Chemical Terrorism

- Chemical agents act quickly. Rapid response is essential.
- Learn to recognize and diagnose the health effects of chemical agents.
- Chemical agents may contaminate you and your facility.
- Do not become a casualty! Implement procedures to decontaminate and treat incoming patients.

AWARENESS

RECOGNIZING CHEMICAL TERRORISM-RELATED ILLNESSES

Adequate planning and regular training are key to preparedness for terrorism-related events. This wall chart is only a summary of important information. For more detail to assist you in preparedness planning, review the resources at the bottom of this wall chart.

Healthcare providers should be alert to illness patterns and reports of chemical exposure that might signal an act of terrorism. The following clinical, epidemiological and circumstantial clues may suggest a possible chemical terrorist event:

- Any unusual increase in the number of people seeking care, especially with respiratory, neurological, dermatological or gastrointestinal symptoms
- Any clustering of symptoms or unusual age distribution (e.g., chemical exposure in children)
- Any unusual clustering of patients in time or location (e.g., persons who attended the same public event)
- Location of release not consistent with a chemical's use
- Simultaneous impact to human, animal and plant populations

Any unusual symptoms, illnesses or clusters of these should be reported immediately. Notify the county health department and regional Poison Control Center.

PHONE NUMBERS

Poison Control Centers	**1-800-222-1222**
County Health Department	
Consult phone book blue pages under "County Offices"	_____
New York State Department of Health (NYSDOH)	
Bureau of Toxic Substance Assessment	**518-402-7800**
Wadsworth Center Laboratories	**518-474-7161**
After hours: NYSDOH Duty Officer	**1-866-881-2809**
After hours: SEMO State Warning Point (SEMO - State Emergency Management Office)	**518-457-2200**
New York City Department of Health	
Poison Control Center	**212-764-7667**

PERSONAL PROTECTIVE EQUIPMENT (PPE)

DO NOT BECOME A CASUALTY!

Exposure can occur from inhalation of vapors, dermal contact or eye contact. The following general information can help responders/healthcare providers determine appropriate PPE.

Inhalation Exposure:

Protection from both vapors and particulates may be required when the chemical agent is being released. After release, protection from vapors is most important. Half-face and full-face respirators, with the appropriate canister, can provide protection from vapors. These operate by negative pressure and must be fit tested for optimal protection. Powered, air-purifying respirators (PAPR) and self-contained breathing apparatus (SCBA) provide even greater protection and operate under positive pressure so that fit characteristics are less important. Surgical and N-95 masks will not protect against inhalation of vapors.

Dermal Exposure:

Latex examination gloves provide very little protection from most chemical agents and can cause allergies. Gloves made of Viton, nitrile, butyl or neoprene provide better protection and, in some styles, allow adequate dexterity. However, the resistance of these materials to different chemicals varies and it is best to have a variety of gloves available. Double gloving may provide additional protection. Chemical-resistant aprons, suits and boots can also minimize dermal exposure.

Eye Exposure:

Full-face respirators, PAPR and SCBA will provide protection from both splashes and vapors. Protective eyewear, such as goggles or a face shield, will **not** provide protection from chemical vapors. Protective eyewear is necessary during decontamination to prevent splashing into eyes.

For more information, refer to *OSHA Best Practices for Hospital-Based First Receivers of Victims from Mass Casualty Incidents Involving the Release of Hazardous Substances*. Available at:

http://www.osha.gov/dts/osta/bestpractices/firstreceivers_hospital.pdf

DECONTAMINATION GUIDELINES

Decontamination is the most important first step in patient care. Confirm or provide patient decontamination upon arrival.

To decontaminate:

- Immediately remove patient clothing. Removed clothing should be double bagged and sealed.
- Flush patient eyes with plenty of water or normal saline.
- Wash patient skin with soap and water. Do not abrade skin. Follow with a thorough water rinse.
- Do not use bleach, concentrated or diluted, on people.

AGENTS

Table 1. RECOGNIZING, DIAGNOSING, AND TREATING HEALTH EFFECTS OF CHEMICAL AGENTS

Agent Type	Agent Names	Mode of Action	Any Unique Characteristics	Signs and Symptoms	Treatment	Other Patient Considerations
Nerve (See Table 2 below)	- Cyclohexyl sarin (GF) - Sarin (GB) - Soman (GD) - Tabun (GA) - VX - Some insecticides (cholinesterase inhibitors) - Novichok agents/ Soviet V	- Inactivate acetylcholinesterase enzymes, causing both muscarinic and nicotinic effects	- Miosis (pinpoint pupils) - Copious secretions/ sweating - Muscle twitching/ fasciculations	- Miosis (pinpoint pupils) - Blurred/dim vision - Headache - Nausea, vomiting, diarrhea - Copious secretions/ sweating - Muscle twitching/ fasciculations - Dyspnea - Seizures - Loss of consciousness	- Confirm patient decontamination - **See nerve agent antidote Table 2 below** - Atropine before other measures - Pralidoxime (2-PAM) chloride	- Onset of symptoms from dermal contact with liquid forms may be delayed - Repeated antidote administration may be necessary
Asphyxiant / Blood (See Table 3 below)	- Arsine - Cyanogen chloride - Hydrogen cyanide	- Arsine: Causes massive intravascular hemolysis which may lead to anemia, jaundice and renal failure. - Cyanogen chloride/ hydrogen cyanide: Cyanide binds with iron in cytochrome a_3 preventing intracellular oxygen utilization. The cell then uses anaerobic metabolism, creating excess lactic acid and metabolic acidosis.	- Possible skin color changes: cherry-red (cyanide or cyanogen chloride); yellow or bronze (arsine) - Possible cyanosis - Possible frostbite*	- Confusion - Nausea - Gasping for air, similar to asphyxiation but more abrupt onset - Seizures - Metabolic acidosis (cyanide or cyanogen chloride)	- Confirm patient decontamination - Rapid treatment with oxygen - For cyanide, use sodium nitrite or amyl nitrite, if available, and then sodium thiosulfate - **See cyanide antidote Table 3 below** - Vigorous supportive care may aid recovery of some patients even without specific antidote - Arsine has no specific antidote	- Arsine and cyanogen chloride may cause delayed pulmonary edema
Choking / Pulmonary-damaging	- Chlorine - Hydrogen chloride - Nitrogen oxides - Phosgene	- Acids or acid-forming agents which react with cytoplasmic proteins and destroy cell structure	- Chlorine is a greenish-yellow gas with pungent odor - Phosgene gas may smell like newly-mown hay or grass - Possible frostbite*	- Eye and skin irritation - Airway irritation - Dyspnea, cough - Sore throat - Chest tightness - Wheezing - Bronchospasm	- Confirm patient decontamination - Fresh air, forced rest - Semi-upright position - If signs of respiratory distress are present, oxygen with or without positive airway pressure may be needed - Maintain adequate oxygenation - No specific antidote	- May cause delayed pulmonary edema, even following a symptom-free period that varies in duration with the amount inhaled - May lead to ARDS (Acute Respiratory Distress Syndrome)

Agent Type	Agent Names	Mode of Action	Any Unique Characteristics	Signs and Symptoms	Treatment	Other Patient Considerations
Blistering/ Vesicant (See Table 4 below)	- Mustard/Sulfur mustard (HD, H) - Nitrogen mustard (HN-1, HN-2, HN-3) - Lewisite (L) - Phosgene oxime (CX)	- Exact mechanisms of biologic activity are unknown - Mustard: Forms metabolites that bind to enzymes, proteins and other cellular components - Lewisite: Binds to thiol groups in many enzymes -Phosgene oxime: Mechanism unknown, but corrosive like strong acids	- Mustard (HD) may have an odor like horseradish, garlic, or mustard - Lewisite (L) may have an odor like geranium - Phosgene oxime (CX) may have a pepper-like or pungent odor	- Skin, eye and mucosal irritation - Skin erythema and blistering - Tearing, conjunctivitis, corneal damage - Mild respiratory distress to marked airway damage	- Confirm patient decontamination - If dyspneic, give oxygen - Specific antidote British Anti-Lewisite (BAL) may decrease systemic effects of Lewisite - **See Lewisite antidote Table 4 below** - Mustard and phosgene oxime have no specific antidotes	- Possible pulmonary edema - Mustard has an asymptomatic latent period - Lewisite has immediate burning pain, blisters later - Phosgene oxime causes immediate pain - Monitor electrolyte balance; fluid loss is likely to be less than in comparable thermal burns - Neutropenia and sepsis
Incapacitating / Behavior-altering (See Table 5 below)	- Agent 15/BZ	- Competitively inhibits acetylcholine which disrupts muscarinic transmission in central and peripheral nervous systems (atropine-like action)	- May appear as mass drug intoxication with erratic behaviors, shared realistic and distinct hallucinations, disrobing and confusion - Hyperthermia - Mydriasis (dilated pupils)	- Dry mouth and skin - Initial tachycardia - Altered consciousness, delusions, denial of illness, belligerence - Hyperthermia - Ataxia (lack of coordination) - Hallucinations - Mydriasis (dilated pupils)	- Confirm patient decontamination - Evaluate mental status - Use restraints as needed - Monitor core temperature carefully - Specific antidote physostigmine may be available - **See Agent 15/BZ antidote Table 5 below**	- Hyperthermia and self-injury are greatest risks - Hard to detect because it is an odorless and non-irritating substance - Possible serious arrhythmias
Cytotoxic Protein	- Ricin - Abrin	- Inhibit protein synthesis	- Exposure by inhalation or injection causes more pronounced signs and symptoms than exposure by ingestion	- Latent period of 4-8 hours, followed by flu-like signs and symptoms - Progress within 18-24 hours to: - Nausea, cough, dyspnea, pulmonary edema (inhalation exposure) - GI hemorrhage with emesis and diarrhea; hypovolemic shock; hepatic, splenic and renal failure (ingestion exposure)	- Confirm patient decontamination - Maintain fluid/ electrolyte balance - Maintain adequate oxygenation - Provide pain management - No specific antidote	- Rapid progression of signs and symptoms - Death possible within 36 hours - If patient survives beyond 5 days without complications, recovery is likely

* Frostbite may occur from skin contact with liquid arsine, cyanogen chloride or phosgene.

ANTIDOTES

Table 2. NERVE AGENT ANTIDOTE RECOMMENDATIONS

Nerve agent antidotes may be obtained as auto-injector syringes. These devices rapidly deliver antidotes intramuscularly, typically to the thigh or buttocks. Atropine, in auto-injector form, is available as the AtroPen in amounts of 0.5, 1, or 2 mg. 2-PAM chloride, in auto-injector form, is available as the 600 mg ComboPen. A Mark I kit contains two auto-injector syringes; the smaller one with 2 mg atropine and the larger one with 600 mg 2-PAM chloride.

The spring-loaded design of the auto-injectors provides a forceful delivery that may cause tissue damage, especially to children and smaller patients. Children weighing less than 15 lb (about 7 kg), generally those younger than 6 months old, should not ordinarily be treated with the nerve agent antidote auto-injectors. In this age group, atropine should be individualized at doses of 0.05 mg/kg.

Patient	Mild/Moderate Effects[1]	Severe Effects[2]	Other Treatment
Child	Atropine: 0.05 mg/kg IM **or** IV (minimum 0.1 mg, maximum 5 mg); **and** 2-PAM chloride: 25 mg/kg IM **or** IV (maximum 2 g IM **or** 1 g IV)	Atropine: 0.1 mg/kg IM **or** IV (minimum 0.1 mg, maximum 5 mg); **and** 2-PAM chloride: 50 mg/kg IM **or** IV (maximum 2 g IM **or** 1 g IV)	Assisted ventilation after antidotes for severe exposure. **Repeat atropine** at 2-5 minute intervals until secretions have diminished and breathing is comfortable or airway resistance has returned to near normal. **Repeat 2-PAM chloride** once at 30-60 minutes, then at one-hour intervals for 1-2 doses, as necessary. **Diazepam** for seizures: Child - 0.05 to 0.3 mg/kg IV (maximum 10 mg); Adult - 5 mg IV **Other benzodiazepines (e.g. lorazepam, midazolam)** may provide relief. **Phentolamine** for 2-PAM chloride-induced hypertension: 1 mg IV for children; 5 mg IV for adults.
Adult	Atropine: 2 to 4 mg IM **or** IV; **and** 2-PAM chloride[3]: 600 mg IM, **or** 25 mg/kg IV slowly	Atropine: 6 mg IM; **and** 2-PAM chloride[3]: 1,800 mg IM, **or** 50 mg/kg IV slowly	

1. **Mild/Moderate effects of nerve agents** include localized sweating, muscle fasciculations, nausea, vomiting, weakness, dyspnea.
2. **Severe effects of nerve agents** include unconsciousness, seizures, apnea, flaccid paralysis.
3. Dose selection of 2-PAM chloride for elderly patients should be cautious (usually starting at 600 mg IM, or 25 mg/kg IV slowly) to account for the generally decreased organ functions in this population.

NOTE: 2-PAM chloride is pralidoxime chloride or Protopam Chloride.

CHEMPACK: CHEMPACK is a federal program to provide nerve agent antidotes (Atropine, 2-PAM, Diazepam) to medical personnel during an emergency. Contact your county EMS coordinator, health department or emergency management office for more information.

Table 3. CYANIDE ANTIDOTE RECOMMENDATIONS

Victims whose clothing or skin are contaminated with hydrogen cyanide liquid or solution can secondarily contaminate response personnel by direct contact or through off-gassing vapors. Avoid dermal contact with cyanide-contaminated victims or with gastric contents of victims who may have ingested cyanide-containing materials. Victims exposed **only** to hydrogen cyanide gas do not pose contamination risks to rescuers. **If the patient is a victim of recent smoke inhalation (may have high carboxyhemoglobin levels), administer only sodium thiosulfate.**

Patient	Mild (conscious)	Severe (unconscious)	Other Treatment
Child	If patient is conscious and has no other signs or symptoms, antidotes may not be necessary.	Sodium nitrite[1]: 0.12 - 0.33 ml/kg, not to exceed 10 ml of 3% solution[2] (300 mg) slow IV over absolutely no less than 5 minutes, or slower if hypotension develops **and** Sodium thiosulfate: 1.65 ml/kg of 25% solution IV over 10 - 20 minutes[3]	For sodium nitrite-induced orthostatic hypotension, normal saline infusion and supine position are recommended. If still apneic after antidote administration, consider sodium bicarbonate for severe acidosis.
Adult	If patient is conscious and has no other signs or symptoms, antidotes may not be necessary.	Sodium nitrite[1]: 10 - 20 ml of 3% solution[2] slow IV over absolutely no less than 5 minutes, or slower if hypotension develops **and** Sodium thiosulfate: 50 ml of 25% solution (12.5 g) IV over 10 - 20 minutes[3]	

1. If sodium nitrite is unavailable, administer amyl nitrite by inhalation from crushable ampules. If neither is available, use sodium thiosulfate alone.
2. Available from Taylor Pharmaceuticals in cyanide antidote kit, formerly known as the Pasadena or Lilly Cyanide Antidote Kit.
3. If there is an inadequate clinical response after 30 minutes, administer a second dose of sodium thiosulfate which is half the initial dose.

Table 4. LEWISITE ANTIDOTE RECOMMENDATIONS

British Anti-Lewisite (BAL, dimercaprol) was developed as an antidote for Lewisite and is used medicinally as a chelating agent for heavy metals. BAL can be toxic; healthcare providers should read the package insert carefully prior to use. Consult your regional Poison Control Center.

British Anti-Lewisite dosing			
Indications	**Dosing for systemic effects**	**Contraindications**	**Other Treatment**
Due to toxic side effects, BAL should be administered **only** to patients who have signs of shock or significant pulmonary injury. There is evidence that BAL in oil, given intramuscularly, may reduce the systemic effects of Lewisite. BAL, administered IM, has no effect on local lesions of the skin, eyes or airways (See Other Treatment).	IM: 3-5 mg/kg every 4 hours for 4 doses **IV: Never administer BAL in oil via IV route.**	Do **not** administer BAL if the patient presents with any of the following: • pre-existing renal disease • pregnancy (except in life-threatening circumstances) • concurrent use of medicinal iron	BAL skin and ophthalmic ointment decreases the severity of skin and eye lesions when applied immediately after decontamination; however, neither is currently manufactured. They can be used if available.

Table 5. AGENT 15/BZ ANTIDOTE RECOMMENDATIONS

Consult your regional Poison Control Center.

Physostigmine dosing			
Test dose	**Dosing information** [1]	**All routes**	**Contraindications**
If the diagnosis is in doubt, a dose of 1 mg might be given. If slight improvement occurs, routine dosing should begin.	IM: 45 mcg/kg in adults (20 mcg/kg in children) **or** IV: 30 mcg/kg slowly (1 mg/min) **or** PO: 60 mcg/kg if patient is cooperative (dilute in juice due to bitter taste)	Titrate every 60 minutes to mental status.	Do **not** administer physostigmine if the patient is experiencing any of the following: • cardiopulmonary compromise • hypoxia • bronchospasm • acid-base imbalance with history of seizure disorder • acid-base imbalance with history of arrhythmias

1. Physostigmine may be minimally effective if given in the first 4-6 hours following exposure.

MEDICAL PREPAREDNESS REFERENCES AND RESOURCES

1. Agency for Toxic Substances and Disease Registry (ATSDR). 2001. Managing Hazardous Materials Incidents Vol. I, II, III. Division of Toxicology, U. S. Department of Health and Human Services. Public Health Service: Atlanta, GA. http://www.atsdr.cdc.gov/mhmi.html

2. Centers for Disease Control and Prevention Public Health Emergency Preparedness and Response http://www.bt.cdc.gov/Agent/AgentlistChem.asp

3. Chemical Casualty Care Division USAMRICD. 2000. Medical Management of Chemical Casualties Handbook, Third edition. U.S. Army Medical Research Institute of Chemical Defense (USAMRICD). Aberdeen Proving Ground: Aberdeen, MD. https://ccc.apgea.army.mil/sarea/products/handbooks/MMCC/mmccthirdeditionjul2000.pdf

4. National Center for Disaster Preparedness. 2003. Pediatric Preparedness for Disasters and Terrorism: A National Consensus Conference, Executive Summary. Mailman School of Public Health, Columbia University: New York City.

5. Textbook of Military Medicine - Medical Aspects of Chemical and Biological Warfare. https://ccc.apgea.army.mil/sarea/products/textbook/Web_Version/index_2.htm

6. U.S. Army Edgewood Research, Development and Engineering Center. 1999. Technician EMS Course. Domestic Preparedness Training Program, Version 8.0. U.S. Army SBCCOM. Aberdeen Proving Ground: Aberdeen, MD.

DISCLAIMER

The information on this wall chart is meant to be a quick guide and is not intended to be comprehensive. Exercise professional judgment in determining antidote dosages. Also, consult the listed websites, references, and your regional Poison Control Center.

Revised: July 2005