Bioterrorism

Lester Kallus, MD
Emergency Medicine Department
SUNY @ Stony Brook

“Sadly the world has changed. The threat of bioterrorism is real and growing.”

Margaret Hamburg MD – Oct 12, 1999
Assistant Secretary
Department of Health and Human Services
(2009 FDA Commissioner)

New York Times – 9/23/01

- The nation is "woefully unprepared to deal with bioterrorism,“
  Jerome M. Hauer,
  former head of emergency management for
  New York City,
  told Congress 7/01

Bioterrorism – CDC Category A

- High priority agent
- Pose national security risk
- Easily transmitted & disseminated
- High mortality
- Major public health impact

Bioterrorism – CDC Category A

- Anthrax
- Botulism
- Plague
- Smallpox
- Tularemia
- Ebola
- Marburg hemorrhagic fever
- Lassa fever
- Argentine hemorrhagic fever
**Bioterrorism – CDC Category B**
- Easy to disseminate
- Low mortality rates

**Bioterrorism – CDC Category B**
- Q fever
- Brucellosis
- Glanders
- Venezuelan encephalomyelitis
- Eastern equine encephalomyelitis
- Western equine encephalomyelitis
- Ricin
- Clostridium perfringens
- Staph enterotoxin B
- Salmonella Shigella dysenteria
- E coli
- Vibrio cholerae
- Cryptosporidium parvum

**Bioterrorism – CDC Category C**
- Emerging Pathogens
- Possibly engineerable

**Bioterrorism – CDC Category C**
- Nipah virus
- Hantavirus
- Tickborne hemorrhagic fever
- Tickborne encephalitis virus
- Yellow fever
- Multi-drug resistant tuberculosis

**Bioterrorism – Early History**
- Assyrians poisoned wells with Rye Ergot

**Bioterrorism – Early History**
- Romans
  - Used dead animals to foul enemy’s water
  - Lessened numbers
  - Lowered morale
- Tartars
  - Catapulted dead bubonic plague victims
  - Caused medieval European plague epidemic
Bioterrorism – Early History
- British – French-Indian War
  - “Gifts” of smallpox infected blankets
  - Devastated # of Indians

Bioterrorism – Modern Japanese
- Japanese 1918 formed Unit 731
  - Dedicated to BW
  - 1931 used Manchurian prisoners for BW research
  - 1941 sprayed bubonic plague over China
  - 1942 “bacterial bombs” deployed in China
  - Tested BW on US POWs

Bioterrorism – Modern British
- British
  - Feared a German-Japanese advantage in WW II
  - Studied anthrax dispersion
  - Gruinard Island off the coast of Scotland
  - Too close to mainland
    - infected coastal sheep
  - Gruinard Island still contaminated with spores

Bioterrorism – Modern US
- US Program – 1942
  - Acquired Japanese data
  - 1956 – USSR accused US of using BW in Korea
  - USSR threatened retaliatory chemical & BW

Bioterrorism – Modern Russian
- 1979 – Sverdlovak factory exploded followed by Anthrax outbreak – >66 dead
- All accusations of BW research were denied
- 1992 – Yeltsin confirmed Anthrax research vowed to stop all BW research
- Allegations of “super virus” research
Modern Bioterrorism
- Rajneeshe Cult members
  - sprayed salmonella on Oregon salad bars
  - >700 infected

Bioterrorism – advantages
- Great killing efficiency
- Botulinum 3 million x more potent than Sarin
- Cheap
- Conventional weapons explode once
- BW like the energizer bunny – keeps on going

Bioterrorism cost to affect 1 km²

<table>
<thead>
<tr>
<th>Type of weapon</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>$2000</td>
</tr>
<tr>
<td>Nuclear</td>
<td>$800</td>
</tr>
<tr>
<td>Chemical</td>
<td>$600</td>
</tr>
<tr>
<td>Biological</td>
<td>$1</td>
</tr>
</tbody>
</table>

Bioterrorism dispersal equipment
- Piece of fruit
- Missile
- Aerosol equipment (e.g. farm equipment)

Airplane with 50 kg agent, 2 km line upwind of 500,000 people

<table>
<thead>
<tr>
<th>Agent</th>
<th>Downwind Reach</th>
<th>Dead</th>
<th>Incapacitated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rift Valley Fever</td>
<td>1</td>
<td>400</td>
<td>35,000</td>
</tr>
<tr>
<td>Tick borne Encephalitis</td>
<td>1</td>
<td>9,500</td>
<td>35,000</td>
</tr>
<tr>
<td>Typhus</td>
<td>5</td>
<td>19,000</td>
<td>85,000</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>10</td>
<td>500</td>
<td>100,000</td>
</tr>
<tr>
<td>Q Fever</td>
<td>&gt;20</td>
<td>150</td>
<td>125,000</td>
</tr>
<tr>
<td>Tularemia</td>
<td>&gt;20</td>
<td>30,000</td>
<td>125,000</td>
</tr>
<tr>
<td>Anthrax</td>
<td>&gt;&gt;20</td>
<td>95,000</td>
<td>125,000</td>
</tr>
</tbody>
</table>

Bioterrorism – disadvantages
- Unpredictable
- Weather
  - Especially if worried about your own troops
  - Guinard Island (Scotland) is a prime example
- Lifespan of material
- How soon can your troops rush in?
- Horrible stigma – politically damaging
**Bioterrorism detection**
- Covert event
  - Persons unknowingly exposed
  - Suspected only upon unusual clustering of disease
- Announced event
  - Mostly hoaxes in US (so far)
  - Must prepare for both types

---

**Bioterrorism & capitalism**
- Spam email from janne33@kol.co.kr 10/11/01
  - We have Gas Masks certified by Israeli Defense and the ONLY anthrax antibiotic available (also Viagra)
  - “Stock up now while supplies last worldwide

---

**Epidemiologic features**
- Rapid increase in disease incidence (days or hours)
- Epidemic curve rises & falls in short period
- Unusual increase in people seeking care
  - Fever
  - Respiratory
  - GI sx

---

**Epidemiologic features**
- Endemic disease in unusual pattern
- Lower attack rate in people who were indoors
- Clusters of patients from one locale
- Large # of fatal cases
- Characteristic disease:
  - Pulmonary anthrax
  - Tularemia
  - Plague
Infection control practices

- Isolation precautions
  - Generally not transmitted from person to person (except pneumonic plague & smallpox)
  - Handwashing
  - Gloves (wash after removing gloves)
  - Mask & Eye protection
  - Gowns

Patient placement

- Small scale event
  - Routine facility placement
  - Routine infection control practices
- Larger scale event
  - Practical alternatives
  - Group affected patients
  - Set up a response center (controlled entrance)

Discharge management

- Generally keep in hospital until non-infectious
- Consider need for home care - large scale event

Post-mortem care

- Path department should be informed!
- Consider funeral directors when developing plans

Prophylaxis & immunization

- Recommendations subject to change
- Consult local & state health departments & CDC
- Maintain good records

Psychology of biology of bioterrorism

- Fear & panic in patients
- Minimize panic by clearly explaining risks
- Avoid unnecessary isolation or quarantine
- Reassure unexposed patients with somatic sx.

CDC

[Image of CDC logo]
Psychology of biology of bioterrorism
- Fear & panic in staff
- Provide bioterrorism education
- Invite active, voluntary involvement in planning
- Encourage participation in drills

Anthrax – 3 forms
- Pulmonary – the bioterrorism form
- Cutaneous
- GI

Anthrax
- Bacillus anthracis
- Spore forming gm(+) rod
- Sheep, goats, cattle
- Eat contaminated soil
- Humans infected from:
  - Skin
  - Ingestion
  - Inhalation of spores (associated with bioterrorism)

Pulmonary anthrax
- 1900 – 2000 – 18 cases (last in 1976)
- October 2001 – 22 cases
  - 11 life-threatening infection
  - 5 deaths from inhalational anthrax

Anthrax - pulmonary
- Person to person transmission does not occur
- Person to person transmission does not occur
- Person to person transmission does not occur
- Person to person transmission does not occur
- Person to person transmission does not occur
- Person to person transmission does not occur
**Anthrax Fun Spores**

- Transmitted by spores
  - Inhalation of aerosolized spores
  - Cutaneous contact with spores
  - Ingestion of contaminated food

**Anthrax – pulmonary**

- 1st, a non-specific prodrome – flu-like symptoms
- Possible brief interim improvement
- 2-4 days later
  - Abrupt respiratory failure
  - Hemodynamic collapse
  - Widened mediastinum (mediastinal widening)
  - Gm(+) bacilli on blood culture
  - Tx too late after pulmonary sx

**Anthrax diagnosis**

- Isolation of B. anthracis from specimen
- 4-fold or greater rise in Elisa
- Demonstration via immunofluorescence

**Anthrax Incubation Period**

- Vaccine available (Inactivated, cell-free)
- Routine procedure for military
- Not recommended for civilians

**Anthrax Infection Control**

- Isolation precautions (use of gloves!)
- Private room is not necessary
  - No human-human transmission
- Standard precautions used
- Standard disinfecting equipment
**Post Exposure Management**

- Re-aerosolization risk is low
- In cases of high risk
  - Cleanse skin
  - Instruct patient to remove clothing in labeled plastic bag
  - Patient must shower with soap & water
  - Standard precautions when handling belongings
  - Decontaminate surfaces

---

**Anthrax prophylaxis**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td>750 mg BID</td>
<td>10-15 mg/kg BID</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>500 mg OD</td>
<td>NR</td>
</tr>
<tr>
<td>Ofloxacin</td>
<td>400 mg BID</td>
<td>NR</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>100 mg BID</td>
<td>2.5 mg/kg BID</td>
</tr>
</tbody>
</table>

- **If exposure confirmed**
  - Rx for 8 weeks
  - Rx with vaccine

---

**Patient, Visitor & Public Information**

- Exposed victims are NOT contagious
- Prophylactic antibiotics ARE available
- Vaccine IS available

---

**Botulism**

- Clostridium botulinum
- Gm+ bacillus
- Produces potent neurotoxin
- Toxin releases acetylcholine
- Results in flaccid paralysis

---

**Botulism clinical features**

- Food-borne disease most common
- Inhalation disease also possible
- NOT transmitted from person to person

- Food-borne accompanied by GI sx
- Both forms share:
  - Responsive patient, no fever
  - Symmetric cranial neuropathies
  - Blurred vision & **diplopia**
  - Respiratory dysfunction (paralysis)
  - No sensory deficit
Botulism – mode of transmission
- Toxin-contaminated food
- Aerosolized – bioterrorism form

Botulism – Incubation period
Neuro symptoms
- GI form – 12-36 hours
- Inhaled form – 24-72 hours

Botulism confirmation
- Clinically compatible case
- Laboratory:
  - Detection of botulinum toxin in serum, stool or food

Botulism prevention
- Vaccine currently under development
- Immunization lasts at least 1 year
- Routine immunization not recommended
- Heat labile – so heat the food

Infection Control Practices
- Standard precautions
- Patient-to-patient transmission does not occur
- Standard precautions for transport

Post exposure management
- Suspicion even if just one case
- If not bioterrorism, maybe mass food exposure
- Carefully monitor any suspected patient
- Decontamination not indicated
- Trivalent antitoxin available
- Prepare for ventilatory support
Botulism lab support
- Routine labs of limited value
- Coordinate labs of limited value
  - Public Health Authorities
  - FBI

Pneumonic Plague
- *Yersinia pestis*
- Gm(-) rod, non motile, pleomorphic

Pneumonic Plague – clinical features
- Fever, cough, chest pain
- Hemoptysis
- Lymphadenopathy
- Muco-purulent watery sputum
  - gm(-) rods on gm stain
- X-ray shows bronchopneumonia
- Highly contagious
- Buboes possible, not necessary

Plague – mode of transmission
- Normally fleas from infected rodents
- Bioterrorism – aerosolized
- Person-to-person transmission possible
  - Large aerosol droplets

Plague – incubation period
- 2-8 days if flea borne
- 1-3 days if pulmonary exposure

Plague communicability
- Cough produces infectious particle droplets
- Use mask for patient care until 72 hrs of abx
**Plague confirmation**
- Laboratory — presumptive:
  - Elevated serum antibody titer to Y. pestis (in patient with no history of vaccination)
  - Detection of F1 antigen by fluorescent assay
- Laboratory — confirmatory
  - Isolation of Y. pestis or
  - 4fold or greater change in serum antibody

**Plague prevention**
- Vaccine available — not effective for pneumonic
- Not available in US
- Involves multiple doses over several weeks
- Post exposure immunization useless

**Plague Infection Control**
- Droplet precautions
- Large droplets (generally > 5µ in size)
- Wear mask at least within 3 ft of patient
- Private room
- Cohort placement (if no private rooms available)
- Maintain 3 feet between patients

**Post Exposure Management**
- Risk or re-aerosolization is low
- Remove contaminated clothing – plastic bag
- Handle clothes minimally – avoid agitation
- Patient should shower thoroughly
- Standard Universal Precautions
- Environmental surface decontamination

**Plague Prophylaxis for 7 days**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxycycline</td>
<td>100 mg BID</td>
<td>2.5 mg/kg BID</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>500 mg OD</td>
<td>10-15 mg/kg BID</td>
</tr>
</tbody>
</table>

**Plague public information**
- Fact sheet should be prepared:
- Description of droplet precaution
- Difference between prophylaxis & treatment
- Decontamination by showering
**Smallpox**
- Variola virus
- Can be transmitted via airborne route
- Single case is a public health emergency

**Smallpox Mode of transmission**
- Large & Small droplets = airborne!
- Patient-to-patient transmission likely
- More infectious if coughing or bleeding

**Smallpox incubation period**
- 7-17 days
- 12 day average

**Smallpox prevention**
- Vaccine available
- No longer recommended last case 20 years ago but…
- Immunization does not confer lifelong immunity but…

**Smallpox original vaccine**

**Smallpox Infection Control**
- Prevent inhalation of particles ≤ 5µ
- Strict Universal Precautions
- Transfer to appropriate isolation room
- In large epidemic, may cohort patients
- Limit transportation (but use mask on patient if necessary)
Smallpox post exposure management
- Decontamination not indicated
- Post exposure immunization effective
- Vaccination alone if < 3 days
- IGG also if > 3 days
- Vaccination contraindicated:
  - Pregnancy
  - Immunocompromised patient

Steps to take upon initial suspicion

Sandia Laboratory – Decontamination Foam

Application new chem-bio decontamination foam from pressurized canister