

CHEMICAL TERRORISM AGENTS AND SYNDROMES: Watch for these signs and symptoms

Agents	Signs	Symptoms	Onset	Clinical Diagnostic Tests	Exposure Route and Treatment	Differential diagnosis
Nerve Agents: Sarin (GB); Tabun (GA); Soman (GD); Cyclohexyl Sarin (GF); VX; Novichok agents, other organophosphorus compounds including carbamates and pesticides	Pinpoint pupils (miosis) Bronchoconstriction Respiratory arrest Hypersalivation Increased secretions Diarrhea Decreased memory, concentration Loss of consciousness Seizures	Moderate exposure: Diffuse muscle cramping, runny nose, difficulty breathing, eye pain, dimming of vision, sweating, muscle tremors. High exposure: The above plus sudden loss of consciousness, seizures, flaccid paralysis (late sign)	Aerosols: Seconds to minutes Liquids: minutes to hours	Red blood cell or serum cholinesterase (whole blood) Treat based on signs and symptoms; lab tests only for later confirmation	Inhalation and dermal absorption Atropine (2mg) IV; repeat q 5 minutes, titrate until effective, average dose 6 to >15 mg – use IM in the field before IV access (establish airway for oxygenation) Pralidoxime chloride (2-PAMCl) 600-1800 mg IM or 1.0 g IV over 20-30 minutes (maximum 2 g IM or IV per hour) Additional doses of atropine and 2-PAMCl depending on severity Diazepam or lorazepam to prevent seizures if >4 mg atropine given Ventilatory support	Poisoning from organophosphate and carbamate pesticides may occur as a result of occupational exposure Cyanide poisoning Myasthenia gravis
Cyanides: hydrogen cyanide (HCN), cyanogen chloride	Moderate exposure: Metabolic acidosis, venous blood-O ₂ level above normal, hypotension, "pink" skin color High exposure: Above signs plus coma, convulsions, cessation of respiration and heartbeat	Moderate exposure: Giddiness, palpitations Dizziness, nausea, vomiting, headache, eye irritation, increase in rate and depth of breathing (hyperventilation), drowsiness High exposure: Immediate loss of consciousness, convulsions and death within 1 to 15 minutes	Seconds to minutes	Bitter almond odor associated with patient suggests cyanide poisoning Metabolic acidosis Cyanide (blood) or thiocyanate (blood or urine) levels Treat based on signs and symptoms; lab tests only for later confirmation	Inhalation, ingestion and dermal absorption 100% oxygen by face mask; intubation with 100% FiO ₂ if indicated Amyl nitrite via inhalation, 1 ampule (0.2 mL) q 5 minutes Sodium nitrite (300 mg IV over 5-10 minutes) and sodium thiosulfate (12.5 g IV) Additional sodium nitrite should be based on hemoglobin level and weight of patient	Similar CNS illness can result from: Industrial/occupational exposure to HCN and derivatives; carbon monoxide (CO) exposure from incomplete combustion of natural gas or petroleum fuels (exhaust fumes in enclosed areas); hydrogen sulfide (H ₂ S) exposure from sewers, animal waste, industrial sources) Poisoning from nerve agents
Vesicants/Blister Agents: sulfur mustard, lewisite, nitrogen mustard, mustard lewisite, phosgene-oxime	Skin erythema and blistering; watery, swollen eyes; upper airways sloughing with pulmonary edema; metabolic failure; neutropenia and sepsis (esp. sulfur mustard, late in course)	Burning, itching, or red skin Mucosal irritation (prominent tearing, and burning and redness of eyes) Shortness of breath Nausea and vomiting	Lewisite, minutes; Sulfur mustard, hours to days	Often smell of garlic, horseradish, and/or mustard on body Oily droplets on skin from ambient sources Urine thiodiglycol Tissue biopsy (USAMRICD)	Inhalation and dermal absorption Mustards no antidote For lewisite and lewisite/mustard mixtures: British Anti-Lewisite (BAL or Dimercaprol) IM (rarely available) Thermal burn therapy; supportive care (respiratory support and eye care)	Diffuse skin exposure with irritants, such as caustics, sodium hydroxides, ammonia, etc., may cause similar syndromes. Sodium hydroxide (NaOH) from trucking accidents
Pulmonary/Choking Agents: phosgene, chlorine, diphosgene, chloropicrin, oxides of nitrogen, sulfur dioxide	Pulmonary edema with some mucosal irritation (greater water solubility of agent = greater mucosal irritation) leading to ARDS or non-cardiogenic pulmonary edema Pulmonary infiltrate	Shortness of breath Chest tightness Wheezing Laryngeal spasm Mucosal and dermal irritation and redness	1-24 hours (rarely up to 72 hours); May be asymptomatic period of hours	No tests available but history may help identify source and exposure characteristics (majority of incidents generating exposures to humans involve trucking with labels on vehicle)	Inhalation No antidote Management of secretions; O ₂ therapy; consider high dose steroids to prevent pulmonary edema (demonstrated benefit only for oxides of nitrogen) Treat pulmonary edema with PEEP to maintain PO ₂ above 60 mm Hg	Mucosal irritation, airway reactions, and deep lung effects depend on the specific agent, especially water solubility
Ricin (castor bean oil extract)	Clusters of acute lung or GI injury; circulatory collapse and shock, tracheobronchitis, pulmonary edema, necrotizing pneumonia	Ingestion: Nausea, diarrhea, vomiting, fever, abdominal pain Inhalation: chest tightness, coughing, weakness, nausea, fever	18-24 hours 8-36 hours	ELISA (from commercial laboratories) using respiratory secretions, serum, and direct tissue	Inhalation and Ingestion No antidote Supportive care For ingestion: charcoal lavage	Tularemia, plague, and Q fever may cause similar syndromes, as may biological weapons and chemical weapon agents such as Staphylococcal enterotoxin B and phosgene
T-2 mycotoxins: Fusarium, Myrothecium, Trichoderma, Verticillium, Stachybotrys	Mucosal erythema and hemorrhage (intestinal necrosis) Red skin, blistering Increased salivation Pulmonary edema Seizures and coma Liver/renal dysfunction	Dermal and mucosal irritation; blistering, necrosis Blurred vision, eye irritation, tearing Nausea, vomiting, and diarrhea Ataxia coughing and dyspnea	2-4 hours	ELISA from commercial laboratories Gas chromatography/Mass spectroscopy in specialized laboratories	Inhalation and dermal contact No antidote Supportive care For ingestion: charcoal lavage Consider high dose steroids	Pulmonary toxins (O ₃ , NO _x , phosgene, NH ₃) may cause similar syndromes though with less mucosal irritation.

- Centers for Disease Control and Prevention. Demilitarization of Chemical Weapons. <http://www.cdc.gov/nceh/demil/articles/initialtreat.htm>.
- Centers for Disease Control and Prevention. Chemical Agents Listing and Information. <http://www.bt.cdc.gov/Agent/AgentlistChem.asp>.
- Committee on R&D Needs for Improving Civilian Medical Response to Chemical and Biological Terrorism Incidents, Institute of Medicine. Chemical and Biological Terrorism. Washington, DC: National Academy Press. 1999 <http://www.nap.edu/catalog/6364.html>
- The Henry L. Stimson Center. Chemical and Biological Weapons Nonproliferation Project. Table E: Medical Characteristics of Chemical Warfare Agents <http://www.stimson.org>.
- Macintyre AG, Christopher GW, Eitzen E, Gum R, Weir S, DeAtley C, et al. Weapons of mass destruction events with contaminated casualties: Effective planning for health care facilities. JAMA 2000;283:242-249.
- NIOSH/OSHA/USCG/EPA. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. Washington, D.C.: Department of Health and Human Services. 1985.
- US Army Medical Research Institute of Chemical Defense (USAMRICD) Medical Management of Chemical Casualties Handbook. 3rd ed. USAMRICD: Aberdeen Proving Ground, MD. July 2000. <http://ccc.apgea.army.mil/products/handbooks/mmccthirdeditionjul2000.pdf>
- Wannemacher RW, Wiener ST. Trichothecene mycotoxins. In: Sidell FR, Takafuji ET, Franz DR, eds. Medical Aspects of Chemical and Biological Warfare. Washington DC: Borden Institute, Walter Reed Army Medical Center. 1997. pages 655-676.

UNIVERSAL PERSONAL PROTECTIVE EQUIPMENT (PPE)*	NOTIFICATION PROCEDURES	FOR MORE INFORMATION	UNIVERSAL DECONTAMINATION PROTOCOL	DETECTION OF OUTBREAKS
<p>Level A: Maximum protection against vapor and liquids. Environment known to be immediately dangerous to life and health (harm occurs within 30 minutes). Fully encapsulating, chemical-resistant suit, chemically resistant gloves and boots, and a pressure-demand supplied air respirator (air hose) and escape self-contained breathing apparatus (SCBA)</p> <p>Level B: Minimum protection exposure to unknown hazards. Full respiratory protection is required but danger to skin/risk of dermal absorption from vapor is less. Agent not identified, or concentration not known to be safe (i.e., field decontamination or ambulatory setting). Nonencapsulating, splash-protective chemical resistant suit (splash suit), chemical resistant gloves and boots/shoes, and a pressure-demand supplied air respirator (air hose) and escape SCBA</p> <p>Level C: Until patient/victim decontamination completed. Organic vapor/P11 cartridge respirator or hood, nonencapsulating chemically-resistant (i.e., coated Tyvek) suit and gloves</p> <p>* Training required to properly and safely use PPE</p>	<ol style="list-style-type: none"> 1. First call the local Health Director; after hours contact local Health Director via 911. 2. If criminal activity is suspected, call your local law enforcement and the FBI. 3. Alert local HAZMAT team via fire department at 911. 	<ul style="list-style-type: none"> • Contact your local poison control center or National Poison Control 800-222-1222 • Contact your public health regional surveillance team • Contact your institution industrial hygienist or safety officer • Department of Justice Domestic Preparedness National Response Hotline 800-424-8802 • If you need further help in clinical diagnosis, call CDC Emergency Response 770-488-7100 • Review US Army Chemical Casualty Care handbook (http://ccc.apgea.army.mil) 	<ol style="list-style-type: none"> 1. Remove clothing quickly and seal in plastic impervious bags (save for authorities). Strongly recommended even if exposure only to vapor or aerosol agent. 2. Wash skin and shampoo with hypoallergenic liquid soap and copious tepid water in sequential steps of rinse, soap, rinse, wait one minute, then final additional rinse (20 minutes). 3. Latent response from cyanide or pulmonary agents do not require decontamination. 4. Decontamination waste water may require special collection or treatment. (Discuss with local water authorities; notify local water authorities at the time of an event.) 5. Pure metals and strong corrosives require dry decontamination (i.e., gentle brushing or vacuuming of larger particles) before water is applied. 6. Clean and decontaminate the healthcare facility according to the specific agent involved. http://www.bt.cdc.gov/Agent/AgentlistChem.asp 	<p>Epidemiologic Strategies</p> <ul style="list-style-type: none"> • A rapidly increasing disease incidence • An unusual increase in the number of people seeking care, especially with neurologic, respiratory, dermal and/or gastrointestinal symptoms • Higher attack rate among persons who had attendance at similar activities or events (work site, convention, sports events) with either indoor or outdoor exposure. • Clusters of patients arriving from a single locale • Large numbers of rapidly fatal cases • Any patient presenting with symptoms and/or signs that suggest inhalation, ingestion, or dermal exposure to a toxic chemical agent

<p>Support provided by: The North Carolina Institute for Public Health and The North Carolina Center for Public Health Preparedness, in the School of Public Health at The University of North Carolina at Chapel Hill</p>	<p>Chart developed by: North Carolina Statewide Program for Infection Control and Epidemiology (SPICE) email: spice@unc.edu KK Hoffmann,* DJ Weber,* W Stopford,† CG Smith,‡ J Newmark,§ BI Maliner,§ EP Clontz,* WA Rutala*</p>
<p>In view of the possibility of human error or changes in medical sciences, neither the authors, nor the publisher, nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete. Readers are encouraged to confirm the information contained herein with other sources and check drug package inserts for warnings and contraindications.</p>	

* North Carolina Statewide Program for Infection Control and Epidemiology, University of North Carolina at Chapel Hill School of Medicine
 † Duke University Medical Center
 ‡ North Carolina Department of Health and Human Services and University of North Carolina at Chapel Hill
 § US Army Medical Research Institute of Chemical Defense