

- Identify clinical and epidemiologic clues that may suggest occurrence of chemical disaster
- Identify illnesses and injuries seen in chemical disasters
- Describe actions to protect health, safety, and security of responders and affected populations in a chemical disaster
- Discuss diagnostic and treatment considerations for individuals exposed to blister/vesicant agents, choking/pulmonary agents, asphyxiant agents, and nerve agents

Background

- Chemical agents can be released by a variety of intentional or unintentional means, such as:
 - Industrial accidents
 - Transportation
 - Terrorism



Senior Airman Darlene Seltmann/US Air Force

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Detection of Chemical Exposure

- Nature of agent or method of exposure may be unknown
- Each class of agent has a specific set of signs and symptoms, called a *toxidrome*
- *Signs and symptoms* can help determine:
 - Onset – Present within minutes to hours of event
 - Possible Signs/Symptoms – Nausea, vomiting, diarrhea, loss of consciousness, seizures, respiratory difficulty, pupil changes, fasciculation, weakness, etc.

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Detection Situational Awareness

- Information gathering
 - ✓ Multiple 911 calls from same area
 - ✓ Known hazards, substance leaking or spilling
 - ✓ Time of symptom onset
 - ✓ Foul or unusual odors present
 - ✓ Dead animals
- Ensure responder safety; prevent secondary contamination

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Detection

- Detection devices may be used by HAZMAT:
 - Multi-gas meters
 - Oxygen sensors
 - Chemical agent monitors
- When detectors are not available, responders must begin treatment based on clinical presentation

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Safety and Security

- Responders must utilize PPE to reduce the risk of exposure
- Consider recommendation to shelter in place in contaminated areas vs evacuation
- Notify receiving hospitals early
- For the ill or injured:
 - Remove individual from toxic area
 - Perform decontamination
 - Prevent further exposure

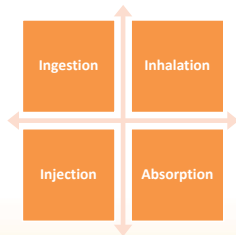


WHS/Stephen Panko

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Casualty Management: General Considerations



- Toxins may enter the body through one of four ways
- Have high suspicion if multiple patients from same location present with same onset symptoms
- Different agents have different probability of secondary exposure

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**Casualty Management:
Triage Considerations**

- Triage - often required when multiple casualties present
- Contamination – Decontaminate prior to medical care but do not delay lifesaving intervention
- Triage pre and post decontamination

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**Casualty Management:
Assessment**

Cardiovascular	Fast/slow heartbeat, low/high blood pressure, decreased blood flow
Skin	Blistering, redness, pallor, sweating
Gastrointestinal	Nausea, vomiting, diarrhea
Neurologic	Seizures, loss of consciousness
Respiratory	Difficulty breathing, wheezing

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**Casualty Management:
Pediatric Considerations**

- Children exposed faster and inhale more agent due to faster breathing rate and metabolic rate
- Increased skin absorption due to thin skin
- Agents that are heavier than air more accessible due to child's size
- Limited ability to recognize and flee from danger

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**Casualty Management:
Injuries and Illnesses → Agent Types**

Central Nervous System	• Nerve, incapacitating, asphyxiant, or any agent
Respiratory System	• Nerve, choking, blister, asphyxiant
Circulatory System	• Nerve, incapacitating, asphyxiant, or any agent
GI System	• Nerve, any agent
Skin	• Nerve, incapacitating, blister

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**Casualty Management:
Treatment Principles**

May include, in accordance with protocols, resources:

- Oxygen therapy
- Placement of intravenous (IV) lines
- Anticholinergic medications/nerve agent antidotes
- Administration of bronchodilators
- Airway control - intubation if needed
- Bleeding control

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Selected Chemical Agents

- Blister (Vesicant) Agents
- Choking (Pulmonary) Agents
- Asphyxiant (Cyanide) Agents
- Nerve (Organophosphate) Agents

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Selected Chemical Agents
Blister (Vesicant)

- Chemicals that cause blisters to form on skin
- Skin primary route of absorption, pulmonary and GI tract secondary route
- Persistent in the environment, heavier than air
- Types are:
 - Lewisite: colorless, oily, smells like geraniums
 - Mustard: oily, smells like horseradish or garlic

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Diagnosis of Blister Agents

Eyes	Itching, burning, blindness
Gastrointestinal	Vomiting, diarrhea
Skin	Blistering and erythema
Respiratory	Edema and sloughing of respiratory tract

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Treatment of Blister Agents

- Immediate decontamination of all exposed - symptomatic AND asymptomatic
 - Those with secondary exposure need decontamination
- Remove clothing, wash with soap and water or hypochlorite solution, wash exposed eyes
- British anti-lewisite (BAL) – chelating agent used to reduce lewisite effects
- Overall treatment is supportive

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Selected Chemical Agents
Choking or Pulmonary

- Symptoms related to water solubility
 - Highly water soluble agents cause upper airway damage and have strong warning properties
 - e.g., Anhydrous Ammonia
 - Intermediate water soluble agents cause upper and lower airway damage and have moderate warning properties
 - e.g., Chlorine
 - Poorly water soluble agents cause lower airway damage and have poor warning properties
 - e.g., Phosgene

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Chlorine

- No specific diagnostic test
- Chlorine agents:
 - Reacts with water in airways to form hydrochloric acid
 - Bleach-like smell, irritation of nose, throat
 - Lungs: wheezing, pulmonary edema
 - Eyes: burning, corneal abrasions

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Phosgene

- No specific diagnostic test
- Phosgene – smells like newly mown hay
- Initial exposure may cause mild tearing and cough or patients may be asymptomatic
 - Early symptoms may not indicate level of exposure
- Asymptomatic patients should be observed for the development of delayed pulmonary edema (up to 24 hours)

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Treatment of Choking/Pulmonary Agents

- No specific therapy
 - Supportive care and remove to fresh air
 - Patients with mucus membrane irritation should be wet decontaminated
- Pain
 - Analgesics
- Respiratory complaints
 - Oxygen, Bronchodilators, Intubation PRN
- Eye exposure
 - Irrigate and check pH (goal: pH 7)

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**Selected Chemical Agents
Asphyxiant**

- Sources
 - Natural occurring (e.g., peach pit)
 - Mass produced for industrial uses
 - Produced by combustion - wool, silk, plastics, synthetics
- Prevents body's cells from utilizing oxygen
- Can be ingested, inhaled, or absorbed through skin

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**Selected Chemical Agents
Cyanide**

- Odor is unreliable (may be no odor)
 - Many people cannot detect the odor (genetic)
- Low level: Nonspecific signs and symptoms: headache, excitement, dizziness, weakness
- High level: Cardiac arrhythmias, hypotension, seizures, death

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Treatment
Cyanide Agents


- Remove victim to fresh air quickly, use proper PPE
- Medications
 - Cyanokit – Hydroxocobalamin, 5 g IV
 - Older treatments (Lilly/Pasadena kit) may still be used and consists of three drugs – two given IV
 - Amyl nitrite (inhaled)
 - Sodium nitrite (IV)
 - Sodium thiosulfate (IV)
- Supportive treatment
 - Oxygen

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Selected Chemical Agents
Nerve

- Interfere with body's ability to break down acetylcholine
- Major cause of death is hypoxia
- Found in pesticides: diazinon and parathion
- Warfare agents: sarin (GB), tabun (GA), soman (GD), VX

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Detection of
Nerve Agents

Nerve agent detection kit

Shannon Arledge/FEMA

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Diagnosis of Nerve Agents

- Detection based on toxidrome
 - D** iarrhea
 - U** rination
 - M** iosis – pinpoint pupils
 - B** ronchorrhea/bronchospasm
 - E** mesis
 - L** acrimation – tearing
 - S** alivation/sweating
- Large inhalational dose lethal immediately
- Small dermal doses may have delayed effects

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Treatment of Nerve Agents

- Rapid control of airway – intubation as needed
- Medications:
 - Atropine
 - Pralidoxime chloride
 - Benzodiazepines

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Lesson Summary

- Chemical agents
 - Released intentionally or unintentionally
 - Varied time of onset
 - Effect on children different than adults
- Have a high suspicion for chemical incidents

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Lesson Summary

- Use proper PPE
- Decontaminate any contaminated patient prior to medical treatment (except LSI)
- Treatment plans may be guided by clinical presentations rather than identification of agent

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Questions?