



## **Biological Terrorism: Are You Prepared?**

A biological terrorist attack on US soil is a very real threat. The victims of such an attack would present to emergency departments. What are the agents likely to be used in such an attack? What are the presenting symptoms? What types of decontamination and infection control measures are necessary to protect health care workers? What outside resources are available in the event of such an attack? What can be done now to prepare for such a catastrophe? These questions and more will be answered by an expert faculty.

- Recognize the presenting symptoms of the agents most likely to be used in a biological terrorism attack.
- List decontamination and infection control measures necessary for various agents.
- Recruit outside agencies as resources for assistance.
- Develop a plan to prepare for the possibility of such an attack.

MO-17  
Monday, October 11, 1999  
9:00 AM - 9:55 AM  
Room # N251  
Las Vegas Convention Center

## **FACULTY**

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USAMRIID

# Medical Aspects of Biological Warfare Threats

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# Biological Warfare

The intentional use of microorganisms or toxins derived from living organisms to produce death or disease in humans, animals, or plants

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# International Biological Weapons Programs

Known

Iraq

Russia

Probable

China

Iran

North Korea

Libya

Syria

Taiwan

Possible

Cuba

Egypt

Israel

Source: Committee on Armed Services, House of Representatives. Special Inquiry into the Chemical and Biological Threat. Countering the Chemical and Biological Weapons Threat in the Post-Soviet World. Washington, D.C.: U.S. Government Printing Office; 23 Feb 1993. Report to the Congress.

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## Offensive BW Program: USSR

- Continued after 1972 BWC
- Biopreparat
  - Agency under ministry of defense
  - Up to 55,000 scientists and technicians research labs
  - production facilities
  - Sverdlosk accident: Anthrax spores
- Program inherited by Russia
  - 1992: President Yeltsin promises to terminate program
  - Still employs estimated 25-30,000

Proceedings US Naval Institute 1995; Feb: 40-45

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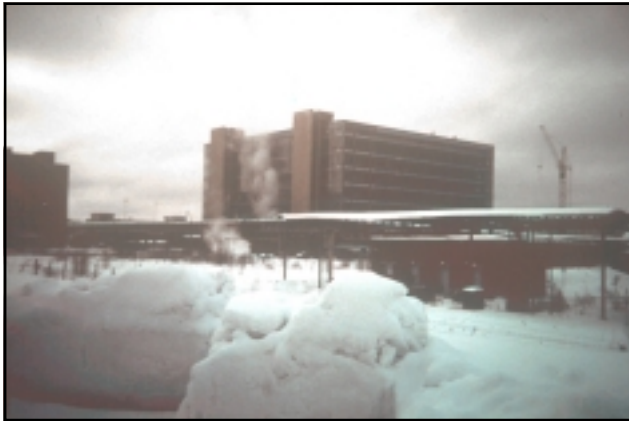
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**Soviet BW Priorities**  
"Agents Likely to be Used"



- Smallpox
- Plague
- Anthrax
- Botulism
- VEE
- Tularemia
- Q Fever
- Marburg
- Influenza
- Melioidosis
- Typhus

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## Destroyed U.S. Biological Warfare Agents

### Lethal

- *B. anthracis*
- Botulinum toxins
- *F. tularensis*

### Anticrop

- wheat stem rust
- rye stem rust
- rice blast

### Incapacitating

- *Brucella suis*
- VEE virus
- SEB
- Q fever agent

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## BW Agent Characteristics

- ✓ Infectivity/Toxicity
- ✓ Stability
- ✓ Ease of Production

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## Lethal vs. Incapacitating Agents

Lethal	Incapacitating
<i>Bacillus anthracis</i>	VEE Virus
Botulinum toxin	Q Fever
<i>Francisella tularensis</i>	Staph Enterotoxin B (SEB)
<i>Yersinia pestis</i>	
Smallpox	
Ricin toxin	

From a military standpoint, incapacitation of a high percentage of enemy forces may be as operationally significant as effects caused by lethal agents.

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## BW Proliferation and the Changing World

- Increasing number of countries developing BW capability
  - at least 5 countries are implicated as sponsors of international terrorism
- Regional aggressors and terrorist groups
- Groups or individuals who seek revenge against the government or society
  - extremist groups
  - religious fanaticism
- State Sponsored vs. Non-State Sponsored

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## Biological Terrorism

- Use of biological agents to intentionally produce disease or intoxication in susceptible populations to meet terrorist aims
- Has been done in the past on a limited scale
- Awareness of threat has increased: Japanese cult had capability of growing Anthrax and *Clostridium botulinum*, also of making Ricin
- U.S. must be prepared to respond to this threat

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BIOLOGICAL			
CATALOG OF TERROR	Ricin toxin	Botulinum toxin	Anthrax spores
For only a few thousand dollars, a terrorist group could be able to develop a chemical, biological or radiological weapon that would be as devastating as a small nuclear bomb.	Derived from the seeds of the castor-oil plant	Produced by the bacterium that causes botulism. It is one of the most powerful poisons.	Taken from many soil bacteria and animal carcasses.
How it kills	Plugs the blood, causing circulatory collapse.	Paralyzes respiratory muscles, leading to death.	Aspiration. It can cause pneumonia and suffocation.
Amount needed to inflict heavy casualties over 1 sq. mi. (1/4 sq. mi.)	800 g	80 g	8 g
How hard it is to make	Biological materials are abundant. Commercially sold to legitimate research institutions, but terrorists may be able to obtain substances with little or no difficulty.		
Cost	\$10,000 to \$20,000	\$20,000 to \$30,000	\$30,000 to \$50,000

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### Recent Activity Involving Terrorist Use of BW

- Report that Aum tried to disseminate anthrax
- FBI: Much “interest” with few actual incidents
- FBI: Including ricin incidents, BW threats “much more common” than chemical threats
- Recent cases: Larry Harris and plague/anthrax; B’nai B’rith hoax; threat to Florida water supplies; several ricin cases; Charlotte, NC incident; multiple anthrax hoaxes nationwide

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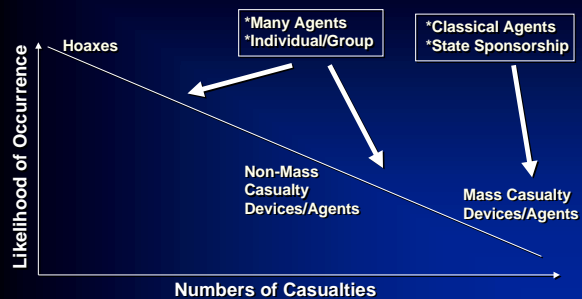
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### The Biological Terrorist Spectrum




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## How might it happen?

- **Covert attack**

- Patients may present first in doctors' offices
- Initially may appear to be natural outbreak
- Early samples sent to reference laboratory
- Subsequent patients diagnosed symptomatically

- **Overt attack on large (identified) population**

- Will be important to ID exposed patients
- Nasal swab evaluated with simple field assay

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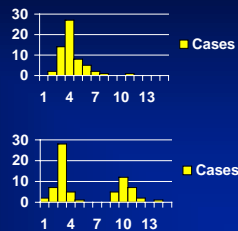
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## Epidemic Curve

- Person-to-person transmission vs. point source
- BW attack likely to affect many people at one time
- May cause secondary outbreak if person-to-person spread possible



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## BW Attack or Naturally Occurring Disease

- Environmental detectors may not be sufficient
- First evidence of BW attack may be ill person
- **Helpful findings**
  - Occurrence of large numbers of acutely ill persons
  - Illness reflects an unusual or impossible agent for geographic area
  - Unusual distribution of disease
  - Unexplained number of dead animals
  - Direct evidence—munitions with BW agents

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## Routes of Exposure

- Inhalation of Aerosols:
  - Point or line source in field
  - Limited, air-delivery in enclosed space
- Oral: Contamination of food or water
- Dermal: Mucous membranes or abrasions
- Percutaneous: Intentional or accidental

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## Inhalation

- Aerosols are probably the most significant route delivery for BW weapons.
- Aerosol delivery systems often generate invisible clouds with droplets less than 10 micrometers ( $\mu\text{m}$ ).
- Droplets less than 5  $\mu\text{m}$  optimally geared for reaching the distal airways and lodging in terminal bronchioles and alveoli to be picked up by the systemic circulation
- Aerosols of most agents produce systemic disease

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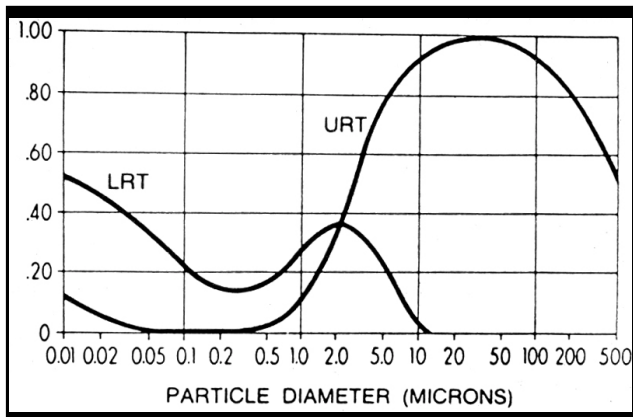
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### The Ag Pilatus Porter

Any Pilatus Porter can be converted to an Ag version and re-standardized by the operator within a few hours. Two versions are available:

<b>Integral tank</b> Installed in the cabin compartment. Capacity 1200 litres. 3000 US Gallons stainless steel. Pump 3000 US Gallons with 1000 PSI. Spray boom for 100 nozzles. or 2700 MICROAIRS. Operation changed from 100 PSI to 150. depending on equipment.	<b>Self-contained</b> Underwing spray pod. MICROAIR. 2 pods. Each with underwing. hard points. Capacity 1000 US Gallons. each. The advanced MICROAIR. Ag 4000 has a variable out. put of 5-20 Bar/min. 10-4000 Gallons each.
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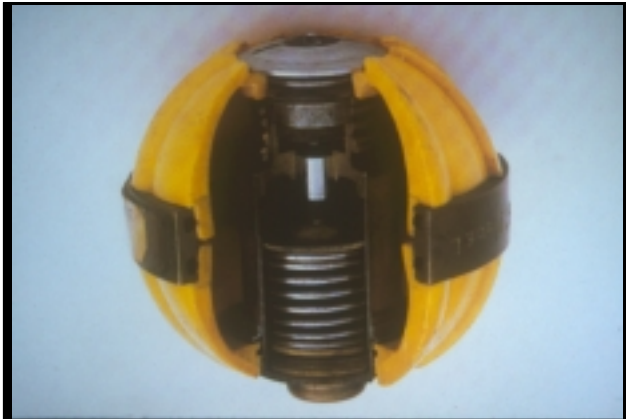
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## Oral

### Potentially significant route of delivery

Contamination of food and water supplies, either purposefully or incidentally after an aerosol biological warfare attack, represents a hazard for infection or intoxication by ingestion

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## Dermal

- Intact skin provides an excellent barrier for many but not all biological agents (example - mycotoxins).
- Mucous membranes and abraded, or otherwise damaged skin can allow passage of some bacteria, viruses, and toxins and thus should be protected.
- Potential but unlikely vector-borne delivery of biological agents.
- Potential (most likely terrorist initiated) injection of biological agents from a distance

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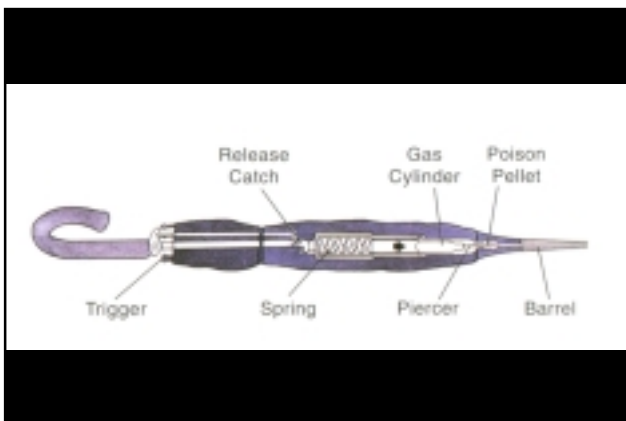
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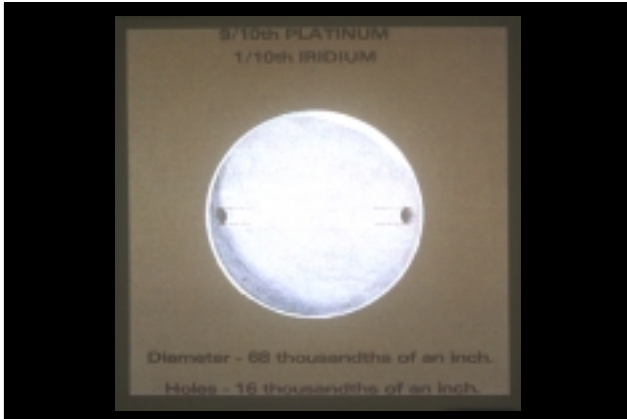
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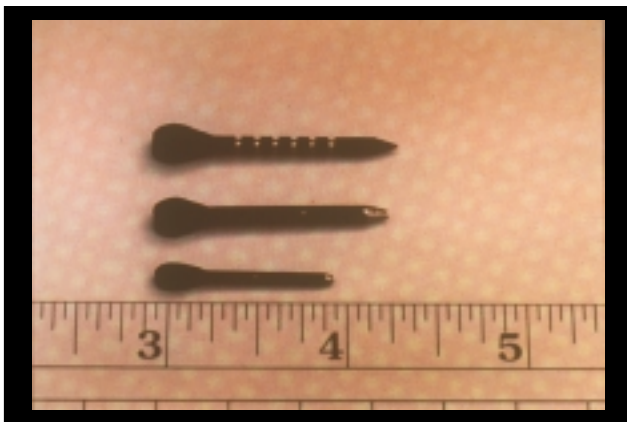
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**What Must We Protect Against?**

**Scenarios for Use:**

Open-Air - Line Source Delivery

Open-Air - Point Source Delivery

Limited Air-Delivery Applications

Limited Delivery in Water/Food Supplies

Direct Application (Assassination)

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## Acquisition of Etiologic Agents

- Field samples or clinical specimens
- Multiple culture collections
- Universities
- Commercial biologics supply houses
- Foreign laboratories
- Genetic engineering to enhance virulence

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## Sources of Agents for Terrorism Use

- World Directory of Collections of Cultures and Microorganisms
  - 453 worldwide repositories in 67 nations
  - 54 ship/sell anthrax
  - 18 ship/sell plague
- International black-market sales associated with governmental programs

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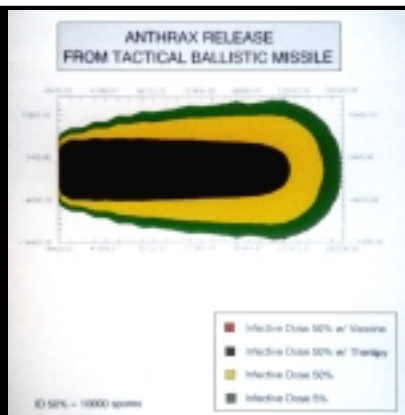
...for a large-scale operation against a civilian population, casualties might cost \$2000 per square kilometer with conventional weapons, \$800 per square kilometer with nuclear weapons, \$600 per square kilometer with nerve gas, and \$1 per square kilometer with biological weapons

Chemical-Biological Expert  
Panel Appearing Before the  
United Nations in 1969

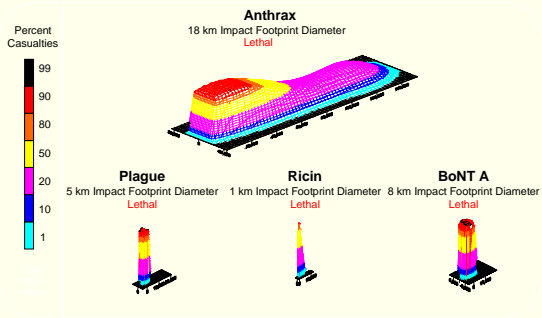
### Hypothetical Dissemination by Airplane of 50 kg of Agent Along a 2 km Line Upwind of a Population Center of 500,000\*

Agent	Downwind Reach (km)	Dead	Incapacitated
Rift Valley Fever	1	400	35,000
Tick-Borne Enceph.	1	9,500	35,000
Typhus	5	19,000	85,000
Brucellosis	10	500	100,000
Q Fever	>20	150	125,000
Tularemia	>20	30,000	125,000
Anthrax	>>20	95,000	125,000

\* Health Aspects of Chemical and Biological Weapons, WHO, 1970.



### Agent Comparisons: Area Coverage



### Impact of BW on the Medical Care System

- Terror in affected population and the medical care system
- Overwhelming numbers, ICU demands, special medication needs
- Need for protection personnel in medical care areas
- Problems with handling of remains

### Shopping Mall Scenario - Denver

- Anthrax aerosolized into shopping mall ventilation system: 10,000 people are present and 9,000 people are exposed; terrorist announces attack at 24 hours
- 90% of exposed started on antibiotics by end of day 2, 10% cannot be found initially
- Total number hospitalized 4950, total requiring ICU care 2925, total deaths 855, total ventilators required 2601, total ICU beds 300 (only 150 available)
- Even a small scale bioterrorism event completely overwhelms city's medical care resources
- The 13,000 military beds deployed for the Persian Gulf War would STILL not provide enough ICU beds (only about 1300)

### Maximum Credible Event

- Well-Funded Organization or State-supported
- Capability of producing weapons-grade agents
- Proper aerosol dispersal mechanisms
- Intent:
  - Kill large numbers
  - Overwhelm Resources
  - Cause massive societal disruption

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### Highest Threat

- Dispersed in aerosol
- Highly lethal
- Production capability/knowledge available
- Lack of treatment or vaccine
- Communicable
- Mere threat of use creates panic

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### Agents With Greatest Potential to Cause Mass Casualties

Anthrax, Smallpox

- Well-demonstrated historical devastation potential
- Both highly lethal agents
- Stable in aerosol
- Devastating psychological impact
- Capable of large quantity production

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## Anthrax

- Disease recognition likely delayed
- Case fatality 80% or greater
- Illness development may be delayed
- Vaccine not available for routine civilian use
- Antibiotic requirements would be enormous
- Stable for storage for years

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## Sverdlovsk Epidemic

- 77 patients
  - 55 males, ages 24-52 (mean age 42)
    - 60% or 33 moderate or heavy smokers
    - 50% or 33 moderate or heavy EtOH
  - 22 females, ages 24-69 (mean age 55)
  - 73 of 77 lived/worked within 4 Km in narrow zone southeast of Compound 19 during 1st week of April, 1979
  - 2 April: Prevailing northwest winds 18 Km/hr
- Onset 4 April-15 May
  - Modal incubation period: 9-10 days

Meselson et al. *Science* 1994;266:1202-8

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## Inhalation Anthrax

<u>INCUBATION - DAYS</u>	<u>CASES</u>	<u>DIED</u>	<u>DAYS TO DEATH</u>
0-6	9	9	3.0
7-13	24	23	2.0
14-20	8	8	3.5
21-27	5	5	2.0
28-44	11	5	4.0

## Inhalational Anthrax

- Incubation period 1-6 days
- Nonspecific symptoms
  - Malaise, fever, fatigue, cough, chest discomfort
- Terminal phase
  - Dyspnea, stridor, cyanosis, increased chest pain, chest wall edema, followed by shock and death within 24-36 hours
- Meningitis seen in up to 50% of cases





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## Smallpox

- More difficult to obtain than anthrax, plague, bot
- Delayed recognition allows second generation spread
- Waning immunity in population
- Case-fatality rates 30% or more
- No treatment/limited vaccine supplies
- Highly infectious at low dosages

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### Other Agents to Consider

#### Plague

- Known historical potential
- Devastating psychological impact
- Communicable bacterial agent

#### However:

- Treatment/prophylaxis readily available
- Difficulties in producing and dispensing large quantities

Other Bacterial agents (Q fever, Tularemia, Brucellosis)

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### Other Agents to Consider

#### Botulinum Toxin

- Lethal
- Requirement for ICU care
- Many countries studying

#### However:

- Small effect on open-air targets
- Producing/dispersing large amounts difficult

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## Agents of Concern

Anthrax  
Smallpox

Plague  
Tularemia

Bot Tox  
VHF

## Is BW the Ultimate Weapon?

- Agents easy to obtain
- Relatively easy and inexpensive to produce
- Numerous, easily available delivery modes
- Dissemination over tremendous areas from long distances away
- Agent clouds are invisible to human eye
- Detection is a problem
- Great numbers of casualties possible
- First sign may be large numbers of dying or ill
- May rapidly overwhelm medical resources
- Even threat of use would create fear, panic
- Potentially an ideal terrorist weapon
- Perpetrators could escape days before effects (agents with incubation times of several hours/days)

## Medical Response to BW Threats

EXPOSURE	ONSET OF ILLNESS
Pre-exposure	Incubation period (minutes - 3 weeks)
Immunization (active)	Diagnosis (specific agent)
Prophylaxis (drugs or immune serum) Detection	Active or Passive immunization
	Pre-treatment (drugs)
	Overt disease
	(Diagnosis)
	<u>Treatments:</u>
	• Antibiotics
	• Antivirals
	• Antitoxins
	• Passive Immunotherapy

## BIDS



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## Medical Biological Defense BW Vaccine Status

 <b>Vaccines</b>	<b>Licensed</b>	<ul style="list-style-type: none"><li>▶ Anthrax (BioPort Corp.)</li><li>▶ Plague (Greiner Laboratories)</li><li>▶ Smallpox (Wyeth Laboratories)</li></ul>
	<b>IND</b>	<ul style="list-style-type: none"><li>▶ Tularemia</li><li>▶ Venezuelan Equine Encephalitis (VEE)</li><li>▶ Eastern Equine Encephalitis (EEE)</li><li>▶ Western Equine Encephalitis (WEE)</li><li>▶ Q-Fever (Coxiella burnetii)</li><li>▶ Botulinum Toxoids</li><li>▶ Smallpox (cell culture derived)</li></ul>
	<b>Emerging</b>	<ul style="list-style-type: none"><li>▶ Botulinum (recombinant C fragment)</li><li>▶ Anthrax (Recombinant PA)</li><li>▶ VEE, EEE, WEE (recombinants)</li><li>▶ Staphylococcal Enterotoxins (recombinants)</li><li>▶ Plague (F1-V antigen)</li><li>▶ Ricin (A Subunit)</li><li>▶ Filovirus (Ebola, Marburg)</li><li>▶ Multi-Valent and Improved Vaccine Presentation</li></ul>

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## Rapid and Confirmatory Diagnostics



- Development and evaluation of diagnostic assays
- Technologies field-tested with Theater Area Medical Laboratory
- DOD Reference laboratory for biological agent confirmation
- Special laboratories to safely handle highly hazardous organisms

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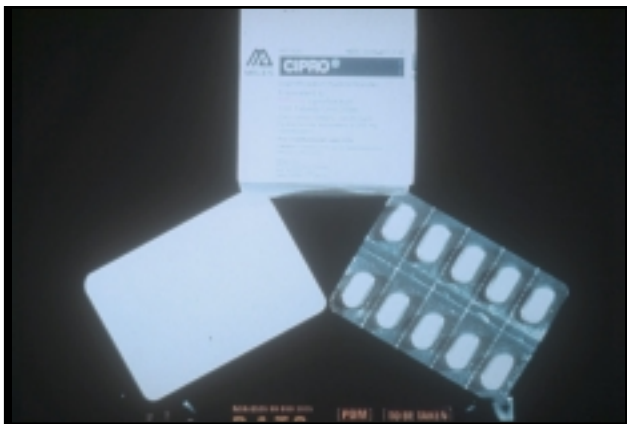
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## Countermeasures to BW Agents

Active immunization

Passive Immunoprophylaxis/Chemoprophylaxis

Detection

Physical Protection

Identification/Diagnostics

Decontamination

Passive Immunotherapy

Chemotherapy

Response to Bioterrorism  
may start here

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## What Must We Do?

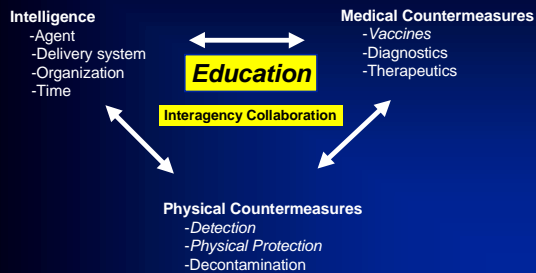
- Identify the attack
- Confirm agent i.d. or the diagnosis
- Identify potentially exposed individuals
- Pretreat the potentially exposed
- Control movement of potentially exposed and ill
- Develop a case definition
- Describe the outbreak
- Treat patients
- Calm the public and contain the outbreak

May have only 24-48hr

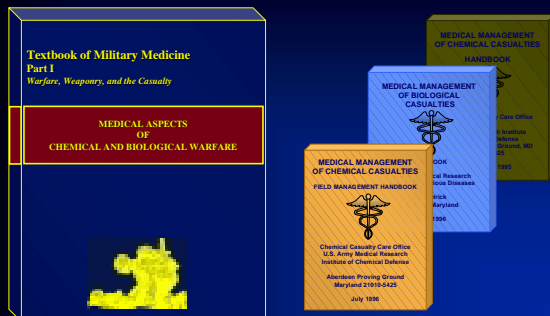
If we overreact, the terrorist wins!

## Protecting Our Citizens

(A Case for Integration & Teamwork)



## Medical CB Handbooks






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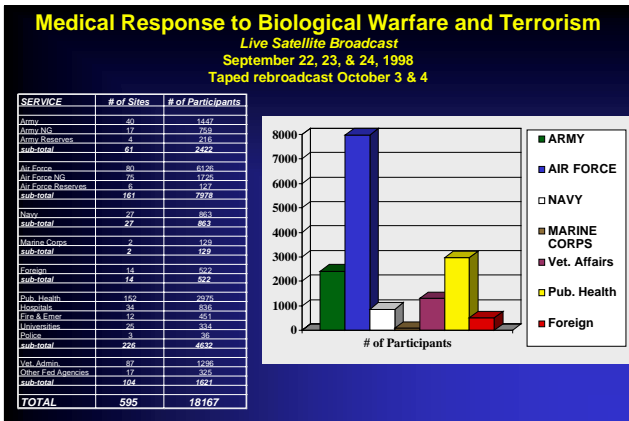
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### Counterterrorism Support: USAMRIID

- Threat evaluation
- Rapid bio agent identification
- Reference laboratory for agent confirmation
- Expertise in personal protection, science, operations and decontamination
- Medical consultation
- Biological Threat Response Cell
- 0300/0400
- FEST/DEST/CBRRT
- Scientific Advisors to TEU and CBIRF



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### Biological Terrorism What's Important to the Nation?

- Awareness of the Risk
  - The real threat...not just the popular threat
- Education
  - What we don't know can hurt us!
- Readiness for the Unexpected
  - Stockpiled Drugs and Vaccines, Diagnostics, Planning, Exercises
- A strong Public Health Infrastructure and Tech Base
  - The consequences of lack of preparedness are unacceptable

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## USAMRIID: A Unique National Resource

- Highly trained, award-winning scientific staff
- Unique, state-of-the-art research facilities
- Medical products and information for the warfighter



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