

This document aids healthcare providers in evaluating patients for potential exposure to toxic chemicals and provides them with appropriate steps to identify and treat patients in healthcare settings. **To report suspected cases, access diagnostic testing, or to obtain more information contact the Division of Disease Control at 215-685-6741, M-F, 8:30am – 5:00pm. After hours and on weekends and holidays call 215-686-4514 and press 1 for Unified Dispatch, ask for DDC On-Call staff. More information concerning treatment of chemical exposure can be found on the Centers for Disease Control and Prevention’s website at <https://centerforhealthsecurity.org/resources/fact-sheets-by-the-center-for-health-security>**

Potential incidents that could lead to an influx of patients exposed to toxic chemicals:

- Chemical terrorism
- Transportation Accidents (e.g. freight train accident/fire, truck carrying hazardous materials accident/fire)
- Industrial/Refinery fire, explosion, or disruption
- Chemical spill/Water contamination emergency
- Secondary emergency caused by a natural disaster/severe flooding

Common Signs & Symptoms and Associated Chemical Agents

Some chemical agents of concern associated with these toxic syndromes are listed below. These lists are not exhaustive, and most symptoms will be caused by common agents. Additional information on selected agents is provided on pages 2-8.

Seizures/Convulsions	Loss of Consciousness	Respiratory Symptoms (cough, difficulty breathing, drooling, etc.)	Eye Irritations (lacrimation, redness, etc.)	Irritated or Burning Skin (redness, rash, blistering, etc.)	Abdominal Symptoms (nausea, vomiting, diarrhea, etc.)
<ul style="list-style-type: none"> •Asphyxiant metabolic agents •Convulsant agents •Nerve agents •Organic solvents 	<ul style="list-style-type: none"> •Asphyxiant metabolic agents •Asphyxiant simple agents •Incapacitating agents •Nerve agents •Organic solvents 	<ul style="list-style-type: none"> •Asphyxiant metabolic agents •Asphyxiant simple agents •Biotoxins •Blister agents •Corrosive agents (inhaled) •Choking agents •Nerve agents •Organic solvents •Riot agents 	<ul style="list-style-type: none"> •Asphyxiant metabolic agents •Blister agents •Corrosive agents (inhaled, dermal, eye exposure) •Incapacitating agents (QNB) •Choking agents •Nerve agents •Riot agents 	<ul style="list-style-type: none"> •Blister agents •Corrosive agents (dermal, eye exposure) •Organic solvents •Riot agents 	<ul style="list-style-type: none"> •Asphyxiant metabolic agents •Biotoxins •Corrosive agents (ingested)

Agent	Signs	Symptoms	Route/Onset	Diagnostic Testing	Treatment
<p>Asphyxiants Metabolic/Blood Agents</p> <ul style="list-style-type: none"> • Cyanides (CN) • Hydrogen Sulfide (HS) • Carbon Monoxide (CO) • Methylene chloride (metabolized to CO in the body) • Sodium azide • Arsine • Aniline 	<p>Chemicals interfere with oxygen transport or with intracellular oxygen. Also known as “Knockdown Syndrome” as severe exposures of these agents can cause rapid loss of consciousness.</p> <ul style="list-style-type: none"> • Unreliable SpO₂ • Low EtCO₂ • Metabolic acidosis • Elevated lactate • Venous blood O₂ above normal • Patients have a bitter almond odor for CN • “Cherry red” skin and lips for CN and CO • Red eyes for HS • Signs of pulmonary edema (for HS) 	<p>Moderate Exposure</p> <ul style="list-style-type: none"> • Flushing of skin • Fatigue • Lightheadedness • Nausea and Vomiting • Abdominal pain • Shortness of Breath <p>High Exposure</p> <ul style="list-style-type: none"> • Same as above • Respiratory distress • Loss of Consciousness • Seizures/Convulsions 	<p>Route: Inhalation or Ingestion</p> <p>Onset: Can take seconds to minutes but overall is dependent on the chemical, route and level of exposure</p>	<p>Urine test; blood test</p>	<p>Manage airway; oxygen therapy; supportive care</p> <p>Available antidotes:</p> <p>Carbon monoxide: Hyperbaric oxygen</p> <p>Cyanide: Nithiodote (adult) – Sodium Nitrite 300mg/10mL IV over 5-10 minutes + Sodium Thiosulfate 12.5g/50 mL IV immediately after dose of Sodium Nitrite</p> <p>Nithiodote (pediatric) – Sodium Nitrite 0.2 mL/kg (max 10 mL) IV over 5-10 minutes + Sodium Thiosulfate 1.6 mg/kg of 25% preparation immediately after dose of Sodium Nitrite</p> <p>OR</p> <p>Cyanokit (adult): Hydroxocobalamin 70mg/kg to max 5 grams IV over 15 minutes; additional dose based on severity</p> <p>Aniline: Methylene Blue (adult): 1-2 mg/kg of a 1% solution IV over 5 minutes; additional doses dependent on severity</p> <p>Methylene Blue (neonatal): 0.3-1 mg/kg IV over 5 minutes; additional doses dependent on severity</p>

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					No antidote available for Arsine, Hydrogen sulfide, Methylene chloride, Sodium azide
Asphyxiants Simple/Blood Agents: <ul style="list-style-type: none"> • Nitrogen • Carbon dioxide • Propane • Methane • Noble gas (e.g. Argon) 	Chemicals that cause hypoxemia due to oxygen displacement in an enclosed environment. <ul style="list-style-type: none"> • Tachycardia • Tachypnea • Anxiety 	<ul style="list-style-type: none"> • Fatigue • Altered Mental Status • Respiratory distress • Loss of consciousness 	Route: Inhalation Onset: dependent on the chemical, route and level of exposure	Use history to identify source (e.g. were they found in a confined space or fire, did they improve upon removal from their environment)	Manage airway; oxygen therapy; supportive care No antidotes available
Biotoxins <ul style="list-style-type: none"> • Abrin • Colchicine • Ricin • Strychnine • Tetrodotoxin 	Substances that are both toxic and have a biological origin, such as fungi, animals, and plants. <ul style="list-style-type: none"> • Clusters of acute lung or GI injury • Circulatory collapse and shock • Tracheobronchitis, • Pulmonary edema • Necrotizing pneumonia • Dehydration 	<ul style="list-style-type: none"> • Nausea, Vomiting, Diarrhea • Fever • Abdominal pain • Chest tightness • Coughing • Weakness 	Route: Inhalation or ingestion Onset: hours	ELISA using respiratory secretions, serum, and direct tissue	Supportive care Available antidotes: Charcoal Lavage (if ingested)
Blister/Vesicant Agents <ul style="list-style-type: none"> • Sulfur Mustard • Lewisite • Mustard-Lewisite • Nitrogen Mustard • Phosgene Oxime • T2 Mycotoxins 	Chemicals that severely blister the eyes, respiratory tract, gastrointestinal (GI) tract, and skin on contact. <ul style="list-style-type: none"> • Skin erythema and blistering • Red, watery and swollen eyes 	<ul style="list-style-type: none"> • Burning, itching, red skin • Eye irritation • Difficulty breathing • Nausea and vomiting • Cough • Chest tightness • Sore throat 	Route: Inhalation or dermal Onset: Sulfur mustard: hours to days Lewisite: minutes	Urine test; Tissue biopsy* (*US Army Medical Research Institute of Chemical Defense)	Quick decontamination; manage airway; oxygen therapy; supportive care Available antidotes: Lewisite and lewisite mustard: British Anti-Lewisite (BAL or Dimercaprol) IM (rarely available)

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	<ul style="list-style-type: none"> Upper airways sloughing with pulmonary edema Metabolic failure Body smells of garlic, horseradish or mustard; Oily droplets on skin from ambient sources Bone marrow suppression with neutropenia and sepsis (especially sulfur mustard late) 				<p>No antidote available for Mustard, Sulfur Mustard, Nitrogen Mustard, Phosgene Oxime, and T2 Mycotoxins</p>
<p>Convulsant Agents</p> <ul style="list-style-type: none"> Hydrazine TETS (Tetramethylenedisulfotramine) Picrotoxin Strychnine 	<p>Chemicals that cause central nervous system disinhibition or excitation, leading to generalized convulsions.</p>	<ul style="list-style-type: none"> Seizures/Convulsions Rapidly fatal if not treated 	<p>Route: Inhalation, ingestion, and dermal</p> <p>Onset: dependent on the chemical, route and level of exposure</p>	<p>Urine test, Blood test, Gas Chromatography</p> <p>Test dependent on the chemical. Use history to help identify source and exposure characteristics.</p>	<p>Manage airway; supportive care.</p> <p>Available antidotes:</p> <p>Hydrazine:</p> <p>Pyridoxine (adult): 5 grams IV; additional doses based on severity</p> <p>Pyridoxine (pediatric): 70 mg/kg IV (max 5g); additional doses based on severity</p> <p>No antidote available for TETS, picrotoxin and strychnine</p>
<p>Corrosive Agents</p> <ul style="list-style-type: none"> Hydrochloric acid Nitric acid Sulfuric acid Hydrofluoric acid Sodium hydroxide Potassium hydroxide 	<p>Substances with significant irritant and corrosive properties. Symptoms depend on route of exposure.</p> <p>Ingested:</p> <ul style="list-style-type: none"> Burns in the lips, mouth, esophagus, GI tract Drooling 	<p>Signs depend on route of exposure.</p> <p>Ingested</p> <ul style="list-style-type: none"> Burns Nausea Vomiting (with blood) Diarrhea (with blood) Belly pain 	<p>Route: Inhalation, ingestion, dermal, and eye contact</p> <p>Onset: dependent on the chemical, route and level of exposure</p>	<p>Use history to help identify source and exposure characteristics.</p> <p>Radiological studies to assess internal damage.</p>	<p>Decontamination; Manage airway; Supportive care</p> <p>No antidotes available</p>

	<ul style="list-style-type: none"> Potential inhalation effects <p>Inhaled:</p> <ul style="list-style-type: none"> Nasal and oral secretions Lacrimation Wheezing/Stridor Excessive lacrimation <p>Dermal/Eye routes:</p> <ul style="list-style-type: none"> Skin erythema and blistering 	<p>Inhaled:</p> <ul style="list-style-type: none"> Respiratory distress Coughing Watery eyes <p>Dermal/Eye routes:</p> <ul style="list-style-type: none"> Burning, red skin Red, watery eyes 			
<p>Incapacitating Agents</p> <ul style="list-style-type: none"> Fentanyl QNB (BZ) 	<p>Substances that make people unable to think clearly or that cause an altered state of consciousness.</p> <p>Fentanyl</p> <ul style="list-style-type: none"> Acidosis Hypotension Bradycardia Shock Gastric hypomotility Pulmonary edema <p>QNB</p> <ul style="list-style-type: none"> Hyperthermia Low urine output Flushed skin Cardiac arrhythmias Electrolyte disturbances 	<ul style="list-style-type: none"> Pinpoint or dilated pupils Altered level of consciousness <p>Fentanyl</p> <ul style="list-style-type: none"> Above symptoms Respiratory depression Respiratory arrest <p>QNB</p> <ul style="list-style-type: none"> Above symptoms Dry mouth Delusions/hallucinations Eye irritation 	<p>Route: Inhalation, ingestion, dermal, or eye contact (QNB)</p> <p>Onset: Minutes to hours</p>	Urine test; blood test	<p>Supportive care</p> <p>Available antidotes</p> <p>Fentanyl: Narcan 0.4 to 2 mg IV, repeat doses as needed</p> <p>QNB: Physostigmine (adult): 0.5 – 2 mg IV over 5 minutes; repeat every 5 minutes PRN (max 2 mg)</p> <p>Physostigmine (pediatric): 0.02 mg/kg IV (max 0.5 mg dose) over 5 minutes; repeat every 5 minutes PRN (max 2 mg)</p>
<p>Choking/Pulmonary Agents</p> <ul style="list-style-type: none"> Ammonia Chlorine (Cl) Phosgene (CG) Phosphine Sulfur dioxide 	<p>Substances that cause pulmonary edema with some mucosal irritation leading to acute respiratory distress syndrome or non-cardiogenic</p>	<ul style="list-style-type: none"> Respiratory distress Coughing Chest tightness Burning sensation of eyes and throat 	<p>Route: Inhalation, ingestion, dermal, or eye contact</p> <p>Primarily inhalation for Cl,</p>	No tests available. Use history to help identify source and exposure characteristics.	<p>Manage secretions and airway; Oxygen therapy; Treat pulmonary edema with PEEP to maintain PO₂ above 60 mmHg.</p> <p>Available Antidote:</p>

<ul style="list-style-type: none"> • Bromine • Chloropicrin • Mercury (Hg) 	<p>pulmonary edema; Pulmonary infiltrate</p> <ul style="list-style-type: none"> • Wheezing/Stridor/Rales • Laryngeal spasm • Nasal and oral secretions (drooling and mucus) • Mucosal and dermal irritation and redness 	<ul style="list-style-type: none"> • Blurred vision, watery eyes 	<p>Hg, CG and Phosphine</p> <p>Onset: Seconds to hours; 1-24 hours (rarely up to 72 hours); may be asymptomatic period of hours</p>		<p>Mercury: DMSA (chelating agent) such as Succimer or Chemet</p> <p>No other antidotes available</p>
<p>Nerve Agents</p> <ul style="list-style-type: none"> • Tabun • Sarin • Soman • Cyclosarin • Venomous Agent X • Novichok • Organophosphates (pesticides) <ul style="list-style-type: none"> ○ Malathion ○ Parathion ○ Chlorpyrifos • Carbamates (pesticides): <ul style="list-style-type: none"> ○ Aldicarb ○ Methomyl 	<p>Chemicals that cause overstimulation of cholinergic receptors leading to first activation and then fatigue of target organs.</p> <ul style="list-style-type: none"> • Pinpoint pupils • Bronchoconstriction • Bradycardia • Respiratory arrest • Hypersalivation • Increased secretions • Urination • Decreased memory/concentration/confusion 	<p>Moderate exposure:</p> <ul style="list-style-type: none"> • Diffuse muscle cramping • Muscle tremors • Runny nose • Difficulty breathing • Eye pain, dimming of vision, watery eyes, blurred vision • Sweating • Cough • Chest tightness • Headache • Vomiting • Diarrhea <p>High exposure:</p> <ul style="list-style-type: none"> • Same as above • Sudden loss of consciousness • Seizures • Flaccid paralysis (late sign) 	<p>Route: Inhalation, ingestion, dermal, eye contact</p> <p>Onset: Liquids: minutes to hours</p> <p>Aerosols: seconds to minutes</p>	<p>Red blood cell or serum cholinesterase (whole blood)</p> <p>Treat based on signs and symptoms; lab tests only for later confirmation</p>	<p>Manage airway; oxygen therapy</p> <p>Available antidotes:</p> <p>Atropine 2mg IV; repeat q 5 minutes, titrate until effective, average dose 6 to > 15mg (use IM in the field before IV access)</p> <p>Pralidoxime chloride (2-PAMCl) 600-1800mg IM or 1.0g IV over 20-30 minutes (max. 2g IM or IV per hour)</p> <p>Additional doses of atropine and 2-PAMCl depending on severity</p> <p>Diazepam or lorazepam to prevent seizures if >4mg atropine given</p>

<p>Organic Solvents/Hydrocarbons/ Halogenated hydrocarbons</p> <ul style="list-style-type: none"> • Gasoline • Kerosene • Paraffin • Benzene • Toluene • Xylene • Carbon tetrachloride • Methylene chloride • Freon • Nitrous oxide • Halothane • Isoflurane • Chloral hydrate • Methaqualone • Etomidate • Propofol • Benzodiazepines <ul style="list-style-type: none"> ○ Diazepam ○ Alprazolam ○ Midazolam • Barbiturates <ul style="list-style-type: none"> ○ Phenobarbital ○ Pentobarbital 	<p>Substances that cause a decreased level of consciousness, depressed respirations, and in some cases, ataxia from acute exposures to solvents, inhalational anesthetics, or sedative-hypnotic compounds. Does not consider the delayed effects of solvent exposures.</p> <ul style="list-style-type: none"> • Chemical dermatitis • Depression • Behavioral changes • Cardiac dysrhythmias 	<ul style="list-style-type: none"> • Slurred speech • Abnormal eye movements • Difficulty walking and balancing • Confusion • Loss of consciousness • Seizures/convulsions • Respiratory arrest • Cardiac arrest 	<p>Route: Inhalation, ingestion or dermal</p> <p>Onset: dependent on the chemical, route and level of exposure</p>		<p>Manage airway; supportive care</p> <p>Available antidotes:</p> <p>Benzodiazepines</p> <p>Flumazenil (adult): 0.2 mg IV over 30 seconds; repeat doses of 0.5 mg at 1 minute intervals PRN (max 3 mg)</p> <p>Flumazenil (pediatric): 0.01 mg/kg IV over 15 seconds; repeat 0.01 mg/kg at 1 minute intervals PRN (max: 0.05 mg/kg or 1 mg, whichever is lower)</p> <p>No other antidotes available.</p>
<p>Riot Agents</p> <ul style="list-style-type: none"> • Chloroacetophenone • Chlorobenzylidene malononitrile (CS) • Chloropicrin (PS) • Dibenzoxazepine (CR) • Bromobenzylcyanide (CA) 	<p>Chemical compounds that temporarily make people unable to function by causing irritation to the eyes, mouth, lungs, and skin.</p> <ul style="list-style-type: none"> • Ocular signs: Lacrimation, erythema, corneal injury, blepharospasm. 	<ul style="list-style-type: none"> • Eye irritation, redness, blurred vision • Cough • Hoarseness • Difficulty breathing • Sore throat • Dysphagia • Salivation • Oropharyngeal and nasal burning 	<p>Seconds to minutes, delayed onset dermatitis (8 hours) rarely</p>	<p>No tests available. Use history to identify source and exposure characteristics.</p>	<p>Respiratory support with supplemental oxygen, bronchodilators if severe respiratory injury; clothing removal; eye irrigation</p> <p>Effects usually short-lived.</p> <p>No antidotes available</p>

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	<ul style="list-style-type: none">• Respiratory signs: Rhinorrhea, cough, dyspnea, tachypnea, wheezing or rales, hypoxemia, pulmonary edema.• Skin: Erythema, blistering				
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Sources:

<https://chemm.hhs.gov/agentcategories.htm>

<https://www.mdpoison.com/healthcareprofessionals/antidotes.html>

<https://mdpoison.com/media/SOP/mdpoisoncom/ToxTidbits/2016/June%202016%20ToxTidbits.pdf>

<https://mdpoison.com/media/SOP/mdpoisoncom/ToxTidbits/2015/February%202015%20ToxTidbits.pdf>

<https://www.cdc.gov/niosh/ershdb/agentlistcategory.html>

[https://nrt.org/Main/Resources.aspx?ResourceType=Hazards%20\(Oil,%20Chemical,%20Radiological,%20etc\)&&ResourceSection=2&Category=Chemical](https://nrt.org/Main/Resources.aspx?ResourceType=Hazards%20(Oil,%20Chemical,%20Radiological,%20etc)&&ResourceSection=2&Category=Chemical)