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 an important aspect to preparedness for terrorism-related events. This wall chart is a quick guide, summary of important information. Healthcare providers should be alert to patterns of illness and reports of chemical exposures that might signal an act of chemical terrorism event.

CDC LRN-C sample collection, packaging, and shipping, SCPaS, see the internet reference at the bottom center of this wall chart.

Clinical, epidemiological or circumstantial clues that may suggest a chemical terrorist event:

- Unusual increase in the number of people seeking care with respiratory, neurological, dermatological or gastrointestinal symptoms.
- Clustering of symptoms or unusual age distribution e.g., chemical exposure in children.
- Unusual clustering of patients in time or location including those who attended the same public or private event.
- Location of a chemical release not consistent with expected use.
- Simultaneous impact to human, animal and plant populations.
- Accidental exposure to chemical agent as historical ocean-dumped ordnance, 9-12" military ordnance (Sulfur Mustard), through commercial or recreational fishing. The chemical-agent ordnance may wash ashore with potential exposure to recreational bathers or fishermen.
- Terrorist use of pure or clandestine-synthesized impure chemical warfare agents.

Any unusual symptoms, illnesses or clusters should be reported immediately. Notify the New Jersey Poison Control Center (1-800-222-1222), and DEP ALERT (1- 877-927-6337).

DISCLAIMER: Information provide in wall chart is a quick guide. Emergency staff and hospital clinical staff must confirm treatments with appropriate-current CDC, ATSDR, and medical references.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

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 fromMass Casualty Incidents Involving the Release of Hazardous Substances. Available at: http://www.osha.gov/dts/osta/bestpractices/firstreceivers_hospital.pdf

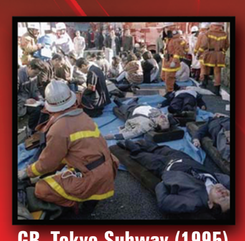
DO NOT BECOME A CASUALTY!

DECONTAMINATION GUIDELINES

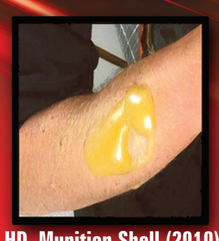
Decontamination is the most important first step in patient care. Confirm or provide patient decontamination upon arrival.

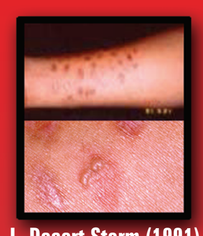
To decontaminate:

- Immediately remove patient clothing, double bag and seal.
- Flush patient eyes with plenty of water or normal saline.
- Wash patient skin with soap and water, no abrasion and final water rinse.
- Do not use bleach, concentrated or diluted, on people.


GB, Tokyo Subway (1995)

CN, Auschwitz, WWII


HD, Munition Shell (2010)


L, Desert Storm (1991)

Cytotoxic Protein


GB, GF, VX, HD
Halabja, Kurdistan (1988)

Agents

Table 1. For CHEMICAL TERRORISM, RECOGNIZE, DIAGNOSE, OBTAIN INDICATIVE-TESTS, TREAT, and OBTAIN DEFINITIVE TESTS for the AGENT, its METABOLITE or BIOMARKER SURROGATE.

Chemical Agent Classification	Agent Names	Mode of Action and Toxicity	Symptoms	Indicative Tests	Treatment (See Tables 2-6)	Definitive Tests: Clinical Samples sent to NJPHEAL or CDC LRN-C
Nerve Agents **Sarin, GB**	Cyclohexylsarin, GF; **Sarin, GB**; Soman, GD; Russian (Soviet) rVX; and VX	Inhibits acetyl cholinesterase. Inhalation: **Sarin (GB)**: LCt_{50} = 100 mg.min/m^3 VX: LCt_{50} = 10 mg.min/m^3.	Miosis (pinpoint pupils). Rhinorrhea; bronchorrhea; obstructed breathing; unconsciousness; seizures; flaccid paralysis, apnea.	Depression of both erythrocyte (red blood cells) and plasma cholinesterase within several hours of exposure.	Mechanical ventilation. Atropine (anticholinergic); Pralidoxime chloride (2-PAMCl); Diazepam (prolonged seizures).	**Metabolites** in Urine are GF-acid, **GB-acid**, GD-acid, rVX-acid and VX-acid Reportable Range: 1 - 200 ppb.
Asphyxiants **Cyanide, CN** **Hydrogen Cyanide, HCN**	Cyanide Salt Hydrogen Cyanide Gas	Cyanide binds iron in cytochrome a3 reduces intracellular oxygen utilization. Inhalation: LCt_{50} = 2500 – 5000 mg.min/m^3.	Cyanosis is a late-finding. Reduced reflexes at 1000 – <2500 ppb; coma/ death 2500 – >3000 ppb CN in blood.	Lactic acidosis (CN interferes with lactate oxidation by liver); arterial oxygen is normal but venous oxygen is high.	Mechanical ventilation. Antidote: Sodium nitrite or amyl nitrite, and then sodium thiosulfate. Alternative antidote: B_{12a}, hydroxocabalamin.	**Cyanide** in Whole Blood Cyanide, CN Reportable Range: 25 - 2500 ppb.
Blistering Vesicant I **Sulfur Mustard, HD**; distilled Sulfur Mustard, >96% purity	Sulfur Mustard (HD) persistent oily liquid that slowly evaporates.	Lipid soluble, irreversibly binds to skin. LD_{50} = 0.7 mg/kg oral. Inhalation: LCt_{50} = 1500 mg.min/m^3.	Latency period is hours to days. Incapacitating eye, skin injuries, and respiratory disease.	None, obtain definitive test for **SBMTE**, the HD metabolite in urine for confirmation of exposure.	Skin blisters: < 2 cm apply antibiotics and cover; when > 2 cm debride and irrigate.	**Metabolite** in Urine **SBMTE** or 1,1'-sulfonylbis [2(methylthio)ethane] Reportable Range: 0.1 – 3100 ppb
Blistering Vesicant II **Lewisite, L (Arsenical)**	Lewisite (L) persistent oily liquid that slowly evaporates.	Skin: systemic poison. Inhalation: pulmonary edema; hypotension. Toxicity: blisters > 14 ug; $LDLo$ = 37.6 mg/ kg; and LD_{50} = 2.8 gm (skin). LCt_{50} = 20 mg.min/m^3.	Immediate. Dermal: burns, erythema, blisters. Eyes: incapacitating burns and inflammation of cornea. Inhalation: respiratory tract mucosa and may cause death.	None, obtain definitive test for CVAA, the metabolite in urine, for confirmation of Lewisite, L, exposure.	Skin blister < 2 cm apply antibiotics, and cover; when > 2 cm debride and irrigate. BAL (British Anti-Lewisite), dimercaprol, 4-5 mg/kg IM; severe: additional 2 mg/kg q.d. (once per day) for 3-4 d.	**Metabolite** in Urine, **CVAA** (2-chlorovinylarsonous acid) Reportable Range: 11 – 3850 ppb
Cytotoxic Proteins **Ricin, Abrin**	Ricin (*Ricinus communis*, Castor Bean) as powder or solution. Abrin (*Abrus precatorius*, Rosary Pea) as powder or solution.	Injection and Inhalation: militarized powder. **Ricin**: LD_{50} 22 ug/kg; **Abrin**: LD_{50} 0.7 ug/kg. Ingestion: Lethal dose 20-30 mg/ kg.	Vomiting, diarrhea, seizures, and blood-in-urine. Multi-organ failure; death is possible in 3 - 5 days.	None; obtain definitive tests for Ricinine and Abrine biomarkers in urine as confirmation of exposure to Ricin/Abrin cytotoxic proteins.	Mechanical ventilation. Supportive care: respiration therapy, fluids, medication for seizure, and low-BP. Ingestion < 1 hour: flushing stomach with charcoal slurry.	**Surrogate Biomarkers** (Naturally occurring with each Cytotoxin protein) in Urine: **Ricinine** Reportable Range: 0.3 – 300 ppb; **Abrine** Reportable Range: 3.5 – 3500 ppb

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 AutoPen 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 chloride3: 600 mg IM, or 25 mg/kg IV slowly	Atropine: 6 mg IM; and 2-PAM chloride3: 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: 0.12 - 0.33 mL/kg, not to exceed 10 mL of 3% solution (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.	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. Oxygen Therapy: the human liver will metabolize cyanide quickly in low doses.
Adult	If patient is conscious and has no other signs or symptoms, antidotes may not be necessary.	Sodium nitrite: 10 - 20 mL of 3% solution 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	

Alternative Cyanide Antidote

Patient	Mild (conscious)	Severe (unconscious)	Other Treatment
Child	If patient is conscious and no other symptoms, antidote may not be necessary.	Cyanokit ® (hydroxocobalamin for injection) 70 mg/kg IV infusion over 15 minutes.	Second dose may be used (patient in extremis) over a 15 min to 2 hour period.
Adult	If patient is conscious and no other symptoms, antidote may not be necessary.	Cyanokit ® (hydroxocobalamin for injection) 5 g IV over 15 min; the diluent is 0.9% NaCl.	Second dose may be used (patient in extremis) over a 15 min to 2 hour period.

Hydroxocobalamin may not be readily available at Sentinel or ER hospitals

Centers for Disease Control and Prevention, Shipping Instructions for Specimens Collected from People Who May Have Been Exposed to Chemical-Terrorism Agents: http://emergency.cdc.gov/labissues/pdf/shipping-samples.pdf, accessed 11/23/11.

Table 4. SULFUR MUSTARD TREATMENT OPTIONS

Sulfur mustard patient may be asymptomatic for 2 - 24 hours. Sulfur mustard is more dense than air; stable – persistent, mutagenic and carcinogenic chemical. Target organs: skin, eyes and lungs.

Patient	Mild (Blisters < 2% body surface)	Severe (Vesicles > 2-5% body surface, penetrates clothing)	Other Treatment
Child	Blisters: < 2 cm cover with topical antibiotics.	Confirm decontamination. Dyspneic: provide oxygen. Pulmonary edema may occur. Treat burns: first/second degree with convalescence.	Vesicles > 2 cm debride; irrigate with sterile saline (aq); topical antibiotics: silver sulfadiazine. Eyes: irrigate; apply topical antibiotics; petroleum jelly may be applied to eyelids.
Adult	Blisters: < 2 cm cover with topical antibiotics.	Confirm decontamination. Dyspneic: provide oxygen. Pulmonary edema may occur. Patient may need continuing care for burns.	

Table 5. LEWISITE (L) 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.

Patient	Mild (Blisters < 2 cm)	Severe (Vesicles > 2 cm)	Other Treatment
Child	Blisters: < 2 cm cover with topical antibiotics.	Administer as in adults using weight-based dosing. 1 mL/ 50 lbs patient weight.	Vesicles > 2 cm debride; irrigate with sterile saline (aq); topical antibiotics: silver sulfadiazine. Eyes: irrigate; apply topical antibiotics; petroleum jelly may be applied to eyelids.
Adult	Blisters: < 2 cm cover with topical antibiotics.	IM: 4-5 mg/ kg or 1 mL/ 50 lbs patient weight; repeat 4 hours for four (4) doses. IV: Never administer BAL in oil.	

Table 6. CYTOTOXIC PROTEIN TREATMENT OPTIONS

Ricin protein, *Ricinus communis,* Castor Bean; Abrin protein, *Abrus precatorius,* Rosary Pea, from weaponized powder or IV aqueous solution. Inhalation and skin exposure are most toxic; oral exposure is less toxic. Multiple-organ damage is likely in survivors. Ricin/Abrin may cause death.

Patient	Mild	Severe	Other Treatment
Child	Supportive care and treatment.	Confirm patient decontamination. Supportive care: respiration therapy, fluids, treat for seizure/ low-blood pressure. Recent Ingestion: flush stomach with charcoal slurry.	Antidotes for Ricin are in human clinical trials. Ricin vaccination trials for US military personnel are being studied.
Adult	Supportive care and treatment.	Confirm patient decontamination. Supportive care: respiration therapy, fluids, treat for seizure/ low-blood pressure. Recent Ingestion: flush stomach with charcoal slurry.	

Chris Christie, *Governor*
Kim Guadagno, *Lt. Governor*
Mary E. O'Dowd, MPH, *Commissioner*
Christina Tan, MD, *State Epidemiologist*
New Jersey Poison Control New Jersey Poison Information, Education System (NJPIES)
December 2011
H5642