95 mask or Positive Airway Purifying Respirator/PAPR), gloves, and other skin/membrane protection.

Basic and Advanced Life Support

Treatment in the field is focused on supportive care.

- Respiratory and circulatory support
- Hydrations
- Temperature regulation

RADIATION – HZT07

DESCRIPTION:

Although acute exposure to radioactive materials is not common it does occur on occasions. Gamma Radiation exposure to the patient (e.g. patient is irradiated but not radioactive) poses no threat to the responder. A significant exposure may cause immediate symptoms that need to be treated in the field. Exposure to either or both Alpha and Beta radiation may present a danger to the emergency responder because these are usually particulate matter carried on the patient and there is risk of secondary contamination. Monitoring all suspected patients who report an exposure to radiation is critical to the safety of the transport and treatment team.

External irradiation - occurs when a part or whole body is exposed to ionizing radiation from an external source, usually Gamma radiation. The patient is not radioactive and can be safely treated without decontamination.

Contamination – This is when a radiological isotope within a gas, liquid, or solid particulate has made its way onto the skin, into the external respiratory system, or has been ingested. In these cases, the radiological isotope (usually α -alpha or β -beta) exists on the skin or tissue.

Incorporation – This is when the radiation contamination has been absorbed into the cells.

Acute Radiation Syndrome – (ARS) is a grouping of symptoms and injuries that appear within 24 hours of an exposure to ionizing radiation. The dose of radiation received by the victim is significant enough to cause cellular degradation and damage to the DNA. This occurs after whole or partial body irradiation of greater than 100 RAD. There are four sub syndromes to the overall acute radiation exposure that can occur within the first 24 hours. They are:

- Neurovascular (N) – Effect on the tissues that make up the central nervous system. Can occur between 10-30 Gy
- Hematopoietic (H) – Can occur at 2-3 Gy which effect the blood supply within the body along with white blood cells and other blood cellular elements depression.
- Cutaneous (C) – Development of ulcerations and lesions within the epidermis, dermis subcutaneous tissue and musculature and/or bone.
- Gastrointestinal (G) – at doses lower the 1.5 Gy breakdown of the mucosal barrier within the GI tract starts to occur.

Patient Approach/Evaluation:

- Approach the scene with caution
- Be aware of potential contaminated terrain and contaminated objects.
- Don appropriate PPE.
- Ensure that the patient is safe to assess and treat.
- Monitor for respiratory compromise, cardiovascular status, shock, or other life-threatening conditions (simple vital signs).
- If in respiratory distress or arrest, follow the local Emergency Airway Procedure.

- Consider secondary contamination. In the case of both Alpha and Beta the patient, if not appropriately decontaminated, presents a significant danger to both EMS and hospital personnel. In cases where decontamination is not possible, wrapping the patient in a plastic sheet will contain the radioactive particulate matter and as travel of alpha/beta radiation is only over very short distances (mm to cm) then this will also shield rescuers from radiation.
- Follow BLS and ALS associated treatment protocols.

TREATMENT:

Basic Life Support

- Decontaminate the victim(s) and meter with a radiological instrument
- Initially determine the history of the injury and the conditions the injury occurred
- Treat Life threatening conditions
- All care is supportive

Advanced Life Support

- Start IV/IO for fluid maintenance and drug administration.

Pediatric Considerations

1. Decontaminate the victim(s) and meter with a radiological instrument
2. Initially determine the history of the injury and the conditions the injury occurred
 - a. May upgrade patient to a higher level of care due to age and size.
3. Treat Life threatening conditions
4. All care is supportive

K9 Patient:

1. Decontaminate the victim(s) and meter with a radiological instrument
2. Initially determine the history of the injury and the conditions the injury occurred
 - a. May upgrade patient to a higher level of care due to size.
3. Treat Life threatening conditions
4. Assume that animals are both externally and internally contaminated due to feeding and grooming behaviors.
5. All care is supportive

ASSOCIATED PROTOCOLS

CLOSED SPACE FIRES (PRODUCTS OF COMBUSTION) – AP01

DESCRIPTION:

Closed space fires produce many toxic substances, including cyanide and carbon monoxide. The mechanism of injury during a fire is three-fold, Thermal damage, pulmonary irritation, and chemical asphyxiation (HCN, CO). Cyanide may have a synergistic effect on Carbon Monoxide. Anyone exposed from a closed space fire should be considered to have inhalation chemical asphyxiation.

Patient Approach/Evaluation:

- Follow the Gateway Protocols for the patient approach and evaluation.

Treatment:

Basic Life Support

- Immediately administer 100% oxygen if conscious, if unconscious secure airway to deliver 100% oxygen.

Advanced Life Support

- If conscious begin CPAP with the PEEP setting >10cm of H₂O.
- If unconscious, provide an advanced airway and monitor end tidal CO₂ (ETCO₂).
- Start IV of 1000 cc normal saline at a KVO rate.
- Treat unconscious patients per local Protocol. Consider evaluating glucose levels and administering Naloxone (Narcan) 2mg, IVP, IO, IM or intranasal every 3-5 minute up to 8mg.
- Give CyanoKit; 5 grams Hydroxocobalamin IV infusion over 15 minutes.
 - Start a dedicated IV line.
 - Reconstitute each 5-gram vial with 200 ml of 0.9% Sodium Chloride. (Lactated Ringers and D5W can also be used if Sodium Chloride is not available). Renders 25mg/ml.
 - Invert or rock the vial. Do not shake.
 - Administer 5 grams over 15 minutes (~15 ml/min).
 - An additional 5 gm dose may be administered if necessary

Pediatric Considerations

CyanoKit – Hydroxocobalamin

- The safety and effectiveness of the Cyanokit have not been established in the pediatric population (per package insert). The Cyanokit has been successfully used in the non-US market at a dose of 70 mg/kg to treat pediatric patients.
- The Cyanokit has been successfully used outside of the U.S. at a dose of 70 mg/kg to treat pediatric patients.

K9 Patient:

Just like an adult or child, treatment of a Canine must begin immediately. It is vitally important to stop the bonding of cyanide to cytochrome c oxidase. This will reestablish cellular metabolism.

Treatment options include:

- Option 1: (preferred)
 - Hydroxocobalamin 150 mg/kg over 10-15 minutes.

WHEEZING SECONDARY TO TOXIC INHALATION - AP02

Note: Wheezing has 2 distinct causes post exposure. When a patient is exposed to a respiratory irritant, wheezing is caused from swelling of the bronchioles. Wheezing can also occur from a chemical sensitivity that has caused the sudden release of histamines stimulating both bronchospasms (asthma) and vasodilation.

DESCRIPTION:

Any wheezing due to exposure of the respiratory system to an irritant or unidentified chemical that presents with shortness of breath, or decreased oximetry. Exposures that are suspected to cause inflammation or has suspicious signs (shark tooth pattern on a Capnography) should have direct observation for at least one hour after exposure.

Patient Approach/Evaluation:

- Follow the Gateway Protocols for patient approach and evaluation.

Treatment:

Basic Life Support

- Maintain an Airway.
- Assist with breathing if appropriate.
- Immediately give 100% humidified oxygen.
- Gather vital signs – auscultate lung fields.
- Identify circulatory status.
- Monitor patient's level of comfortable breathing.
- Initiate updraft of sterile water.

Advanced Life Support

- Initiate a nebulized updraft of either Albuterol (Proventil or Ventolin) and/or Ipratropium Bromide (Atrovent).
 - Albuterol 2.5mg (0.5mL of 0.5% diluted to 3mL with sterile normal saline) give via nebulizer. May be repeated 3 times.
 - Ipratropium Bromide 0.5mg (500 mcg)/2.5 ml via nebulizer repeat at 20 minute intervals for a total of 3 doses (usually only one dose given in the field).
- Administer methylprednisolone (Solu-Medrol) 125 mg, IVP slowly.
 - Monitor heart rate. Contact medical control if HR over 150 bpm.
 - Consider the administration of Brethine (Terbutaline sulfate) 0.5 mg given subcutaneous injection. (0.5ml of a 1mg/ml solution).
- Maintain adequate ventilation and oxygenation
 - Assess:
 - Oximetry
 - Capnography
 - EKG
 - Provide
 - CPAP and set the PEEP setting at or above 10 cm of H₂O and 100% Oxygen. (or select the high setting)
 - Provide advanced airway if needed.
 - Control seizures or anxiety with Valium or Versed

- Diazepam (Valium) 2 – 10 mg or
 - Midazolam (Versed) 2 – 2.5 mg IV/IO (Max 10 mg) or
 - Lorazepam (Ativan) 2mg IM/IV/IO. Can be repeated in 5-10 minutes.
- Consult specific Toxidrome Protocols for additional medical treatment guidance.
- If the wheezing is related to a known exposure (hydrofluoric acid, Chlorine, Chloramine, Ammonia, Phosgene) access the specific protocols for further guidance.
- Contact the Regional Poison Control Center and the receiving hospital and provide **HazMat Alert**.

Pediatric Considerations

- Monitor both cardiac and respiratory status.
- If bronchiole construction (wheezing) occurs administer:

Note: Administration of a nebulized Inhalation Solution is not recommended for Pediatrics less than 2 years old.

- Albuterol (Proventil) - 2-12 years old less than 15 kg: give one 3 ml unit-dose vial of 1.25 mg by nebulizer (5-15 minutes)
 - 13 and older get adult dose
- Ipratropium Bromide 0.02% (Atrovent) - Administered at an adult dose by nebulizer but the number of overall doses is reduced to 2. Only one should be given in the field.
- Monitor the EKG closely for cardiac irritability (ectopy).
- Solu-Medrol (Methylprednisolone)- 2 mg/kg not to exceed 60 mg dose, IV. Give only one dose in the field.

K9 Patient (Wheezing)

- **Ipratropium Bromide (Atrovent) is NOT recommended for dogs.**
- **Albuterol (Proventil, Ventolin) Is commonly prescribed by veterinarians as the drug of choice for bronchial constriction.**
 - **In K9s a conservative oral dose 0.020 - 0.050 mg/kg (20-50 micrograms/kg) PO every 8 – 12 hours. Oral absorption is rapid. May be repeated 4 times a day until symptoms subside.**
- **Brethine (Terbutaline sulfate) – The dosage of Brethine SQ for canines is 0.01 mg/kg every 4 to 6 hours; may also nebulize 0.01 mg/kg diluted in 9 mL of 0.9% NaCl.**

TACHYCARDIA SECONDARY TO CHEMICAL EXPOSURE - AP03

DESCRIPTION:

Although tachycardia represents any abnormal cardiac rhythm with a rate greater than 100 beats per minute, this protocol will focus on supraventricular tachycardia caused by an exposure to a toxin. Typically, these rhythms are related to a chemical exposure causing myocardial sensitization or excessive CNS stimulation. The most common rhythms are Sinus Tachycardia, Atrial Fibrillation, Atrial Flutter and Paroxysmal Supraventricular Tachycardia (PSVT).

Patient Approach/Evaluation:

- Follow the Gateway Protocol for patient approach and evaluation.

Treatment:

Basic Life Support

- Supportive care

Advanced Life Support

- Establish an IV of normal saline.
- Administer Adenocard (adenosine) per local protocols If SVT present. Usually:
 - 6 mg of adenosine is given rapid IV push followed by a 20 ml syringe bolus of 0.9% normal saline.
 - If no conversion within 1-2 minutes give 12 mg IVP, repeat a second time if necessary (30 mg total)
- Diltiazem (Cardizem) 0.25 mg/kg IV/IO bolus over 2 minutes
 - A second bolus of 0.35 mg/kg may be used if necessary.
- If Super Ventricular Tachycardia continues give:
 - Esmolol (Brevibloc) 0.2-0.5 mg/kg IVP q5 min PRN

or

 - Procainamide 5-15 mg/kg IVP with maintenance drip of 20-50 ug/kg/min. (Loading dose: 15 to 18 mg/kg administered as slow infusion over 25 to 30 minutes or 100 mg/dose at a rate not to exceed 50 mg/minute repeated every 5 minutes as needed to a total dose of 1 gram.)
- If the rhythm is from a ventricular source (VT) Initiate administration of Amiodarone 150 mg in 100 ml IV/IO
 - 150 mg in 100 ml NS and infuse IV/IO over first 10 min (15mg/min),
 - This may be followed by 360 mg over next 6 hours (1 mg/min). This is usually completed in the hospital setting.
- Contact Medical Control for additional treatment modalities

Pediatric Considerations

It is extremely difficult to regulate pediatric tachycardia and the use of the adult meds are somewhat dangerous. In field focus should be on maintaining appropriate oxygenation and blood pressure.

K9 Patient

Considering that all antidysrhythmic therapies have the potential to be pro-arrhythmogenic and may have profound effects on cardiovascular function, it is important to consider the risks before beginning therapy. Considerations for determining the need for antidysrhythmic therapy include:

- Can a correctable underlying cause for the arrhythmia be identified (pain, stress, hypoxemia, hyperthermia, anemia, hypovolemia, acid-base or electrolyte imbalance)?
- Is the arrhythmia hemodynamically stable or unstable (i.e. causing clinical signs of hypoperfusion with weak femoral pulses, altered mental status, pale mucous membranes, prolonged capillary refill time, cool extremities)?
 - If "stable", then emergency therapy is not indicated.
- For tachydysrhythmias that are hemodynamically unstable consider the following protocols:
- Regular or Irregular, narrow-complex tachycardia (e.g. supraventricular tachycardia)
 - Provide a vagal maneuver by applying ocular pressure or pressure on the carotid sinus (most effective). For carotid sinus massage, apply gentle, sustained pressure for 5 to 10 seconds over the carotid sinus located immediately caudal to the dorsal aspect of the larynx.
 - Diltiazem (Cardizem)
 - First line drug therapy for SVT in dogs
 - 0.125 to 0.35 mg/kg intravenously (IV) slowly over 2 to 3 minutes; may repeat after 15 min
 - Consider infusion at 0.125 to 0.35 mg/kg/h if dysrhythmia persists
 - Esmolol
 - Second line therapy for SVT in dogs
 - 50 – 100 mcg/kg IV q 5 min. Increase dose incrementally as needed to maximum dose of 50 mcg/kg;
 - Consider infusion of 25 – 200 mcg/kg/min if dysrhythmia persists
 - Consider cardioversion under the guidance of a veterinarian.

Note: Adenosine does not work in dogs. Dogs have a different receptor physiology.

For Unstable, Regular, wide complex tachycardia (Ventricular Tachycardia, VT) with pulse:

Lidocaine

- Administer 2 mg/kg IV/IO over 5 min; repeat as needed to obtain rhythm control every 5 minutes (not to exceed maximum dose of 8 mg/kg).
- Maintenance dosage: Once control of ventricular tachycardia is accomplished start infusion at 50 - 100 mcg/kg/min (recommend starting at 75 mcg/kg/min). Adjust rate as needed based on ECG monitoring.
- Quick calculation for **75 mcg/kg/min (2.25 mg/min)** infusion for average size **30kg** OpK9:
- Add **22.5 mL** of 2% lidocaine to a 1-L bag of 0.9%NaCL to produce a 0.45 mg/mL lidocaine concentration. Start infusion at **10mL/kg/h (or 300 mL/h for 30Kg OpK9)**. (Note: 2% Lidocaine = 20 mg/mL).
 - Reduce infusion rate to 6.7 mL/kg/h (200mL/h) to provide 50mcg/kg/min (1.8 mg/min.
 - Increase infusion to 13.3 mL/kg/h (400mL/h) to provide 100 mcg/kg/min (3.0 mg/min)

Procainamide:

- 2nd line used for VTs refractory to lidocaine.
- Administer 6 -8 mg/kg over 3 minutes, do not exceed total dosage of 20 mg/kg; follow by infusion at 25 to 50 mcg/kg/min. Monitor for hypotension.

Amiodarone: **3rd line treatment however ONLY permitted for IN HOSPITAL USE, under the direct control and guidance of a Veterinarian.**

- For Pulseless, Ventricular Tachycardia/Ventricular Fibrillation:
 - Start cardiopulmonary resuscitation IAW with RECOVER guidelines (<http://acvecc-recover.org/>); Same CPR guidelines as for adult humans.

HYPOTENSION CAUSED BY CHEMICAL EXPOSURE - AP04

DESCRIPTION:

There are two causes of hypotension related to chemical exposure. First are those chemicals that cause extreme loss of fluid volume (may or may not be blood). The other is a chemical that causes loss of vascular tension. If left untreated both of these conditions can lead to death.

Patient Approach/Evaluation:

- Follow the Gateway Protocol for patient approach and evaluation.

Treatment:

Basic Life Support

- Position patient to support blood pressure.
- Administer Oxygen via Non-rebreather mask at 100%.
- If breathing is not sufficient or absent, secure an airway and provide artificial ventilations using positive pressure ventilation.
- Keep the patient warm and monitor for other signs of shock.

Advanced Life Support

- Establish one or two IVs using large bore catheters.
- If the BP is less than 90mm/HG systolic provide a bolus of 250 ml and reassess BP. A second bolus can be provided if the BP is < 90 mm/Hg systolic.
 - Do not institute a fluid bolus if there is evidence of pulmonary edema.
- If the fluid challenge does not stabilize the blood pressure, administer Epinephrine **or** Dopamine **or** Norepinephrine to maintain a systolic pressure of greater than 70 - 90mm/Hg.
 - Epinephrine
 - Push Dose epinephrine 1:100,000 (10mcg/mL).
 - Dilute: Discard 9 mL of Epi 1:10,000 and draw up 9 mL of Normal Saline to create Epi (1:100,000) in 10 mL solution for 10 mcg/mL.
 - Administer: 1mL slowly over 30 seconds IV/IO.
 - May repeat every 1-2min for a max 3 doses.
 - Max total dose 30mcg (3mL).
 - Titrate to MAP at least 70 mmHg.

Or

- Dopamine:
 - Mix 400mg in a 250ml bag of 0.9% D5W = 1600 mcg/ml.
 - Provide an IV infusion rate of 5mcg/Kg/min.
 - If this does not improve the BP the infusion rate can be increased to 10 mcg/Kg/min.

Or

- Levophed (norepinephrine):
 - 8-12 mcg/min titrated to maintain systolic BP higher than 90 mm/Hg

SEIZURES POST EXPOSURE - AP05

DESCRIPTION:

Seizures can be related to a number of causes from CNS over-stimulation, heat, or an exposure to neurotoxins. In all cases, it is important to suppress the seizure activity. Regardless of cause the following medication is used to treat seizures. In addition to seizure treatment, the following drugs can be used for severe anxiety related to chemical exposure.

- Diazepam (Valium) 10mg IV/IO/IM. Maximum dosage 20mg
- or
- Midazolam (Versed) 2.5 mg IV/IO. Repeat at 2-minute intervals to a maximum dosage of 10mg
- or
- Lorazepam (Ativan) 4mg IV/IO/IM. May repeat in 5-10 minutes

Pediatric

- Diazepam (Valium) 0.2mg/Kg. IV/IO/IM
- or
- Midazolam (Versed) 0.1 mg/Kg IV/IO. Repeat at 2-minute intervals to a maximum dosage of 0.6 mg/Kg
- or
- Lorazepam (Ativan) 0.05mg/Kg IV/IO. Can be repeated at 10-15 minutes

K9 Patient

- Check blood glucose levels (normal 70-120 mg/dL)
- If seizures follow the exposure give:
 - Midazolam (Versed) 0.5 gm/Kg IV/IO/IM/IN Repeat at 5-minute intervals for three doses; start infusion at 0.2 – 0.5 mg/kg/h.
 - Diazepam (Valium):
 - Injectable: 0.5 mg/Kg/IV/IN, repeat every 5 minutes as needed for 2 doses.

OPIOIDS AND SYNTHETIC OPIOIDS - AP06

DESCRIPTION:

Although opioid misuse has not typically been a hazardous materials incident that all changed when synthetic Fentanyl and Carfentanyl hit the streets in such high concentrations that the inhalation of dust from these drugs can seriously injure a first responder. For this reason these protocols are found in this document.

Patient Approach/Evaluation:

- Although an overdose by skin absorption is highly unlikely, caution should be used to protect responders especially from respiratory and secondary ingestion exposures.
- Use of BSI will protect rescuers from direct contact.
- Patients may become agitated/violent following Narcan administration due to opioid withdrawal. Be prepared and take the appropriate measures in advance to ensure and maintain personal and scene safety.
- The reversal effects of Narcan will start to wear off in 15-30 minutes and will be gone in about an hour. Opioids typically last four hours or longer so continuous monitoring and additional administration of Narcan should be expected.
- Narcan can precipitate withdrawal reaction in long term narcotic addicts. Seizures are not usually part of the opioid withdrawal syndrome
- Narcan may precipitate dysrhythmias in patients who go into a withdrawal reaction and have pre-existing (known or unknowns) cardiac disease, including ventricular fibrillation or ventricular tachycardia

Note: In patients with absent respirations it is advisable to bag mask ventilate in an attempt to open alveoli prior to the onset of action of naloxone. This may decrease the risk of pulmonary edema after naloxone administration.

Assessment/Treatment:

Basic Life Support

- Maintain an open airway and provide 100% oxygen via NRB mask.
- If the patient is contaminated with the opiate consider decontamination with a 10% hydrogen peroxide solution.
- If patient's breathing is compromised or absent secure an airway and provide ventilation using a BVM and 100% supplemental oxygen.

Advanced Life Support

- If the patient breathing is slow or absent secure an advanced airway and ventilate using a BVM and 100% supplemental oxygen
- Assess oxygenation and cellular metabolism
 - Oximetry – maintain above 94% oxygen saturation.
 - Capnography – End Tidal CO₂ should be between 35 and 45 mm/Hg.
- Initiate and IV with Normal Saline at a KVO rate.
- If there is reason to suspect opioid overdose, administer Narcan.
 - Give Narcan 2 mg IVP, IO, IM or intranasal every 3-5 minutes up to 8mg. Continue treatment until the breathing rate improves or until 8mg has been administered.

- Provide Narcan intranasal route via spray, divide administration of the dose equally between the nostrils to a maximum of 1 ml per nostril. NOTE: intranasal route will NOT be effective if patient is hypotensive or in arrest. IV route is preferred in these cases.
- Narcan can also be administered via IM (if blood pressure adequate) using an auto injector into the anterolateral aspect of the thigh at 0.4mg per injection. Dose can be repeated at intervals of 3-5 minutes.

Pediatric Considerations

- Assess respirations
- Maintain an advanced airway and ventilate using 100% oxygen.
- The pediatric dose of Narcan is 0.1 mg/kg IV, with a maximum dose of 2 mg.

K9 Patient:

- Most dogs used by USAR, Drug Enforcement, and Law Enforcement are 40 Kgs or less (Around 70-80 pounds).
- Support ABC's (establish patent airway, support ventilation, provide oxygen supplementation as needed, initiate CPR if in cardiac arrest):
 - If rescue breathing is warranted, AVOID 'mouth-to-snout'. Instead, use a BVM with a canine specific face mask.
 - K9s with no pulse may be in cardiac arrest or may have an undetected weak or slow pulse. Manage as cardiac arrest patients.
- When feasible, thoroughly wash powder or agent off of K9s hair coat and skin.
 - After washing drug/agent off OpK9, take actions to dry and keep the K9 warm (cover with blanket, sheet).
 - If washing the K9 is not feasible, then consider wrapping the K9 in a sheet, blanket or other similar material to mitigate dispersion of powder off the K9's hair coat.
- Administer naloxone (see dose recommendations listed below) when there is a known or highly suspect risk of exposure, and the K9 is displaying clinical signs such as:
 - Unresponsive or altered mental status
 - Slow or absent breathing or gasping breaths
 - Slow (< 50 bpm) heart/pulse rate and weak femoral pulse quality
 - Weakness or staggering
 - Pinpoint pupils
 - Dysphoria (vocalizing, agitation, appearing frantic, etc.) may be an early indicator of exposure.

When in doubt, administer naloxone.

- Repeat naloxone as needed.

Seek immediate veterinary medical attention even if K9 responds to naloxone administration.

Note: After the administration of naloxone, expect the K9 to rapidly awaken from their state of drug-induced stupor, however, they may still be disoriented and be in a 'protective/ defensive mode. The K9 may want to bite/attack anything in their immediate vicinity, including their

handler. The K9 should be properly restrained with an open basket muzzle secured in place prior to administering naloxone.

Recommended K9 Naloxone Dosing:

- Routes
 - Intravenous (IV) / Intraosseous (IO): 2 mg per 25 kg (55 lbs)
 - Intramuscular (IM): 4 mg per 25 kg (55 lbs)
 - Intranasal (IN): 4 mg per 25 kg (55 lbs)
 - Oral Transmucosal (OTM) (buccal pouch): Use IN dosing recommendations. Consider as a last resort if no other route is available (e.g. cannot establish IV/IO access and IM or IN administration unavailable [blocked nasal cavity, excess nasal discharge, etc.]).
 - Repeat as needed to affect.
 - Two doses are most likely required as the duration of action of naloxone is often much shorter than that of the opioid it is being used to antagonize. Some exposures require 5 - 10x the typical dose of naloxone.
- Onset of Action:
 - IV/IO: rapid onset of action, usually within 1-2 minutes.
 - IM/IN: onset of action within 5 minutes
 - Duration of action: 45-90 minutes, may last longer.

References:

1. Palmer LE, Gautier A. Opioid Toxicity and Naloxone Use in Operational K9s. J Spec Op Med. J Spec Oper Med 2017;17(4):86-92.
2. HSHQDC-17-P-00112 Determining Efficacy of Naloxone Administrated through a Nasal Spray to Reverse Opioids Toxicity or Overdose in DHS Working Dogs Dept of Homeland Security. Final analysis pending.

HEAT and HYPERTHERMIA - AP07

DESCRIPTION:

Heat is produced as a biproduct of metabolism. Under stress, whether the stress is due to eating a large meal, emotions, chemical metabolic stimulation or hard work, the metabolic rate can increase dramatically, adding further to heat production within the body and causing heat related illnesses. The environmental temperature and humidity also play an important factor in control of core temperature.

Patient Approach/Evaluation:

- Remove the patient from the environment. This includes removing all PPE and, if possible, move the patient to a cool and shaded environment.
- Ensure a patent airway.
- Start cooling efforts and rehydration with small sips of cool water.

Note: A person wearing PPE in a hot environment can sweat up to 2000 cc of water per hour. Realistically, a person can only absorb about 700 cc of water an hour. So in incidents of severe dehydration, an IV is necessary to quickly correct the physiologic problem.

Treatment:

Basic Life Support

- Assess vital signs paying attention to the temperature (oral or tympanic).
- Begin cooling efforts by placing cold packs in the axillary, base of neck, and groin.

Note: The body attempts to cool itself by dilating surface blood vessels and allowing sweat to carry away heat. DO NOT apply cooling to large surfaces of the body (like chest and abdomen) as this will constrict the blood vessels and keep the excessive heat in the core of the body.

Advanced Life Support

Heat Cramps - result from a disproportionate loss of fluid and electrolytes from the body. In a hot environment, excessive sweating causes an imbalance in electrolyte concentration. This imbalance results in the skeletal muscles suffering from a deficit of these electrolytes (sodium, potassium, calcium, and magnesium). The cramping usually occurs in larger muscle groups but are most common in the abdomen, legs, arms, and fingers.

Initial Treatment

- Move patient to cooler environment
- Administer oral fluids as tolerated (Gatorade)

Heat Exhaustion (with neurological signs or symptoms be prepared for instating the heat stroke protocol) - is one of the most commonly seen heat emergencies. It is caused by the loss of fluid and sodium (and other electrolytes) as a result of excessive sweating and an

increase of core temperature up to 103 degrees Fahrenheit. If heat exhaustion is left untreated and allowed to progress, heat stroke may result.

Note: An increase of 1 degree of core temperature indicates an increase of 6% of the Basal Metabolic Rate. An increase of 6% of BMR will increase the carbon dioxide production by 6%. A high capnography reading assists in diagnosing heat related injury and indicates a patient who is in danger of Heat Stroke.

- Move patient to cooler environment
- Assess body temperature.
- Cool the body using cold compresses at the base of the neck, axilla, and groin.
- Observe for any signs of heat stroke
 - Assess capnography. Readings above 45 mm/hg indicate a significantly overheated patient that will need rapid cooling.
- Start hydration and cooling
 - Normal Saline 20 mL/kg IV/IO
 - Slight cool saline if possible
 - Administer oral fluids as tolerated (Gatorade)
 - Monitor vital signs
 - Monitor LOC, EKG, and frequent VS as rapid changes are typical in heat related injuries.

Heat Stroke - is the complete failure of the thermoregulatory mechanism and can be observed by cerebral dysfunction. Symptoms include tachycardia followed by bradycardia, hypotension, rapid shallow respirations, seizures, decreased level of consciousness eventually leading to coma. The estimated mortality from heat stroke is from 50-80%.

Treatment

- Rapidly move the patient to a cooler environment
- Begin treatment immediately (this is a true emergency)
 - Remove extra clothing including PPE if the emergency involves an emergency responder.
 - Cool patient by applying cool packs in axilla, neck and groin areas.
 - Start and IV of Normal Saline 20 mL/kg IV/IO. Cool saline if possible.
 - Hydrate until capillary refill time is less than 2 seconds.
 - Prepare for the possibility of seizure activity.
 - Continuously monitor LOC, EKG, and vital signs as they can change rapidly
- Cardiac abnormalities are normal and usually do not require treatment.
 - If Ventricular dysrhythmias become constant and compromise cardiac stability give:
 - Lidocaine 2 mg/kg IVP

Pediatric Considerations

Protocols used for adult patients are the same as those used for pediatric patients.

K9 Patient

Note: In canines, heat stroke is often defined as a state of extreme hyperthermia with a core temperature exceeding 106-109°F (normal body temperature (100 – 102.5°F)).

Important Note: A high body temperature does not always indicate a heat-related illness is imminent. Some OpK9s, performing strenuously or for prolonged periods in hot ambient temperatures, may have rectal temperatures that easily reach 107 - 108°F without any detectable physical or metabolic indications of heat stress or exhaustion; racing greyhounds often reach up to 108°F in a very short racing distance. More than likely, though, these OpK9s are acclimated to the level of activity and climatic conditions they are working in; therefore, not all OpK9s are able to “tolerate” body temperatures to this degree. The degree of acclimation and, therefore, toleration for strenuous and or prolonged activity in hot climate varies from K9 to K9. As such, it is vital to understand a K9’s typical behavior and response (e.g. change in body temperature) to various degrees of strenuous activity, durations of work, and climatic environments, more so, than necessarily relying on one body temperature reading. Identifying normal versus abnormal behaviors for a particular situation, allows earlier intervention which plays a large role in averting a heat-related event.

Parameter	Heat Stress	Heat Exhaustion	Heat Stroke
Breathing 20-40	Controlled Pant – can stop when air is blown over the nose or offered a toy / reward	Uncontrollable panting with noisy breathing possible saliva buildup	Uncontrollable excessive panting
Pulse 60-120 bpm	Borderline Tachycardia strong and steady	Tachycardia? Rapid bounding quality	Tachycardia poor pulse quality – rapid pulse
Temperature 99.5-102.5°F (rectal)	102.5°F depends on acclimation	104°F	>105°F
Capillary refill <2 sec	<2 seconds	< 1 second (hyperdynamic phase)	>2 – 3 seconds
Mucus Membranes (inside lips and gums)	Pink with normal saliva production	Bright red (hyperdynamic phase)	Gums and inside of lip blue/grey ashen
Cognitive	Responsive and ambulates	Weakness and lethargy	Poor or no response to commands
Neurological	Normal	Normal	Seizure, comatose, vomiting, diarrhea, uncoordinated

Treatment for Heat-related illness:

- **Move from hot area into shade or air-conditioned area**
- **As feasible, remove muzzles, harnesses, tactical gear, etc.**
- **If conscious and able to drink, offer cool water**
- **Place on cool surface to promote conductive cooling**
- **Start active external cooling**
 - **Blow a circulating fan or air-conditioning over K9 to promote convective cooling; if in a vehicle with no a/c, drive with windows open.**

- Place cold compresses or ice packs (wrapped in a towel) on the head and neck as well as in the armpits (axillae) and groin.
 - NOTE: avoid placing ice packs on the on limbs as this shunts hot blood back to the body core.
- Immerse in ice water or cold-water bath or consider using nearby bodies of water (pool, lake, river, stream, etc.) to submerge your K9 (keep head above water). If latter not available, douse or spray K9 with cold water from a hose or whatever water source available (e.g. ice cooler, etc.)
- Place IV / IO catheter and start IV / IO fluids; if hypotensive provide a 20 mL/kg bolus Lactated Ringers, repeat as needed 2 -3 x times until femoral pulse quality improves. Maintain at a rate of 3 – 5 mL/kg/h to maintain pulse quality.
- If available, provide supplemental oxygen via face mask or nasal cannula
- STOP active cooling when rectal temperatures reach 103.5 - 104°F
 - Dry K9 off, place on dry surface, avoid direct application of air on K9 from circulating fans or air-conditioning
 - Monitor temperature every ten minutes for at least the next few hours as body temperature may continue dropping to the subnormal range or rise excessively again
 - If body temperature drops below 100°F consider passive warming by covering with blankets or other similar materials
- Transport to appropriate veterinary facility for medical evaluation and treatment.

COLD RELATED INJURIES - AP08

DESCRIPTION:

This section deals with cold injuries related to the exposure to hazardous materials without a focus on environmental injuries. In a hazardous materials environment cold tissue destruction is caused from an exposure to a liquefied gas or to a cryogenic.

PATIENT APPROACH/EVALUATION:

- Follow Gateway Protocols

Frostbite – Frostbite causes destruction of tissue through freezing and rapid changes in osmotic pressures. The temperature that is required to cause a freezing injury is several degrees less than 0°C (32°F). The tissue must reach a temperature of 26.6°F to 24.8°F (-3 to -4°C) for frostbite to occur. The most frequently injured areas, due to frostbite are the feet, lower legs, arms, and hands.

TREATMENT:

Basic Life Support

BLS - Supportive Care

As with all cold environment emergencies:

- Rapid rewarming by:
 - Submerging the affected part in warm water of between 90° and 108°F for 20-40 minutes.
- Monitor vital signs
 - Pay particular attention to
 - Capnography
 - Pulse oximetry
 - EKG

Advanced Life Support

- Start an IV using Normal Saline or Lactated Ringers. Keep infusion rate high enough to maintain blood pressure above 100 Systolic.
- Warm IV solution if possible.
- Provide medication for pain relief as rewarming is extremely painful.

Pediatric Considerations

Follow the adult protocols for frostbite for pediatric patients.

Canine

Follow human adult treatment for treating frostbite in canines.

PROCEDURES:

P1 - Pre-Entry Medical Evaluation.

Purpose

The purpose of this policy is to provide a framework for medical monitoring at the scene of a hazardous materials event. It is meant to establish guidelines for assessing members prior to entering a hazardous chemical environment wearing a level of chemical protective clothing. These entry team members may experience stress from limited vision, mobility, heat or cold exposure, and possibly chemical exposure if the protective equipment fails. Entering an environment that has been determined to be unsafe, regardless if that chemical protective equipment is completely encapsulating or not, adds an additional level of danger to the entry team member.

Policy

Although the annual hazmat physical establishes a fit for duty status, it is prudent to provide a pre-entry physical either the morning of duty or at the scene of the hazardous materials event. The pre-entry exam is needed to determine the current fitness of the entry team member to both function in chemical personal protective equipment and endure the stresses presented by the environment and the required workload. The exams are conducted to determine the current fitness of the entry team member and to set a baseline of data to compare when conducting the Post Entry Medical Evaluation. These exams should include:

Pre-entrance Medical Monitoring

Interview Questions:

1. Are there any current or recent illnesses (within 72 hours) that caused a fever, dehydration (diarrhea, vomiting, profuse sweating), or mandated bed rest?
2. What medications is the entry team person taking or any recent change in medication that has occurred that may change or reduce their fitness within a chemical protective suit?
3. Are there any skin injuries, open wounds, sun burn, skin infections, or rashes?

Note: The determination to allow the entry team member to make entry into the hot zone should be made by a HazMat Medic who has appropriate knowledge of hazardous materials response and toxicology. Ideally, the HazMat Medic should be informed of the chemical involved and the signs and symptoms of exposure. This will allow the medic to pay particular attention to those pre-entry data points that could change if an exposure takes place.

Physical Exam/Vital signs

1. Determine current mental status.
2. Capnography. Any reading outside of 35-45 mm Hg.
3. Blood pressure. A systolic above 150 and/or a diastolic above 100 mm Hg
4. Heart Rate. A heart rate above 100.
5. Respiratory Rate: A respiratory rate above 20 breaths per minute.
6. Oximetry: Saturation reading outside of the parameters of 94-99%.
7. Oral or tympanic temperature. Above 100.7. If the temperature is over 100 also conduct a capnography and ensure that the reading is between 35-45 mm/Hg.
8. Obtain a pre-entry weight. This will be used post entry to determine the overall hydration status.

Note: Exclusion criteria are flexible based on each entry team member and are meant to provide guidance to the HazMat Medic. A HazMat Medic can make a determination of the current physical status of the entry team member based on these findings, patient history, preexisting knowledge of that patient, and overall paramedic intuition.

Note: All medical evaluation documentation is protected by HIPPA and should not become part of the public record associated with the emergency response report.

P2 - Post entry Medical Evaluation/Rehabilitation.

Purpose

The purpose of this policy is to provide guidance for the medical evaluation of responders who have made entry into a hazardous environment wearing chemical protective clothing.

Policy

The Post-entry examination is conducted by a trained Hazardous Materials Medic. It should be completed immediately after decontamination and removal of all chemical protective equipment. The entry team member should be moved to an environmentally controlled area. In a hot environment this may be an area in the shade with fans and cold compresses or other means of reducing body core temperatures. In the cold this may include a heated area such as a rehab trailer. The post entry evaluation should be conducted as soon as the entry member is seated and should not be delayed unless there is a significant safety issue or medical emergency.

Post entrance Medical Monitoring

General Appearance/visual assessment

1. Skin general color/moisture/any obvious signs of injury
2. Mental status. Displays reasonable and active answers to simple questions.

Physical Exam/Vital signs

1. Capnography compared to pre-entry
2. Blood Pressure compared to pre-entry
3. Pulse Rate compared to pre-entry
4. Respiratory Rate compared to pre-entry
5. Oximetry compared to pre-entry
6. Oral or Tympanic Temperature compared to pre-entry and capnography
7. Weight. A loss of $\geq 2\%$ of body weight (4 pounds for a 200-pound responder) is the loss of $\frac{1}{2}$ gallon or approximately 1900 ml. Understanding that the body can absorb about 800 ml per hour this responder needs 2.5 hours to completely recover. If vital signs have been compromised as a result of water loss, an IV should be considered.
8. Pay particular attention to any assessment criteria that may be affected by an exposure to the chemical involved.

Post entry physical exam should be completed as quickly as possible then followed up every 15 minutes post entry until the HazMat Medic determines that the responder is safe to make an addition entry or to return to their normal duties. Re-entry criteria (vital signs) should follow the exclusion guideline criteria for pre-entry physical exam (see Policy P1).

Rehabilitation

During post entry evaluations the entry team member must be provided appropriate rehabilitation. Rehabilitation consists of efforts to bring the entry team member back to a homeostatic state. This may include hydration, forced cooling, carbohydrate replacement, providing a heated environment, or other measures to enable the entry team member to recuperate from the physical stress of entry.

Note: All medical evaluation documentation is protected by HIPPA and should not become part of the public record associated with the emergency response report.

P3 - CPAP – Continuous Positive Airway Pressure

Purpose:

The purpose of this policy is to guide the medical care provider in the use of Continuous Positive Airway Pressure (CPAP) device during the treatment of patients exposed to hazardous chemicals.

Policy:

The Continuous Positive Airway Pressure (CPAP) device is used to increase the intra alveolar pressure throughout the respiratory cycle. The use of CPAP should be considered when increased oxygenation of the blood is needed to provide support to the patient, during any occurrence of chemically induced pulmonary edema, or any time the surfactant in the alveoli is disrupted and there is danger of perfusing atelectasis. These physical assignment signs may be noted during assessment and may indicate the need to provide CPAP

- Accessory muscle use - retractions
- Wheezes, rales, rhonchi
- Respiratory Rate > 25 and labored
- Signs of respiratory fatigue or failure
- Pulse oximetry < 94%
- $\text{ETCO}_2 < 35\text{mm Hg}$

Additionally, through the use of Positive End Expiratory Pressure (PEEP) which can be used during mechanical ventilation, refers to the pressure in the airway at the end of expiration cycle. The PEEP setting in the normal part of the respiratory cycle when the internal Pressure matches the external pressure inside of the alveoli improving oxygen diffusion and maintaining the alveoli open when the surfactant has been disrupted.

Function:

Continuous Positive Airway Pressure can be provided in two different ways. One involves using a CPAP machine designed to provide low level CPAP to breathing patients. Most CPAP machines have a high setting that sets the Positive End Expiratory Pressure (PEEP). The high setting is generally at 15cm/ H₂O and a low setting at 5cm/H₂O.

The second way to provide CPAP is to a non-breathing patient using a bag valve mask with either an integrated PEEP valve or by adding an inline PEEP valve. These valves have settings from 2cm/ H₂O up to 25cm/ H₂O.

Indications:

- Decreased oximetry readings (<94% oxygen saturation). By increasing the partial pressure of oxygen in the alveoli, the oxygen concentration in the blood will be increased.
- After an exposure to Carbon Monoxide or Nitrate/Nitrites. Both change the oxygen carrying capability of hemoglobin. By increasing the pressure and percentage of oxygen in the alveoli, oxygen being carried in the solution of

blood will be increased significantly helping to make up the difference of saturation.

- After an exposure to a chemical irritant with the presence of rales on auscultation. Chemicals that cause chemically induced pulmonary edema also disrupts surfactant found in the alveoli. By providing CPAP the pressure in the alveoli is increased forcing the alveoli to stay open at the end of the expiratory cycle, even in the absence of surfactant. In addition, the increased alveolar pressure will greatly reduce or stop the influx of plasma into the injured alveoli.

Contraindications:

- Inability to protect the airway
- Respiratory arrest or agonal respirations (Consider PEEP)
- Persistent vomiting
- Inability to obtain a good seal

Monitor:

- Vital signs closely
 - Providing CPAP/PEEP increases intrathoracic pressure and tends to increase the blood pressure.
- Pay particular attention to
 - Capnography
 - Pulse oximetry
 - EKG
- Adjust PEEP pressure as needed to correct untoward changes to the vital signs.

P4 – Eye Irrigation Lens System

Purpose:

The Eye Irrigation Lens system is a composite contact style lens attached to a source of irrigation fluid. The lens provides true hands free and total surface area irrigation of an eye that has been exposed to a chemical. The lens is designed to be applied over the exposed eye globe once a numbing solution has been applied.

Policy:

The eye irrigation lens may be used any time a chemical has gained access into the eye.

Contraindications:

The eye irrigation lens cannot be used when there is obvious trauma to the eye or there is foreign solid materials in the eye. This will include contact lenses. If the patient cannot remove their personal contact lens the irrigation lens cannot be used.

Placing the lens:

Step One

Instill 2 drops of Tetracaine into the eye or eyes receiving the eye irrigation lens. Before applying Tetracaine determine if the patient is allergic to “caine” derivatives.

Step Two

Attach the eye irrigation Lens(es) to the delivery source (IV Bag) and begin flow.

Step Three

Have the patient look down and slide the Lens under the upper lid. Then have the patient look up while the lower lid is retracted and drop the Lens into place.

Step Four

Release the lower lid and adjust the flow of fluid into the eye. Then secure the tubing.

Removal of the lens is done in the opposite fashion.

If the lens stays in the eye longer than 20 minutes, remove the lens and reapply Tetracaine.

P5 - Capnography

Purpose:

This procedure outlines the use of capnography as a tool to assist in the medical assessment of a patient exposed to a hazardous chemical. Capnography provides the medical care provider with a digital readout of the level of carbon dioxide during the end tidal phase of exhalation. In addition, it provides a capnogram which is a visual tracing of the level of exhaled carbon dioxide being produced through each respiratory cycle. Both the digital reading and the tracing provides the healthcare provide with information that can be used to guide treatment.

Policy:

Capnography must be in place for every chemically injured patient. Capnography gives an instant reading of exhaled carbon dioxide that is a direct indication of the level of cellular respiration of the monitored patient. This procedure shall be considered:

- Anytime a patient is encountered at a hazmat incident
- When an emergency responder is exposure to a chemical
- During pre and post entry exams and during rehabilitation
- Anytime the medical group deems necessary to evaluate a responder/victim

Function:

Determining the level of CO₂ during expiration provides a direct measurement of the body's ability to perform aerobic metabolism. High and low patterns can help to determine what chemical is injuring the patient and how serious the exposure might be. In addition, it also has the ability to detect metabolic changes early in an event even before symptoms appear. By evaluating the capnogram tracing an emergency care provider can detect the early onset of bronchial constriction before the patient feels labored breathing and before the pulse oximetry is affected.

There are two components to capnography.

- *Capnometer* that provides a numeric measurement of CO₂ production.
- *Capnogram* which is the wave form that is drawn during capnography.

The capnometer measures end tidal CO₂ (ETCO₂ or PetCO₂) which is the level of carbon dioxide released at the end of expiration.

A normal end tidal CO₂ is between 35-45 mm/Hg (Torr). Capnography also captures this cycle of CO₂ production during the breathing process on a capnogram graph.

Seeing a change in the capnography wave form to a shark fin pattern indicates that the bronchioles are being obstructed causing some lengthening of the expiratory process. This obstruction can be caused from bronchospasms, bronchial swelling, or increased mucous production.

POLICIES AND FURTHER GUIDANCE

I. HazMat Alert Policy

This HazMat Alert Policy was developed by Orange County Fire Rescue Department. It has been adopted by all departments in Central Florida and many other departments throughout the State and Country.

Policy:

1 Purpose:

1.1 To create a standard method of patient care for incidents involving patients exposed to or suspected to have been exposed to a Hazardous Substance or Hazardous Material. By declaring a HAZMAT ALERT a pre-planned series of events will take place to protect the patient, our personnel, and the receiving facility's personnel. A HAZMAT ALERT will provide the following:

- Early notification to receiving hospitals of an incoming HAZMAT patient.
- Early involvement of the closest HAZMAT Team in decision making.
- Early involvement of Regional Poison Control or Medical Control.

2. Responsibility:

2.1 All personnel assigned to Fire Operations and Communications.

3. Definition:

3.1 A Hazardous Material is defined as any chemical compound found in solid, liquid or gas form that is not intended for human inhalation, ingestion or absorption.

4. Procedure:

4.1 A HAZMAT ALERT should be initiated:

- At the time of dispatch, when a caller reports a medical emergency involving a chemical smell or hazardous material exposure.
- When the first arriving crew suspects a hazardous materials exposure due to odor, history or other sources of information.
- By Hospital Emergency Department staff in the event a hazardous material exposure is suspected, from a walk-in patient and additional resources are needed.

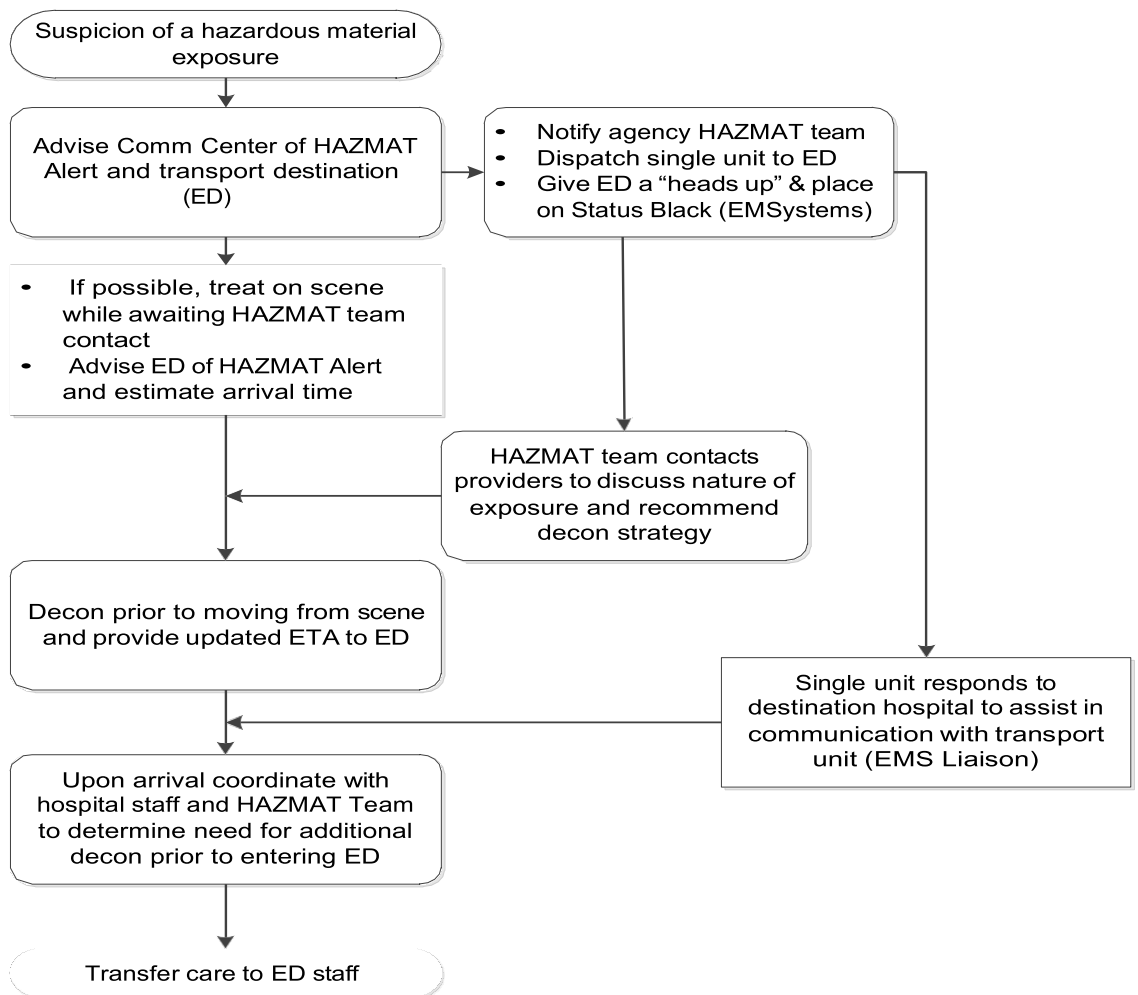
4.2 Actions after a Hazardous Materials Exposure has been recognized:

- Immediately contact the Communications Center and initiate a HAZMAT ALERT.
- Advise the Communications Center of the EMS transport destination as soon as determined.
- Ensure all personnel are in appropriate PPE.

4.3 After acknowledgement of a HAZMAT ALERT the Communications Center will:

- Notify the closest available Hazmat Team to the incident.

- Provide a “heads up” notification to the receiving facility by phone and also initiate a Hazmat Alert to the affected facility via EM System through Medcom.
 - **Notify the Regional Poison Control Center and advise them of the offending chemical, number of patients, and what facility(ies) will be receiving the patient(s).**
 - If requested by the ED the Communications Center can place the receiving facility on Status Black until it is determined to be safe to resume normal EMS transports.
- 4.4** Once notified of the HAZMAT ALERT the agency Hazmat Team will contact the on-scene crew to accomplish the following:
- Identify and research the hazardous material.
 - Determine if Hazmat Team response is needed.
 - Advise on scene crews of level of PPE required.
 - Determine the nature of exposure and appropriate decontamination procedures.
 - Advise on treatment in conjunction with Poison Control and local EMS protocols.
 - Determine and advise when transport can be safely initiated for the patient and personnel.
 - The hazmat team leader will make contact with the receiving facility and pass on all appropriate information about the patient, hazardous material involved, PPE and further decontamination procedures as necessary.
 - Determine if a liaison is required to respond to the receiving hospital and recommend to the agency, the appropriate liaison (i.e. Chief Officer, Hazmat Team, etc.)
- 4.5** Transfer of care:
- Prior to the ED arrival, transporting crews should contact the ED or FD liaison to convey pertinent information on the patient’s exposure, condition and the specifics of the decontamination strategy employed on the scene.
 - Before entering the ED, allow the hospital staff to assess the need for further decontamination.
- 4.6** General approach algorithm to a HAZMAT ALERT



5. References:

5.1 2011 Orange County EMS System Protocols (with minor modifications)

II. Medical Control

DESCRIPTION:

Medical control (also known as medical direction) is a direct link between the medical care providers in the field (EMTs and Paramedics) with a licensed physician under whom they practice. EMTs and Paramedics function as an **"extension" of the physician** while caring for patients in the field and can provide emergency BLS and ALS care in settings away from the hospital

- In Florida the rules and oversight of both BLS and ALS service provision in the field are governed by the Florida Department of Health.
- The Florida Department of Health requires that every agency providing emergency medical care outside of the hospital/clinic setting if overseen by a licensed physician (Medical Director)
- To institute a HazMat Advanced Life Support program that functions outside of the approved medical protocols must gain additional approval from Medical Control.
- In most cases a separate document (Hazardous Materials Medical Protocols) is provided for this function and only emergency medical providers training in these protocols are granted permission to use the specialized drugs, procedures, and techniques required to treat chemically injured patients.

III. Poison Control Centers

Description: American Association of Poison Control Centers (AAPCC)

- The AAPCC supports 55 poison control centers in the United State
- The Florida Poison Information Center Network consists of 3 nationally accredited poison control centers that exist under the auspices of the Florida Department of Health and provide service for the State of Florida.
- Poison centers offer free, confidential, expert medical advice 24 hours a day, seven days a week.
- Poison Help line at 1-800-222-1222 will automatically connect you to the poison control center covering your geographic area.
- Cell phone pictures of products, scene, patient's injuries are useful and can be texted to the hospital, poison control center or medical control.

IV. On-Call K9 Veterinary Services and OpK9 Deployment

DESCRIPTION:

The American Society for the Prevention of Cruelty to Animals® (ASPCA) operate an Animal Poison Control Center 24 hours a day for 365 days a year. If guidance is required in the treatment of a canine contact them at: (888) 426-4435.

The Pet Poison Helpline is operational 23 hours a day as an animal poison control center. They can be reached at: 855 764-7661.

Cell phone pictures of products, scene, patients' injuries are useful and can be texted to the hospital, poison control center or medical control.

Note: Both the ASPCA and the Pet Poison Helpline operate by charging a small fee for their services. If you call them, have a credit card available to pay for the service they will provide. These agencies may waive the fee if they are informed that an Operational K9 exposed in the Line of Duty.

Additional items during deployment:

1. K9 PRE-MISSION MEDICAL THREAT ASSESSMENT (MTA):

- **Where will the K9 be evacuated?**
 - Identify veterinary facilities in AO (contact names and numbers)
 - Identify veterinary capabilities (hours of operations, types of expertise, etc.)
 - Distances and times of travel
 - Will expected casualties be able to make it that far?
- **How will the K9 be evacuated?**
 - Evacuation via ground or air (or water) assets?
 - Who will evacuate the K9 (ideal to have a driver and a provider)?
- **Medical assets properly positioned to ensure continuity of care?**
- **Always Plan Ahead and Always have a backup plan or two**
 - Use the PACE (Primary, Alternate, Contingency, Emergency) principle

2. ANESTHESIA/ANALGESIA PROTOCOLS FOR PROCEDURAL SEDATION AND CHEMICAL RESTRAINT:

Ketamine**

- 2 – 5 mg/kg IV/IO (50 – 125 mg per 25 kg K9)
- 5 – 8 mg/kg IM (125 – 400 mg per 25 kg K9)
- **Always administer Ketamine with a benzodiazepine in K9s to reduce ketamine-induced muscle hypertonicity / myoclonus*

Benzodiazepine

- Midazolam (Versed): 0.2 – 0.5 mg/kg (IV/IO/IM)

- Diazepam (Valium) 0.2 - 0.5 mg/kg IV/IO or 1 – 2 mg/kg Per rectum
- Lorazepam (Ativan): 0.2 mg/kg IV/IO or Intranasal (IN)

+/- Fentanyl (or other opioid): Consider as needed for add further restraint / analgesia

- 5 – 10 mcg/kg IV/IO
- 10 – 20 mcg/kg IM
- *Infusion:* 3-6 mcg/kg/h

3. OpK9 Formulary

4. Additional Med Kit Items specific for K9 (muzzles, larger ETT sizes, K9 specific oxygen mask, leashes, etc.)

5. K9 CPR Guidelines (<http://acvecc-recover.org/>)

RECOMMENDED DRUGS, FORMULARIES, & EQUIPMENT

Adenocard (Adenosine)
 Albuterol (Proventil or Ventolin)
 Amiodarone
 Amyl Nitrite
 Atropine Sulfate
 Brethine (Terbutaline sulfate)
 Calcium Chloride 10% (9.3%)
 Calcium Gluconate 10%
 Dextrose 5%
 Destrose 50%
 Diazepam (Valium)
 Diltazem (Cardizem)
 Dopamine
 Epinephrine
 Esmolol (Brevibloc)
 Fomepizole (Antizole)
 Hydroxocobalamine
 Ipratropium Bromide (Atrovent)
 Isopropyl Alcohol
 Lasix (Furosemide)
 Lorazepam (Ativan)
 Methaline Blue
 Midazolan (Versed)
 Mineral Oil
 Morphine
 Narcan (Naloxone)
 Norepinephrine
 Nitro Glycerine
 Olive Oil
 Polyethylene Glycol
 Ponticaine
 Pralidoxime (2-PAM or Protopam)
 Prednisone
 Sodium Bicarbonate (4.2 and 8.4%)
 Sodium Chloride 0.9% (Normal Saline)
 Sodium Nitrite
 Sodium Thiosulfate
 Solumedrol (Methylprednisolone)
 Tetracaine

Non-Prescription Drugs/formularies

Tums
 Maalox
 Mylanta (Calcium Blend)
 Epson Salt (Magnesium Sulfate)
 80-Proof Vodka or Everclear 190 proof
 Dawn Dish Detergent
 Olive Oil

Prefilled Treatment Kits

Mark 1 (1-2mg Atropine, 1-600mg
 Pralidoxime)

DuoDote (2.1mg Atropine and 600mg
 Pralidoxime from 2 chamber BinaJect
 single needle)

Antidote Treatment – Nerve Agent Auto
 Injector (ATNAA) (2.1mg Atropine and
 600mg Pralidoxime in 1 injector)

Convulsant Antidote for Nerve Agent
 (CANA) (10mg Diazepam/Valium auto
 injector)

Recommended Specialized Equipment

LP 15 with Masimo/Rainbow or RAD-57
 CPAP with manual settings
 In line PEEP valve for BVM (adult and
 pediatric)
 Capnography for NC, Mask, and BVM

K9

Various size masks for BVM
 Oxygen delivery devices
 Muzzle (large and medium)