Nuclear Biological & Chemical Terrorism

-The Threat & Response

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Definition of Terrorism

“Premeditated, politically motivated violence perpetrated against non combatant targets by sub-national groups or clandestine agents!!”

Abraham R. Wagner
Director - DARPA

11 September - WTC

Source:
www.thaibase.com/news/
wtc/ASCE

GOAL

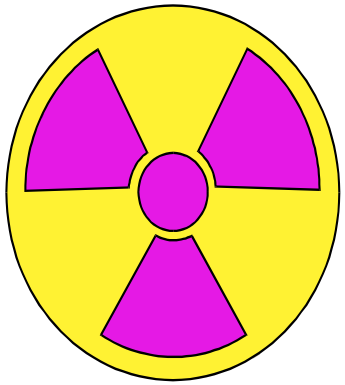
Destroy will!

Surrender principle!

Save your hide!

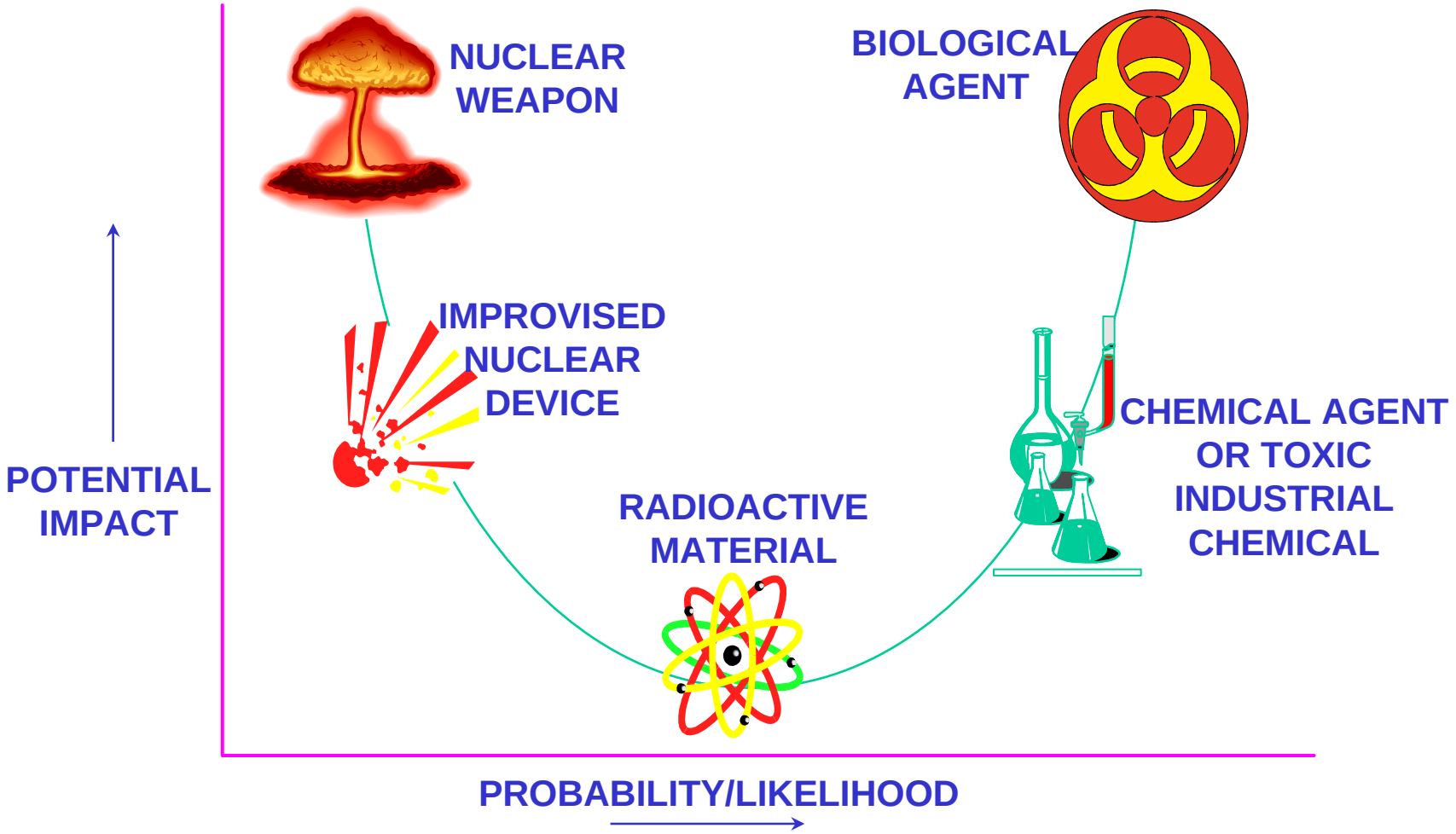
Dr. Lana Kass
April 04

Focus - NBC



- **Radiological Devices**
- **Biological Weapons**
- **Chemical Weapons**

Potential Probability vs. Impact



Why NBC Terrorism?

- Agents are available & relatively easy to manufacture
- Large amount not needed in enclosed space
- NBC incident difficult to recognize
- Easily spread over large areas
- Psychological impact
- Can overwhelm existing resources

Radiological Terrorism
Possible Scenarios

- Nuclear power plant incident
- Hidden source
- “Dirty bomb”
- Improvised nuclear device
- Nuclear weapon

Why Use RDD?

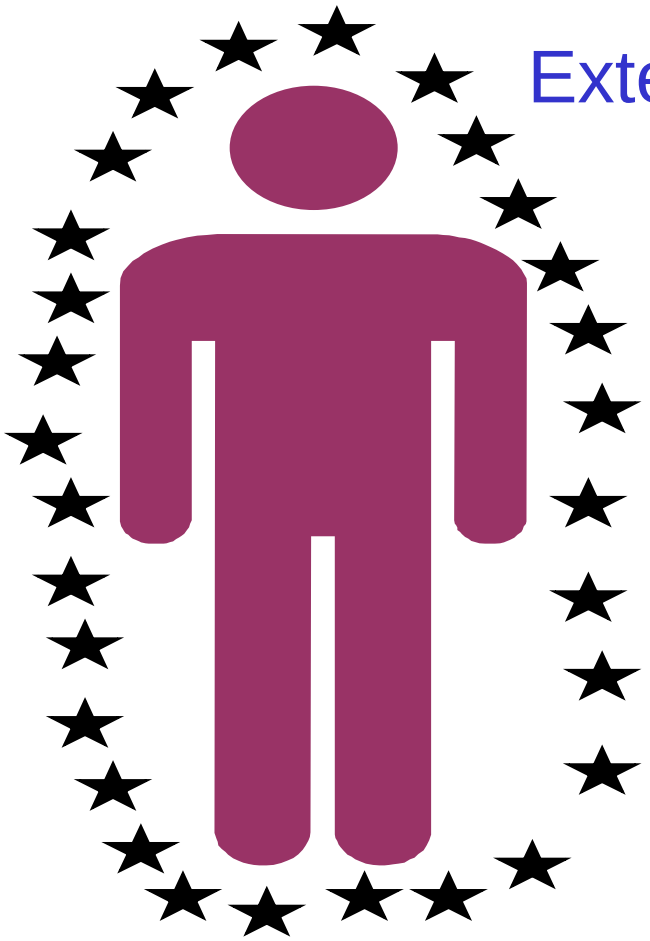
- **An RDD poses the fewest technical barriers**
- **Radiological material is readily available**
  - **In nearly every country**
  - **Concealable**
  - **Portable**
- **Massive economic impact**
  - **Resulting in area denial**
  - **Potentially the most expensive environmental decontamination cleanup in US history**
- **Portray the government as powerless and weak**
- **Coerce a population through fear or traumatization**

Source: Gerald Holton, *Reflections on Modern Terrorism* (2002)

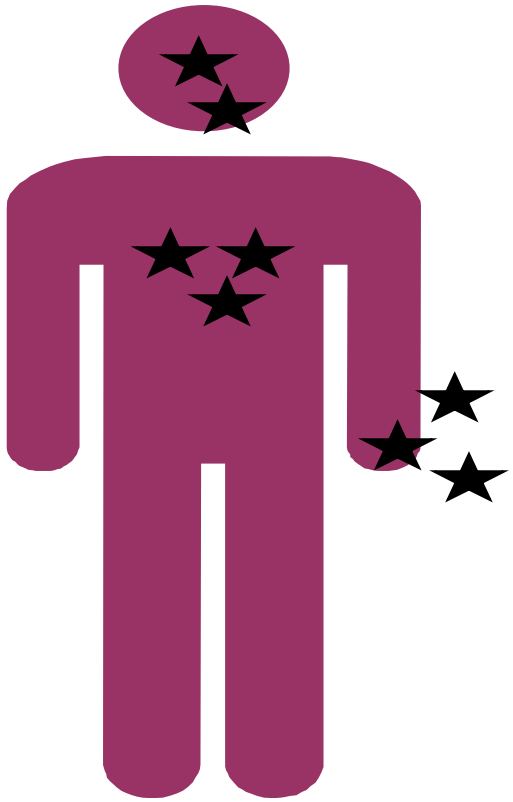
CAUSING PANIC and FEAR

Contamination

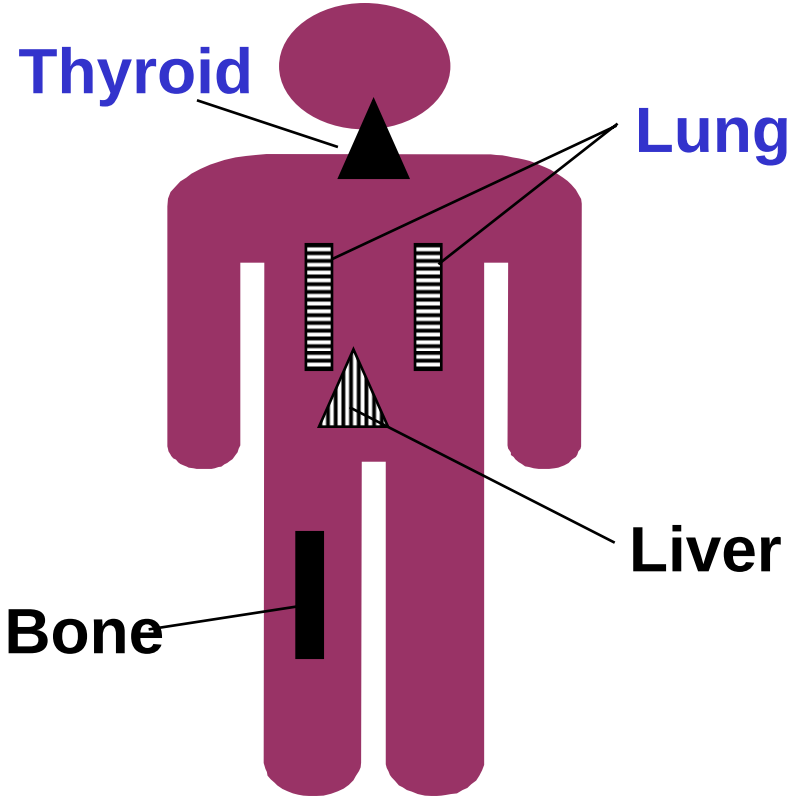
External



Internal



Localization of Internal Contamination



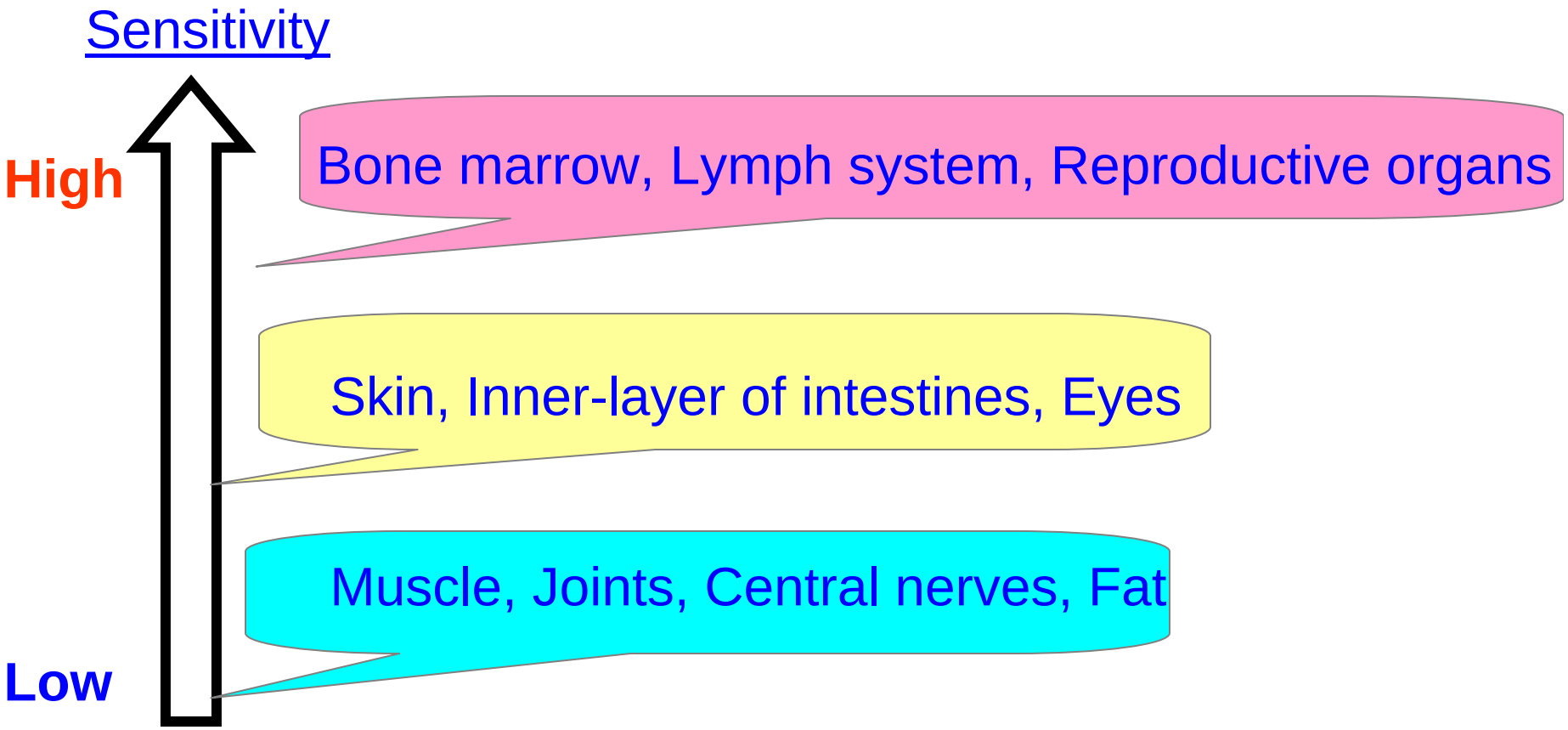
Biological Effects

Cellular Sensitivity

- **Not all living cells are equally sensitive**

Biological Effects

Typically young and rapidly growing cells are more sensitive to radiation



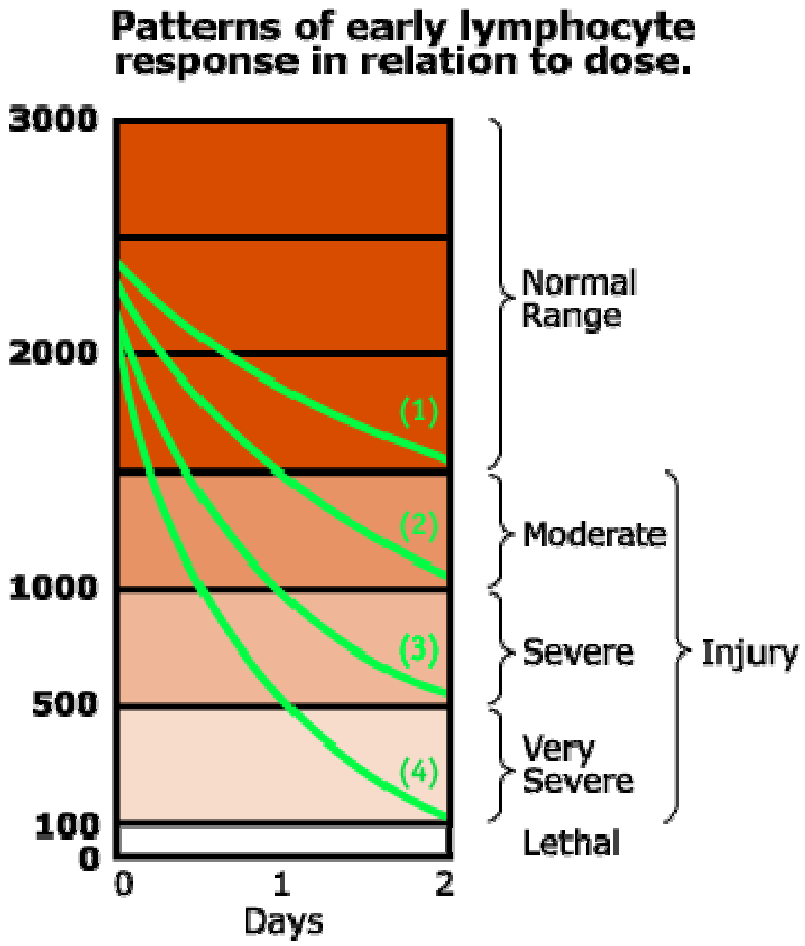
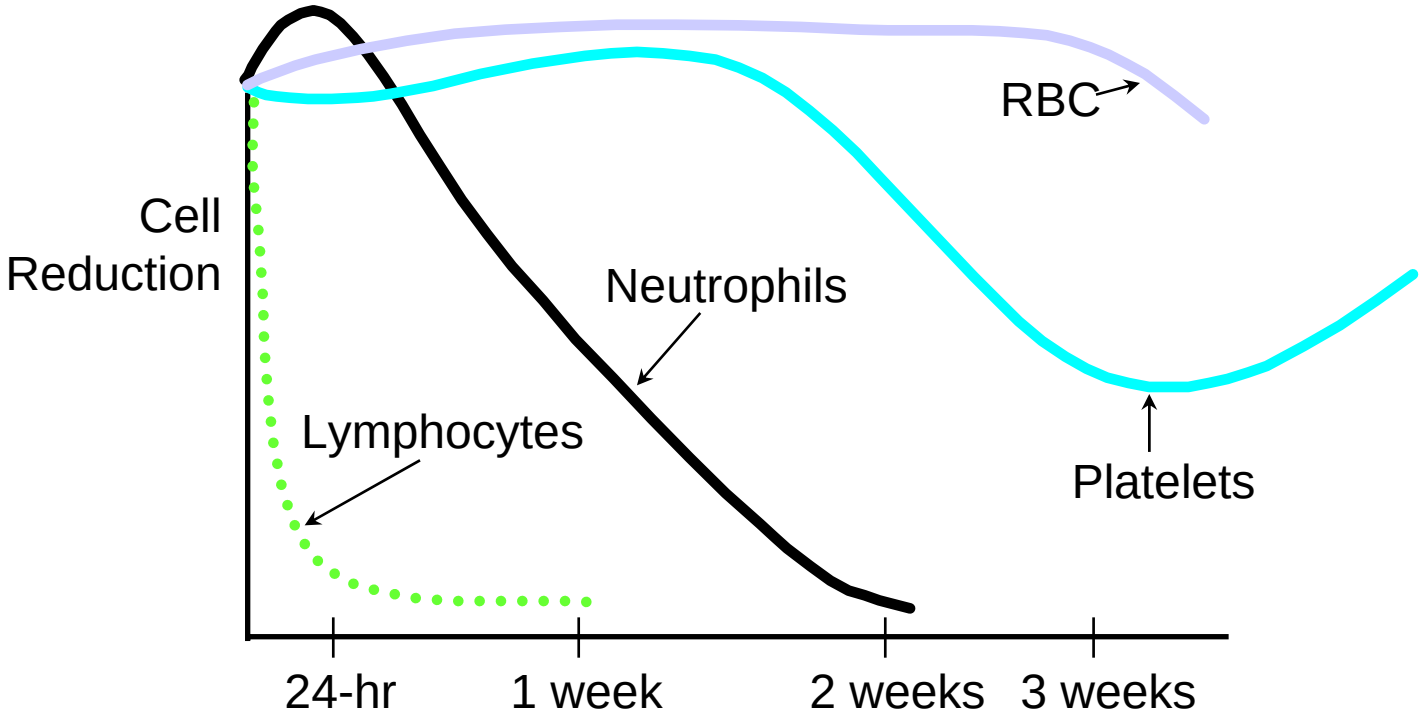


Figure. Classical Andrews lymphocyte depletion curves and accompanying clinical severity ranges. According to the data presented in this paper, curves 1-4 correspond roughly to the following whole-body doses: curve (1) 3.1 Gy; curve (2) 4.4 Gy; curve (3) 5.6 Gy; curve (4) 7.1 Gy.

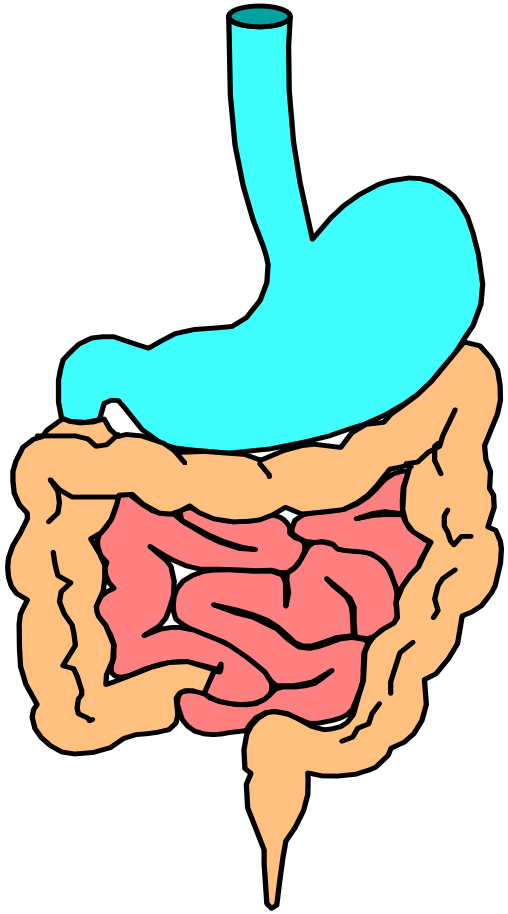
From Goans, Ronald E., Holloway, Elizabeth C., Berger, Mary Ellen, and Ricks, Robert C. "Early Dose Assessment Following Severe Radiation Accidents," *Health Physics* 72(4): 1997.

Hematopoietic System-Blood Count



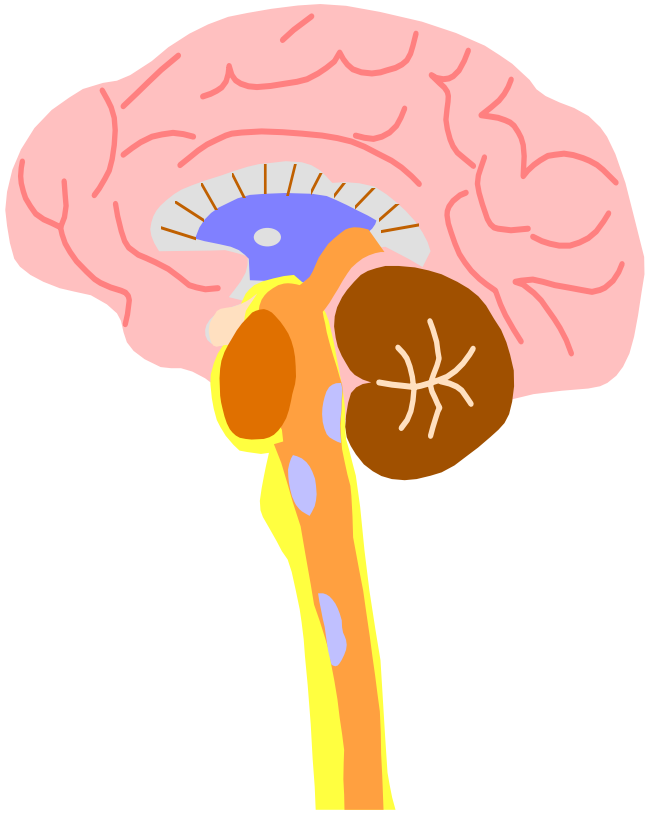
ARS - Gastrointestinal Syndrome

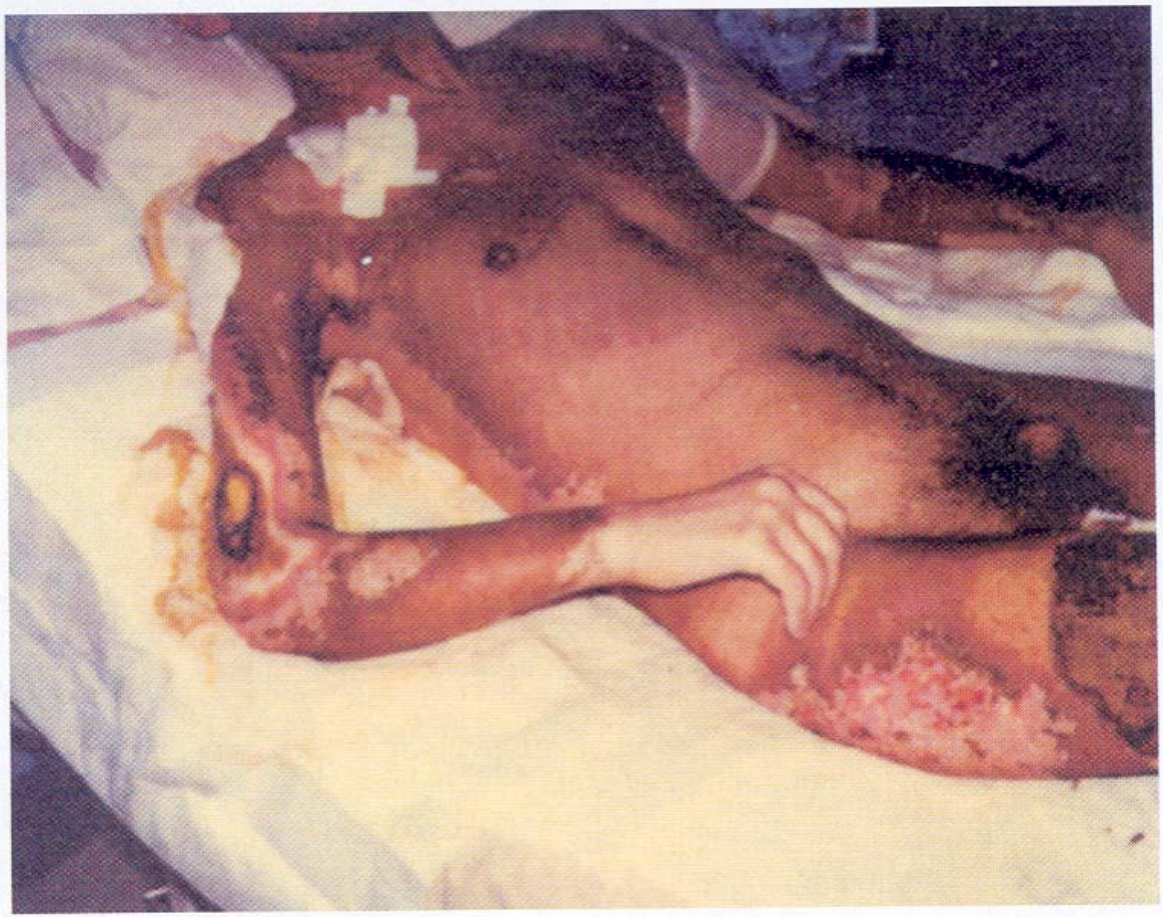
- Seen with radiation doses > 600 rads
- Damages intestinal lining
- Nausea and vomiting within the first 2 - 4 hours
- May develop diarrhea
- Associated with sepsis and opportunistic infections
- At 10 days could develop bloody diarrhea resulting in death



ARS - Central Nervous System

- Seen with radiation dose > 1,000 rads
- Microvascular leaks edema
- Elevated intracranial pressure
- Death within hours





ARS with Cutaneous Syndrome: A case of beta-gamma exposure (Chernobyl accident) with injury of 50% of the skin surface.

Accident in Thailand: Radiation burns on the hands of P1/JC, taken February 23, 2000.

Accident at Yanango: Radionecrotic lesions of the distal left leg and ankle (Apr. 28, 2000).

Accident at Yanango: Perineal area with fibrosis and urethral fistula (February 2001).

Am-241 – 18 Ci used in Oil Well Logging Systems (RDD)

Inner Ring: Current guidelines state that all persons must recieve medical supervision
Middle Ring: Maximum annual dose for radiation workers exceeded
Outer Ring: Current guidelines state that the area should be evacuated before radiation cloud passes

Treatment of Internal Contamination

Element	Immediate Action	Drugs to consider
Americium (Am)	DTPA	DTPA
Arsenic (As)	Consider Lavage	Dimercaprol
Barium (Ba)	Consider Lavage & Purgatives	
Calcium (Ca)	DTPA, Consider Lavage & Purgatives, & Calcium	DTPA

Treatment of Internal Contamination

Element	Immediate Action	Drugs to consider
Carbon (C)		No Treatment available
Cesium (Cs)	Prussian Blue, Consider Lavage & Purgatives	Prussian Blue
Chromium (Cr)	Consider Lavage & Purgatives	No Treatment available for anionic forms, DTPA or DFOA for cations.
Iodine (I)	KI, Consider Lavage	KI

Treatment of Internal Contamination

Element	Immediate Action	Drugs to consider
Plutonium (Pu)	DTPA	DTPA
Polonium (Po)	Consider Lavage & Purgatives	Dimercaprol
Potassium (K)	Consider Purgatives, Diuretics, Aluminum Hydroxide	Diuretics
Radium (Ra)	Magnesium, Sulfate Consider Lavage & Purgatives	

Biological weapons:
the agents, the threat & the response

Characteristics

- Do not penetrate unbroken skin
- Non-volatile
- More toxic than chemicals by weight
- Undetectable by senses
- Limited field detection
- Disseminate as aerosols

CHEMICAL-BIOLOGICAL AGENTS

- Chemical Agents
  - Phosgene, mustard gas, nerve agents, chlorine
    - Violent disease syndromes within minutes at the site of exposure
    - Emergency personnel at the site of exposure
    - No propagation of syndrome outside of affected area
    - Time-limited
- Biological Agents
  - Incubation periods
    - Delayed recognition
  - Physicians
    - Disease syndromes rarely seen – may be initially misdiagnosed
  - Propagated spread of infection – widespread dissemination

IMPACT ON HEALTH CARE SYSTEM

- Unprecedented Numbers of Patients
- Overwhelming Resource Demands
  - Hospital resources
    - Beds and equipment
    - Intensive care demands
    - Personnel
  - Medications/Immunizations
  - Effect of quarantine on routine ops
    - Varicella/smallpox scenario
  - Protection
    - Health care personnel
    - Laboratory personnel

Domestic terrorism

- **1984, Bhagwan Shree Rajneesh, Oregon, salmonellosis (>700 cases, 0 deaths)**
- **1995, Patriot's Council, Minnesota, ricin weapon**
- **1995, Larry Wayne Harris, Ohio, Aryan Nation, illegal acquisition of plague**
- **1996, Texas microbiology lab workers, *Shigella dysenteriae* type 2**
- ***2001, anthrax attackes via US mail***

BIOLOGICAL WARFARE AGENTS

- **Anthrax (*Bacillus anthracis*)**
- **Brucellosis (*Brucella* spp.)**
- **Plague (*Yersinia pestis*)**
- **Q Fever (*Coxiella burnetii*)**
- **Tularemia (*Francisella tularensis*)**
- **Smallpox (Monkeypox)**
- **Glanders (*Burkholderia mallei*)**
- **Influenza**
- **Viral encephalitides (Venezuelan, Eastern, and Western Equine encephalitis viruses)**
- **Viral hemorrhagic fevers (e.g. Rift Valley Fever, Dengue, Hantavirus)**
- **Botulinum toxins (*Clostridium botulinum*)**
- **Staphylococcal Enterotoxin B (*Staphylococcus aureus*)**
- **Multidrug-resistant tuberculosis (*Mycobacterium tuberculosis*)**

ANTHRAX as a Bioweapon

- Aircraft release of 50kg over urban population of 5 million*
  - 250,000 causalities
  - 100,000 deaths without treatment
- Aerosolized release of 100kg upwind of Washington DC†
  - Between 130,000 and 3 million deaths
    - Lethality matching or exceeding that of a hydrogen bomb
- Economic model developed by CDC‡
  - $26.2 billion per 100,000 persons exposed

WHO. *Health Aspects of Chemical and Biological Weapons*. Geneva, Switzerland: WHO; 1970:98-99

† Office of Technology Assessment, US Congress. *Proliferation of Weapons of Mass Destruction*. Washington DC; 1993:53-55. Publication OTA-ISC-559.

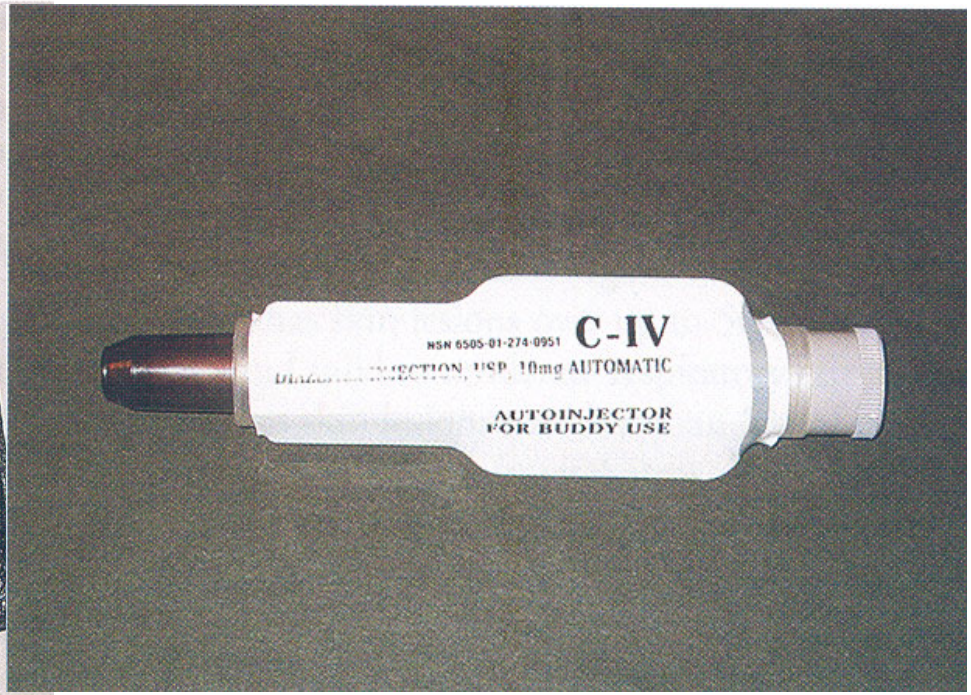
‡Kaufman AF, et al. The economic impact of a bioterrorist attack. *Emerg Infect Dis*. 1997;3:83-94

Defense Against Biological Weapons

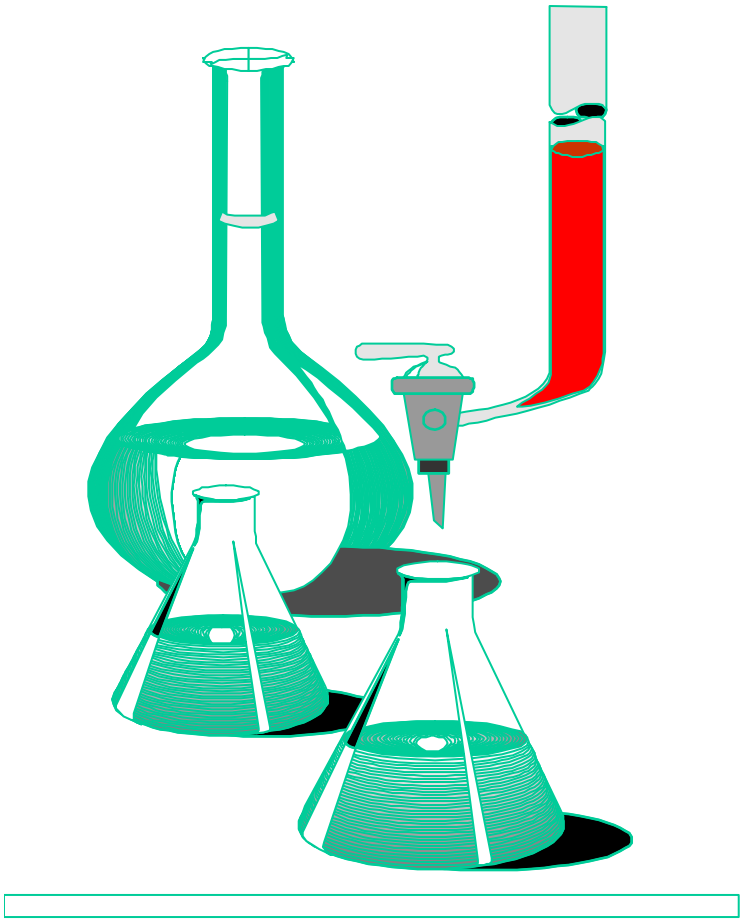
- **Vaccines: technical difficulties**
  - **anticipating strain**
  - **too many agents**
  - **availability: too many doses required**
- **Solution:**
  - **broad spectrum protection**
  - **therapeutic and preventive approaches**

KITS

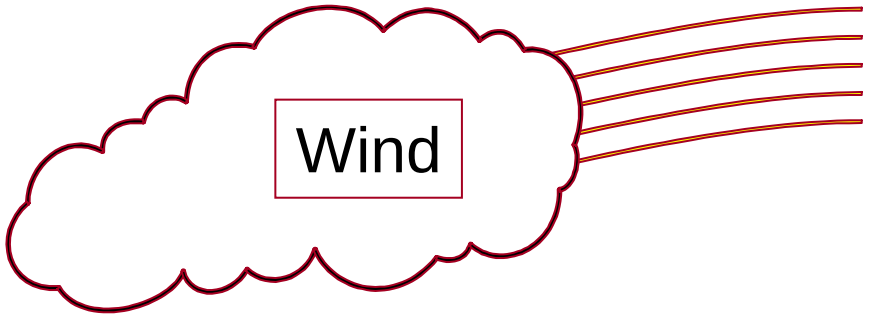

3 HOLD FIRMLY IN PLACE FOR TEN SECONDS
2
1
AtroPen® Auto-Injector
6505-01-174-9919
ANTIDOTE KIT, NERVE AGENT, MARK I
PAT. NO. 4,329,988
9T5327/984300
EXP DATE 12/04


NSN 6505-01-274-0951
C-IV
AUTOMATIC
AUTOINJECTOR
FOR BUDDY USE

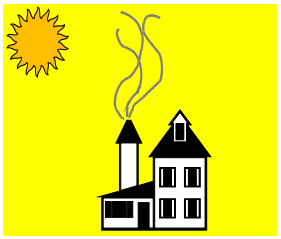
Chemical Agents



Influence of Weather



Air Stability Classes

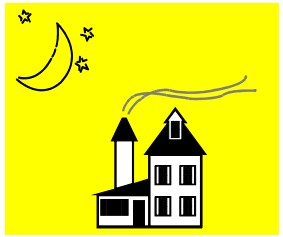


Cool Air

Lapse (unstable)

Warm Air

Neutral



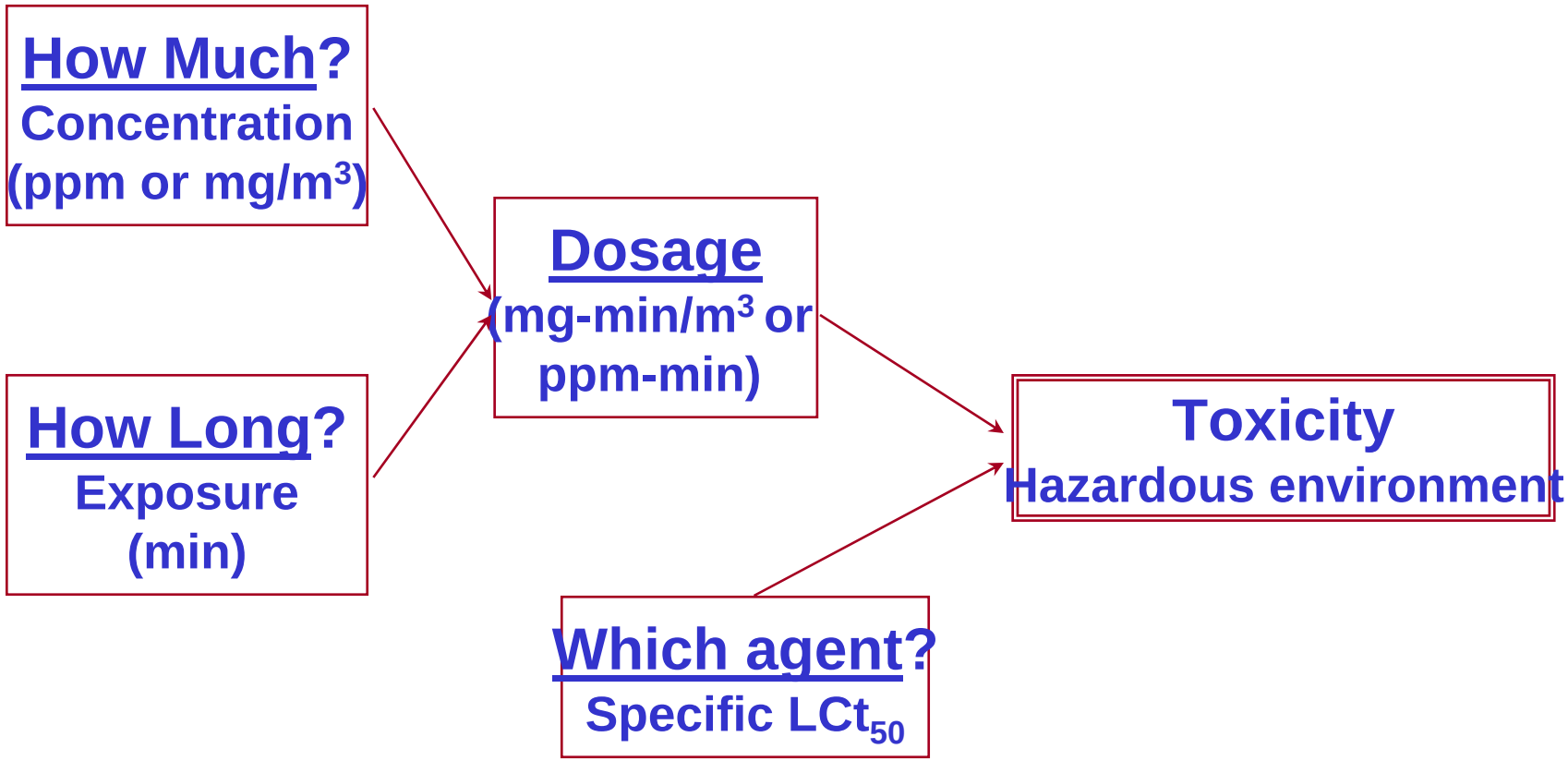
Hot Air

Inversion

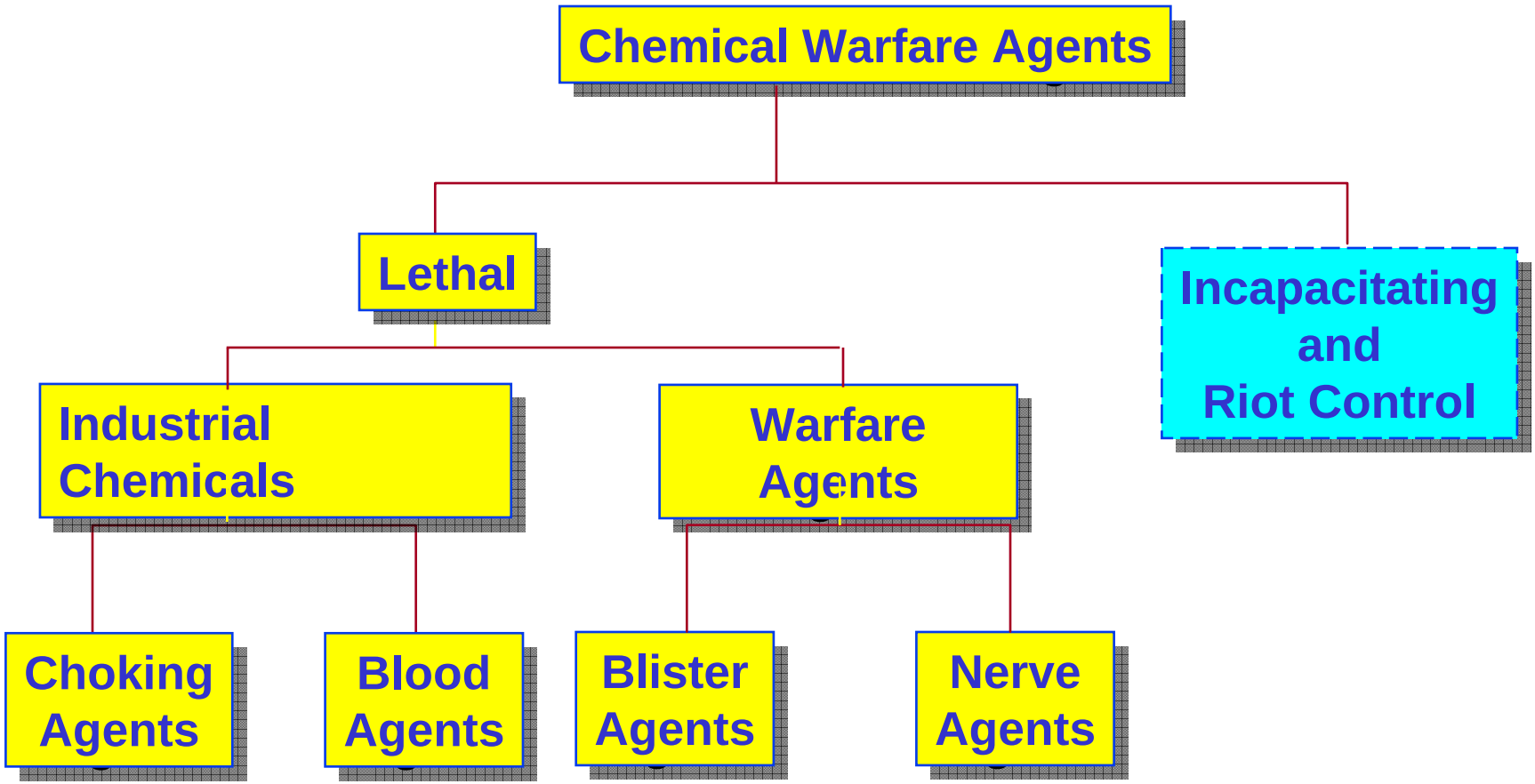
Cool Air

Chemical Agent Toxicity

for Gases and Aerosols



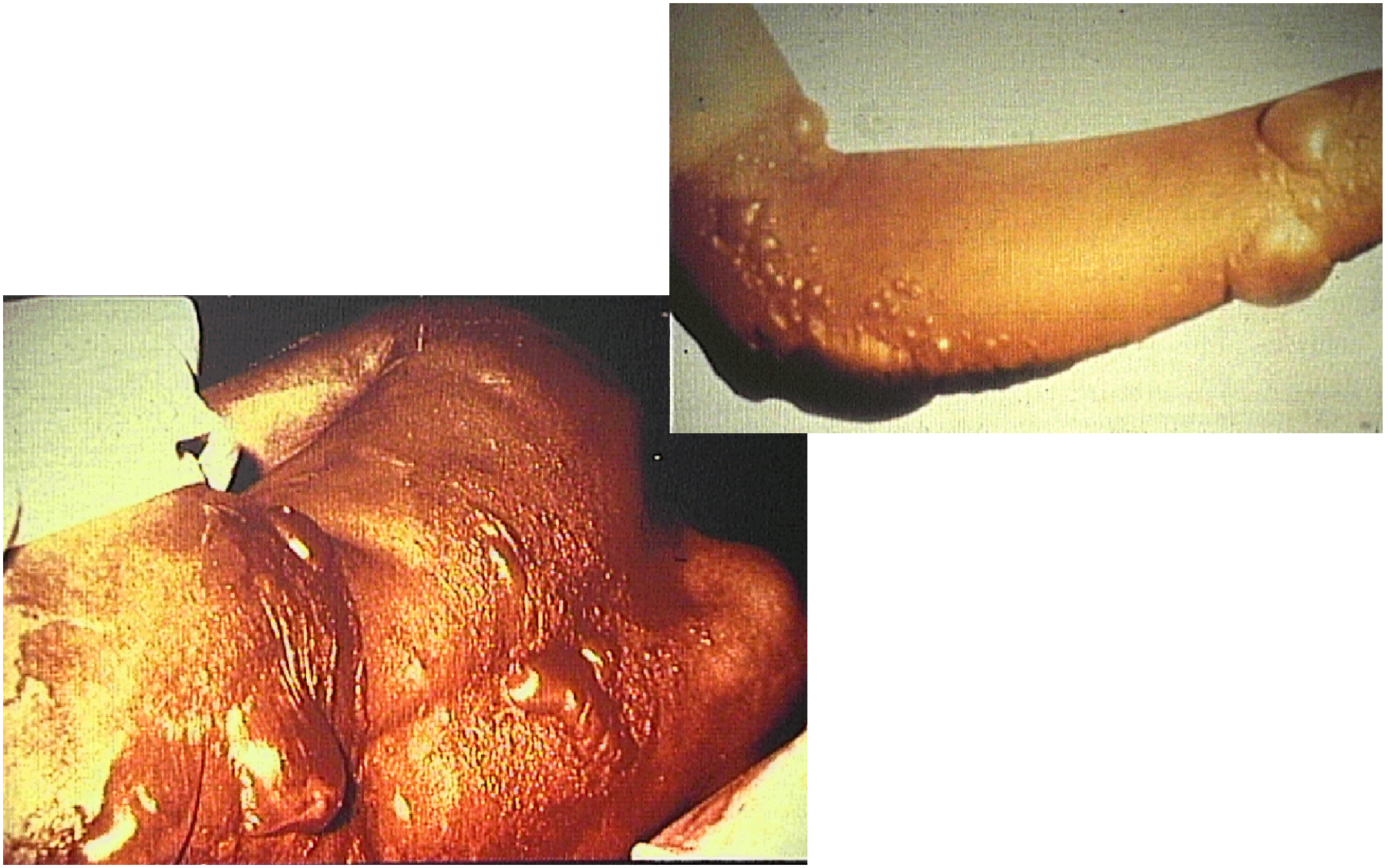
Classes of Chemical Agents



Chemical Warfare Agents

- **Blister Agents**
  - **Sulfur Mustards**
  - **Nitrogen Mustards**
  - **Arsenicals**
  - **Nettle Agents**
- **Nerve Agents**
  - **G- Agents**
  - **V- Agents**
  - **Others**

Blister Agent Exposure



Blister Agent Points of Emphasis

- **Sulfur mustard agent freezes at 57° F**
- **Mustard agent *symptoms* delayed - NOT onset time of effects**
- **Lewisite/phosgene oxime cause immediate, severe pain**
- **Persistency of hours (desert) to days or even weeks (temperate)**
- **Suspected carcinogens**
- **Cumulative effects**
- **Vapor is skin hazard**
- **Blisters on over 50% of body can prove fatal**

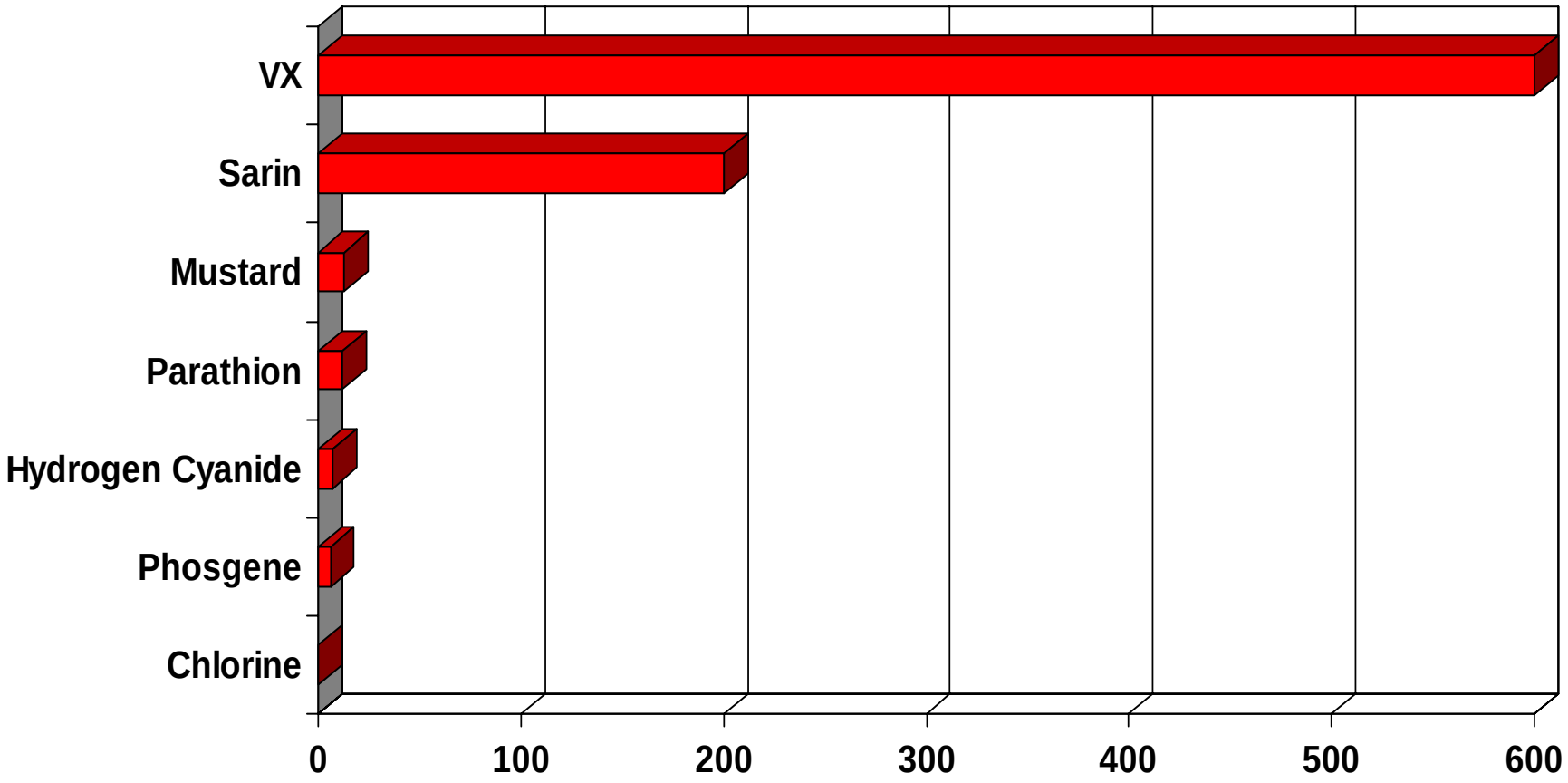
Nerve Agents

Common name / Symbol	**Tabun (GA), Sarin (GB), Soman (GD)**	**V- Agents (VX) (Vx)**
Military Class	G-series	V-series
Volatility ($mg/m^{3)}$	328 - 22,000	10.5
Toxicity (ppm)	12 - 48	4 - 12
Odor	Fruity (GA, GB), Camphor (GD)	Sulfur
Symptoms	• Pinpointing of pupils • Salivation • Vomiting / diarrhea • Difficulty breathing • Tearing (lacrimation) • Twitching / convulsions	
Protection	Respiratory and skin	
First Aid	Atropine + 2-PAM Chloride	

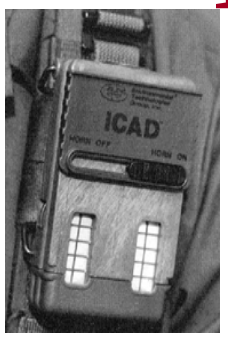
How Much Sarin (GB) Does it Take?

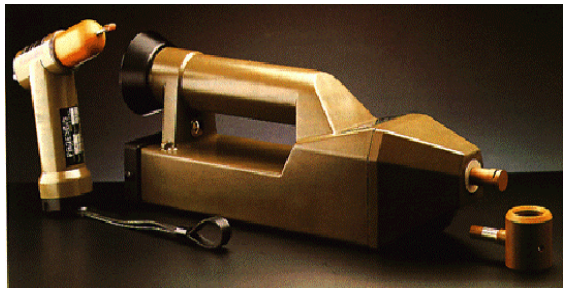
Structure Amount	Volume	Lethal Respiratory	Lethal Dose
Domed Stadium	1.07×10^6 m^3	100 mg-min/m^3	107 kg, about 26 gals
Movie Theater	12,000 m^3	100 mg-min/m^3	1.2 kg, about 5 cups
Conference Room (50-100 seating)	400 m^3	100 mg-min/m^3	33 g, about 1 shot glass

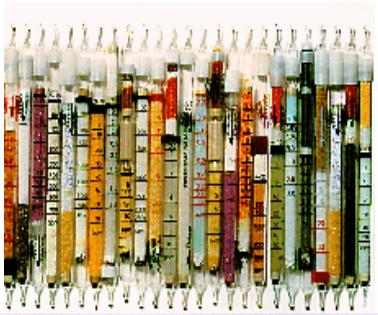
Comparative Toxicity

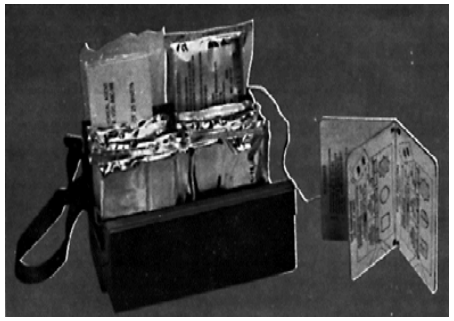


Chemical Detection and Identification Suite



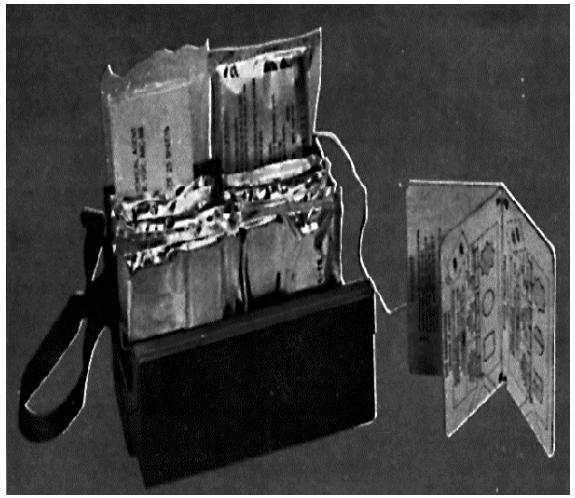






M256A1 Kit

- **Capabilities:**
  - **Detects nerve, blister, blood agents**
  - **Detects below IDLH for most agents**
- **Limitations:**
  - **Takes 15 minutes to use**
  - **Hand manipulations**
  - **Does not detect choking agents**
- **Best uses:**
  - **Initial recon**
  - **Verification of chemical detection**



Personal Protective Equipment

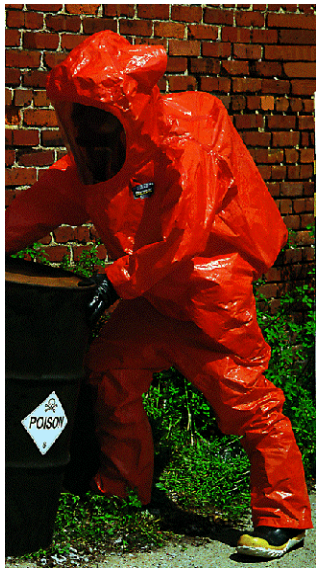
Objectives

- **Identify PPE recommendations for each category of NBC agent**
- **Be able to select the proper level of PPE based on the WMD situation**

Levels of Protection

Greater Hazard

Level A



Level B

Level C

Level D

Bunker Gear ?

Higher Burden

PPE Selection Considerations

- NBC agent
- Solid, liquid, vapor, aerosol
- Agent concentration
- Equipment protection factor
- Weather
- Zone
- Topography/Construction
- Protection level available
- Certified filter canisters
- Duration of mission
- Other considerations

Structural Firefighter Gear with SCBA

- **Excellent respiratory protection (PF ≥ 10,000)**
- **Limited liquid protection**
- **Estimated protection against skin absorption of vapors/aerosols (PF ~ 10)**

Recommended *Initial* Protection Levels

AGENT CATEGORY	MINIMUM *INITIAL* LEVEL OF PROTECTION
UNKNOWN	LEVEL A[1]
NERVE	LEVEL A/B[2]
BLISTER	LEVEL A/B[2]
BLOOD	LEVEL B[3]
CHOKING	LEVEL B[3]
BIOLOGICAL	FILTER[4] w/LEVEL C
RADIOLOGICAL	FILTER[4] w/LEVEL C

[1] Typical “standard” employed by HAZMAT teams

[2] Level B: High vapor/aerosol concentrations or splash hazard may result in agent poisoning

[3] Level A may be required in an enclosed area

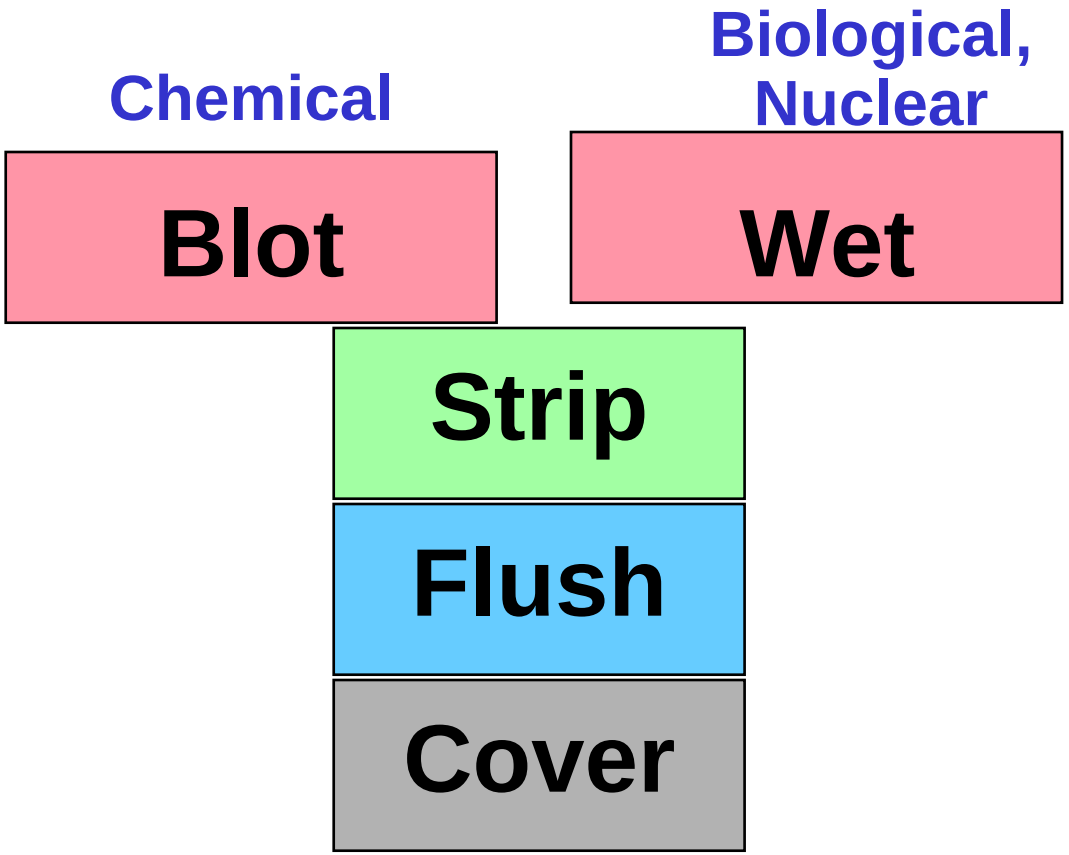
[4] 42 CFR 84 compliant

Downwind Hazard (DWH) Analysis

Factors Affecting DWH Prediction

FACTOR	UNFAVORABLE	MODERATE	FAVORABLE
Wind	12+ mph	8-11 mph	5-7 mph
Air stability	Unstable	Neutral	Stable
Temperature	< 40^0F	40^0- 70^0F	>70^0F
Precipitation	Any	Transitional	None
Cloud Cover	Broken clouds (day)	Thick overcast	Broken clouds Clear sky (night)
Terrain	Hill tops, mountains wooded, urban	Rolling terrain	Flat; Open Water
Vegetation	Heavily wooded	Medium dense	Sparse
Agent	VX, Cyanide	Blister	Sarin
Dissemination	Liquid	Explosive	Spray

Emergency Mass Casualty Decontamination Process



Emergency Mass Casualty Decontamination Procedures

- **Ambulatory decon**
  - **Communicate directions**
  - **Arms out, legs apart, head back**
  - **Top down wash**
- **Non-ambulatory decon**
  - **Cut off clothing**
  - **Use stretcher supports**

Decontaminants of Choice (Personnel)

Water	**Available, removes agent by mechanical action, no ill effects**
Soap and water	**Takes time to mix, extra cost, helps remove more agent, no ill effects**
Bleach and water	**Takes time to mix, extra cost, helps remove and neutralize more agent, can cause skin irritation or damage.**

For emergency decon, benefits of quickly showering with water outweighs extra removal capacity of soap or bleach solutions.

Hypochlorite / Bleach

- **Types: HTH, laundry bleach, household bleach**
- **Use: All chemical and biological agents**
- **Application: personnel, equipment, terrain**
  - **Requires mixing to 5% - 0.5% solutions**
- **Risks:**
  - **Corrosive, oxidizer**
  - **Causes skin burns**