Weapons of Mass Destruction (WMD)
Basic Awareness and Overview

Introduction to WMD

- Weapon of Mass Destruction (WMD) – a weapon of mass destruction is any device that is designed or intended to cause mass destruction and/or death (United States Code , Section 2332a)
- Use of WMD against healthcare entities, or any attack against the US is a serious concern.
- Al Qaeda and other groups have openly pursued WMD obtainment/development and are likely to use these weapons against our nation.

The threat continues today!



Types of WMD: CBRNE Agents

- **C**hemical Agents
- **B**iological Agents
- **R**adiological Agents
- **N**uclear Agents
- **E**xplosive Agents

Terrorist use of CBRNE Agents as WMD

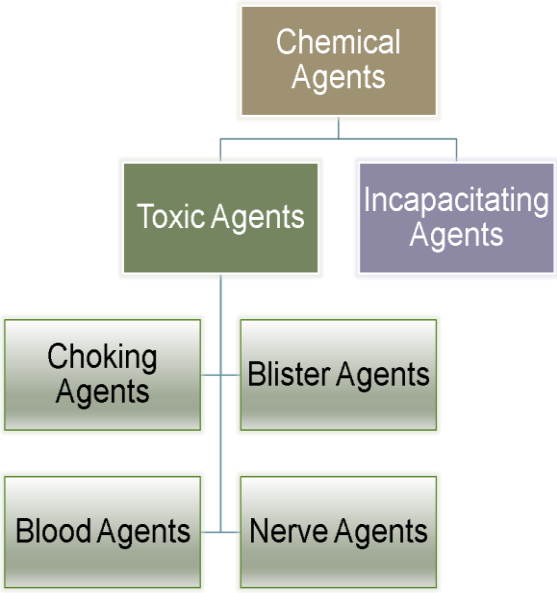
- They are relatively inexpensive
- Usually not strictly monitored and are readily available
- They are very effective and can cause mass fatalities from a single weapon
- Detection is difficult without specialized monitoring devices and often have delayed effects
- Can provide the maximum amount of death and destruction with minimal resources and manpower

Chemical Agents
As Weapons of Mass Destruction

Past Use of Chemical Agents as WMD

- **Bhopal India** (1984) – 40 Tons of methyl isocyanate released into city of 900,000. 6,000 died with 400,000 injured.
- **Tokyo Sarin Subway Attack** (1995) - containers of 30% Sarin placed in Tokyo subway during rush hour. 11 dead, 5,500 victims, 641 presented to local hospital. PPE was not used by hospital, 23% of hospital staff exposed/symptomatic.

Classes of Chemical Agents



Choking Agents

- **Agents**: phosgene, chlorine, diphosgene, chloropicrin, oxides of nitrogen, sulfur dioxide
- **Signs**: Pulmonary edema w/ mucosal irritation (greater water solubility of agent = greater mucosal irritation) leading to ARDS or noncardiogenic pulmonary edema, Pulmonary infiltrate
- **Symptoms**: SOB, chest tightness, wheezing, laryngeal spasm, mucosal/dermal irritation & redness
- **Onset**: 1-24 hours (rarely up to 72 hours)
- **Tests**: None; history may help identify source of exposure
- **Exposure Route**: Inhalation
- **Tx**: No antidote, management of secretions, O2, consider high dose steroids to prevent pulmonary edema (demonstrated benefit only for oxides of nitrogen), Tx pulmonary edema w/ PEEP to maintain PO2 above 60 mm Hg
- **Differential Diagnosis**: mucosal irritation, airway reactions, deep lung effects depend on agent and water solubility

Blood Agents

- **Agents**: cyanides: hydrogen cyanide (HCN), cyanogen chloride (CK)
- **Signs**: Moderate exposure: metabolic acidosis, venous blood-O2 level above normal, hypotension, "pink" skin color. High exposure: previous signs plus coma, convulsions, cessation of respiration and heartbeat
- **Symptoms**: **Moderate exposure: g**iddiness, 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 mins.
- **Onset**: seconds to minutes
- **Tests**: bitter almond odor associated with patient (suggests cyanide poisoning), metabolic acidosis, Cyanide (blood) or thiocyanate (blood or urine) levels, Tx based on signs and symptoms; lab tests only for confirmation
- **Exposure Route**: Inhalation, ingestion, & dermal absorption
- **Tx**: 100% O2 NRB, intubation w/ 100% FiO2 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 based on hemoglobin level and weight of patient
- **Differential Diagnosis**: 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 (H2S) exposure from sewers, animal waste, industrial sources), Poisoning from nerve agents

Blister Agents

- **Agents**: sulfur mustard, lewisite, nitrogen mustard, mustard lewisite, phosgene-oxime
- **Signs**: Skin erythema and blistering; watery, swollen eyes; upper airways sloughing w/ pulmonary edema; metabolic failure; neutropenia and sepsis
- **Symptoms**: Burning, itching, or red skin, mucosal irritation (prominent tearing, burning and redness of eyes), SOB, nausea and vomiting
- **Onset**: lewisite – minutes, sulfur mustard – hours to days
- **Tests**: Often smell of garlic, horseradish, and/or mustard on body, oily droplets on skin from ambient sources, urine thiodiglycol, tissue biopsy
- **Exposure Route**: Inhalation and dermal absorption
- **Tx**: mustard - No antidote, lewisite and lewisite/mustard mixtures - British Anti-Lewisite (BAL or Dimercaprol) IM (rarely available), thermal burn therapy; supportive care (respiratory support and eye care)
- **Differential Diagnosis**: Diffuse skin exposure with irritants, such as caustics, sodium hydroxides, ammonia, etc., may cause similar syndromes. Sodium hydroxide (NaOH) from trucking accidents

Nerve Agents

- **Agents**: Sarin (GB), Tabun (GA), Soman (GD), Cyclohexyl Sarin, (GF), VX, Novichok agents, other organophosphorus compounds including carbamates and pesticides
- **Signs**: Pinpoint pupils (miosis), bronchoconstriction, respiratory arrest, hypersalivation, increased secretions, diarrhea, decreased memory/concentration, LOC, seizures
- **Symptoms**: **Moderate exposure: diffuse** muscle cramping, runny nose, difficulty breathing, eye pain, dimming of vision, sweating, muscle tremors. High exposure: previous plus sudden LOC, seizures, flaccid paralysis (late sign)
- **Onset**: aerosols – seconds to minutes, liquids – minutes to hours
- **Tests**: Red blood cell or serum cholinesterase (whole blood), Tx based on signs & symptoms; lab tests for confirmation
- **Exposure Route**: inhalation and dermal absorption
- **Tx**: Atropine (2 mg) IV; q 5 minutes, titrate until effective, average dose 6 to >15 mg – use IM in the field before IV access (establish airway), 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
- **Differential Diagnosis**: Poisoning from organophosphate and carbamate pesticides may occur as a result of occupational exposure, Cyanide poisoning, Myasthenia gravis

Nerve Agents and Chempack

- One of the KHS facilities houses a Chempak which is a stored supply of medications used to treat nerve agent exposure. This provides KHS with a resource that will increase our ability to quickly and effectively respond to nerve agent attacks.

- The Chempak Program was developed by the Centers for Disease Control and Prevention (CDC) as an extension of the Strategic National Stockpile (SNS).

- Typically the SNS has a 12-hour response time. In some instances, such as a nerve agent attack, 12 hours is too long a time period to wait for an antidote.

Chempack Contents/Access

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For emergency access to the Chempak contact:

The Pharmacy Department at WTC and they will provide further instruction.

Incapacitating Agents

- **Agents**: QNB (Agent Buzz, BZ, 3-Quinuclidinyl benzilate)

- **Signs/Symptoms**: dry mouth, difficulty talking/swallowing, blurred vision, tachycardia, dry/flush skin, rash, increased core body temperature, increased ventilation, Anticholinergic toxidrome, hallucinations, cardiac arrhythmias, stupor, confusion

- **Onset**: 30 mins – 4 hours, skin exposure 20 – 36 hours

- **Tests**: clotting studies

- **Exposure Route**: Inhalation, ingestion, absorption

- **Tx**: supportive care, IV fluids, appropriate cooling measures to address elevated core body temperature and judicious use of sedation using benzodiazepines. Severe toxicity may require the use of physostigmine to temporarily increase synaptic acetylcholine concentrations.

- **Differential Diagnosis**: anxiety, intoxication

Biological Agents
As Weapons of Mass Destruction

Past Use of Biological Agents as WMD

- **Dalles, Oregon** (1984) – Rajneeshees, a religious sect, sprayed Salmonella bacteria on a salad bar in a restaurant: 751 people fell ill from contamination with Salmonella Typhimurium.

- **US Anthrax Outbreak** (2001) – Anthrax spores mailed to several news media offices and to 2 US Senators: 5 dead, 17 others infected

Most Likely Bioterrorism Agents

- **Anthrax:** Initially resembles common cold; progresses into severe breathing problems and shock. Treatable if antibiotics are taken soon after exposure; limited supply of investigational vaccine exists.

- **Botulism:** Blurred vision, difficulty swallowing, speaking, and muscle paralysis. Treatable if assistance with breathing and speaking, and muscle paralysis. is provided; antitoxin is effective if administered early in course of disease

- **Plague:** (pneumonic): Fever, headache, weakness, and cough; may cause shock. Early Tx w/ antibiotics can be effective; there is currently no vaccine available for use in the US.

- **Smallpox**: Fever, headache, nausea, and rash leading to hard blisters. Routine vaccinations ended in the US by 1972; no proven treatment.

- **Tularemia**: Fever, chills, body aches, and weakness; inflammation and hemorrhaging of airways. Vaccine is under review by the FDA, early antibiotic Tx can be effective.

- **Viral Hemorrhagic Fevers**: Fever, fatigue, dizziness, muscle aches, exhaustion, diarrhea; severe cases include bleeding under the skin, in internal organs and body orifices. With few exceptions, there is no cure or established Tx. Care is supportive.

Radiological and Nuclear Agents
As Weapons of Mass Destruction

Past Use/Effect of Radiological/Nuclear Agents

- **Goiania, Brazil** (1987) – worker pries open a lead canister scavenged from an abandoned cancer treatment center. Inside was a sparkling blue powder (radioactive cesium). Residents living nearby pass the canister for nearly a week. A 6 year old girl rubbed the powder over her body and hair so she glowed. Over 200 exposed , 4 dead including 6 year old girl, contaminated soil, businesses, homes, 85 had to be leveled during cleanup.

- **Hiroshima & Nagasaki, Japan** (1945) – nuclear bombs killed 140,000 in Hiroshima and 80,000 in Nagasaki. 15 – 20% died from injuries or effects of flash burns, trauma, radiation burns, illness and radiation sickness. Since then 231 more have died from leukemia and 334 from other cancers attributed to exposure to radiation released by the bombs.

Radiological Agents

- **Radiological Agents***:* anything that emits radiation is said to be radioactive. Small amounts of ionizing radiation can be tolerated, but large amounts can be toxic or deadly. Ionizing radiation can be classified as emissions of alpha particles, beta particles, gamma rays and neutrons.

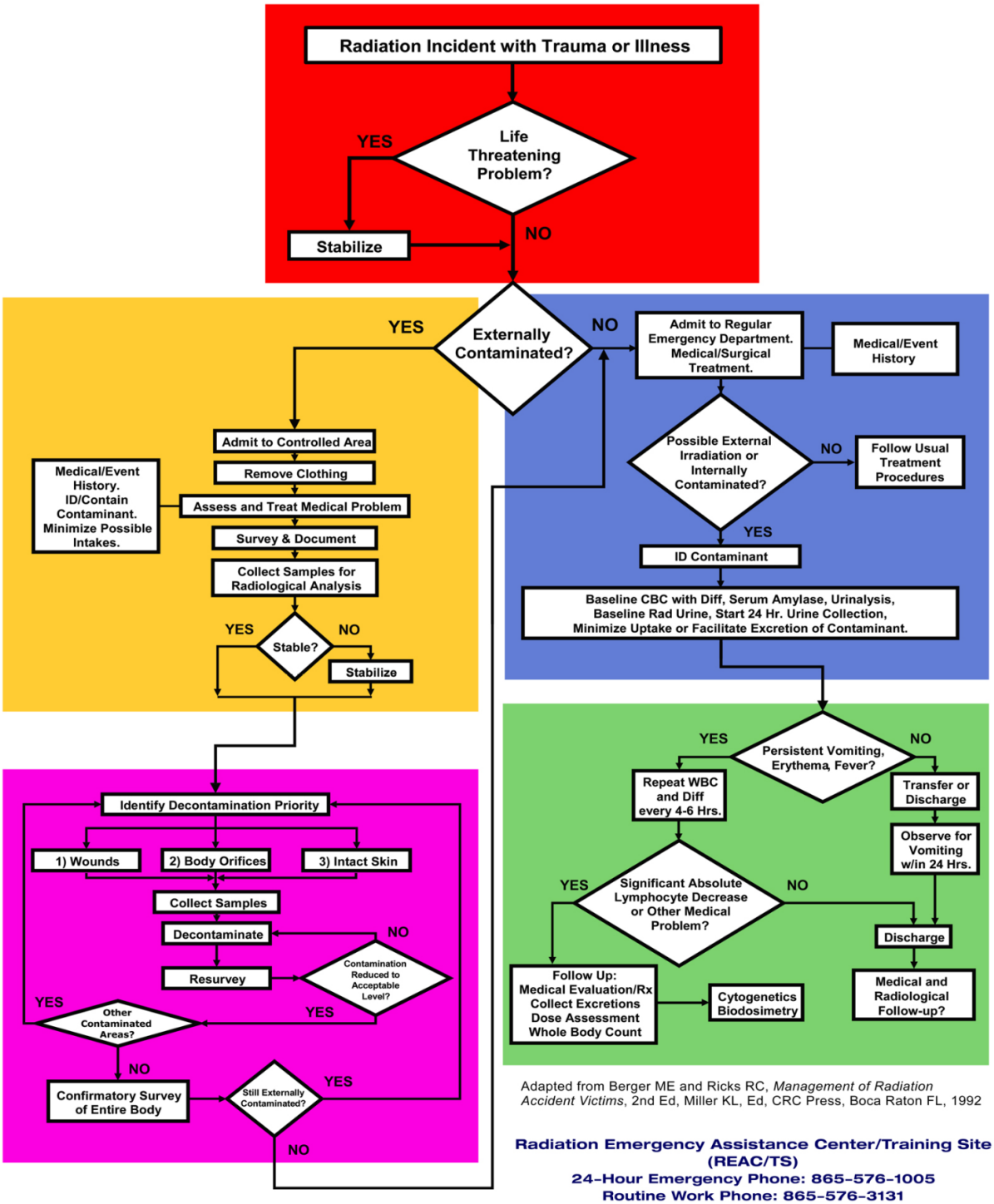
- ***Alpha particles*** – particulate material that quickly loses energy as it travels through air. Alpha particles have limited penetration ability and can be stopped by clothing or a sheet of paper. Because of the limited penetration ability, alpha emitters only present an inhalation or ingestion hazard. If inhaled or ingested they can be absorbed in bones and many organs causing damage (such as the kidney, live and lungs).

- ***Beta particles*** – particulate matter that loses energy slower than alpha particles and travels farther in the air. Metals, plastic, wood, and glass can stop the penetration of beta particles. Beta particles can cause skin burns and if inhaled or ingested can cause organ damage.

- ***Gamma rays*** – pure electromagnetic radiation. It can travel hundreds of meters in open air and can penetrate most materials, however a thick piece of concrete will prevent penetration. Gamma radiation can pose either an internal or external hazard.

- ***Neutron*** – part of the nucleus of an atom that carry no electrical charge. Neutrons can be obtained by combining certain radioactive materials, using neutron generators or by using isotopes to emit neutrons (which are under strict control and in limited supply).

Radiation Victim Treatment



Adapted from Berger ME and Ricks RC, *Management of Radiation Accident Victims*, 2nd Ed, Miller KL, Ed, CRC Press, Boca Raton FL, 1992

Radiation Emergency Assistance Center/Training Site (REAC/TS)
24-Hour Emergency Phone: 865-576-1005
Routine Work Phone: 865-576-3131
On the Web: www.orau.gov/reacts

Acute Radiation Syndrome (ARS)

- ARS – radiation sickness that occurs after the body has received a high dose (usually over a short period of time)

- ARS will develop if the following are true:
  - Radiation dose is high
  - Radiating was penetrating (reaching internal organs)
  - Majority of pts body received dose of radiation
  - Radiation was received during a short period of time (usually minutes).

- ARS – early symptoms are nausea, vomiting and diarrhea. Symptoms may come and go; pt may experience period of feeling well after which the pt will sicken with loss of appetite, nausea, fatigue, vomiting, diarrhea and coma. Pts may also exhibit skin damage (similar to sunburn) and hair loss.

- Recovery/survival rate from ARS decreases w/ increasing radiation dose. Pts who do not recover will most often die within a few months of exposure (bone marrow destruction). Survivors recovery period can be weeks to 2 years.

Explosive Agents
As Weapons of Mass Destruction

Past Use of Explosive Agents as WMD

- **Oklahoma City Bombing** (1995) – Timothy McVeigh uses ANFO/fertilizer bomb: 168 dead, 680 injured, 324 buildings damaged in a 16 block radius.

- **September 11th WTC Attacks** (2001) – terrorist flew planes full of fuel into WTC towers: more than 2,600 dead, over 1,000 injured, NYC hospitals treated 1,103 victims, 181 required admission.

Considerations for Explosive Agents

- Structural integrity of facility (if hospital is site of explosion)
- Crush injury/compartments syndrome (entrapment/collapses)
- Number of casualties requiring trauma/OR services compared to resources available in region
- Number of casualties requiring burn care compared to available resources
- Blast Injuries: auditory, facial, respiratory, digestive, circulatory, CNS injury, renal, extremity (amputation)