Establish Zoonotic Foci Sentinel Systems to Detect Biological Terrorism Events

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Basic Modes of Biological Path

- **Aerosol** *(inhalation)* (highly efficient & effective)
- **Contaminated foodstuffs / water** *(including groundwater)* (moderately efficient)
  - eg. Anthrax may be transmitted through spore-contaminated bonemeal.
- **Vector-borne** (tactically inefficient at best)
  - Arthropods *(fleas, flies, mosquitoes, ticks, lice, etc…)*
  - Vertebtrates *(canines, bovines, avian, etc…)*
  - Person-to-person
Possible Dissemination Means
Environmental Effects on Path Dispersal

- **Sunlight**
  - Most are UV sensitive
  - Weaponized by encapsulation or genetic engineering

- **Relative Humidity**
  - High – wet aerosolized agents
    - Slower evaporation of carrier
    - Slower decay rate of pathogen
  - Low – dry/powdered aerosolized agents
    - Avoids clumping of particles
    - Avoids activation of spores
Naturally Occurring Bio-Th

- **Infectious Diseases of Humans**
- **Zoonoses**
  - Disease pathogens infectious to humans, but normally occurring in a natural cycle in animals, typically wild animals.
    - Direct contact with infective fluids/tissue/particles
    - Many are vectored by arthropods
    - Foci of infection occurs
Disease Cycles

Epidemic triangle

HOST

AGENT

ENVIRONMENT

Dead end host
- Man
- Other animals

Vector

Reservoir

Dead end host
- Man
- Other animals
Biological Weapon Attack

- **Incident**
  - High-profile, dramatic and focal
  - **TACTICAL**
    - Immediate terror
    - Immediate response by public health authorities

- **Non-incident**
  - Covert and multi-targeted
  - **STRATEGIC**
    - May be widespread before recognized
    - Delayed response by public health authorities
eg., Biological Attack: Incident

- October – November ’01
  - Florida / Washington, DC
  - Anthrax spores in letters
  - Instill fear / terror / panic
  - Significant direct “trickle-down” economic impact
    - 5,000 – 10,000 people on antibiotics
    - ~10,000 nasal swab specimens collected
    - $100M mail facility clean-up costs
eg., Biological Attack: Non-Incident

- **September ’84**
  - Dalles, Oregon
  - Salad bars at four local restaurants contaminated with *Salmonella*.
  - ~750 people became ill
  - Followers of Baghwan Sri Rajneesh cultured and disseminated *Salmonella* to influence county election.
  - “Attack” not uncovered until 1986 during trial of cult member on other charges.

Biological Weapons

- **Bacteria**
  - *Bacillus anthracis*
  - *Brucella* (6 biovars)
  - *Clostridium botulinum*
  - *Francisella tularensis*
  - *Yersinia pestis*
  - *Coxiella burnetii*
  - *Pseudomonas spp.*

- **Viruses**
  - Crimean-Congo HF
  - Eastern Equine Encephalitis
  - Ebola
  - Lassa Fever
  - Marburg virus
  - Rift Valley fever
  - Variola (smallpox)
  - Hantavirus
  - Yellow Fever
  - Dengue Fever
  - South American HFs

- **Toxins**
  - Aflatoxin
  - Ricin
  - T2 mycotoxin
  - Botulinum toxins
Vector-Borne Bacterial Bio-Agents

- Anthrax (*Bacillus anthracis*)
- Brucellosis (*Brucella spp.*)
- Tularemia (*Francisella tularensis*)
- Plague (*Yersinia pestis*)
- Q-fever (*Coxiella burnetii*)
Vector-Borne Viral Bio-Agents

- Crimean-Congo Hemorrhagic Fever
- Eastern Equine Encephalitis
- Venezuelan Equine Encephalitis
- Rift Valley fever
- Yellow fever
- Dengue fever
Domestic & Wildlife Reservoirs

Anthrax ♦ Brucellosis ♦ Tularemia ♦ Plague ♦ Q-Fever
Crimean-Congo Hemorrhagic fever ♦ Eastern/Venezuelan Equine Encephalitis ♦ Rift Valley fever
Many strains or isolates available in nature
Relatively well understood (for some?)
Animal models for virulence testing
Animal models for phenotypic manipulation
Animals as production “vessels”
Plausible reason to work with agents
West Nile Virus in the US

- Excellent model for how rapidly and efficiently an introduced, arthropod-borne, viral zoonoses can spread across the U.S.
- Appears to be here to stay
  - Multiple effective vector species
    - ~43 mosquito species have tested positive
  - Multiple reservoir species
    - ~138 bird species have tested positive
- Found in prairie dogs, canines, etc...
- What will occur with SLE and WEE?
  - *Culex tarsalis* is common vector
Vulnerabilities

- **Plague has Long History as Bio-Warfare Agent**
  - 14th Century - Tartars catapulted infected corpses into Kaffa (Escaping Italian inhabitants carried the disease into Italy, thus began the pandemic “Black Death”)
  - 1939/40 - Japanese Military Unit 731 in Ping Fan, Manchuria, delivered infective fleas and Y. pestis saturated rice by airplane onto Chinese population in Chekiang Province

- **Hantavirus (Pulmonary)**
  - Remains viable/infective in rodent droppings and on rodent urine-saturated dust
Tularemia

- Regionally specific disease:
  - Plague-like rodent disease in California
  - Deer fly fever in Utah
  - Glandular tick fever in Idaho and Montana
  - Market men’s disease in Washington, DC
  - Rabbit fever in Central U.S.A.
  - O’Hara’s disease in Japan
- ~1,130 cases in U.S. from 1990-1998
  - 219 in Missouri
  - 275 in Arkansas
- Human case acquired through aerosolized rabbit blood (lawnmower)
Clear Potential for Exposure
We Must Consider

- Emerging and re-emerging vector-borne diseases.
- “Designer” vectors
  - Genetically-engineered mosquitoes, ticks, fleas, or biting flies that are more effective or efficient in vectoring weaponized zoonotic diseases.
- “Strategic Attacks”
Recognizing a Biological Weapon Attack

- Epidemic casualty rates w/in 3 d period
- Higher than normal CFRs
- Outbreak of disease not normally-occurring in the region
- Unusual etiology of disease (disease normally acquired through flea bite, but pulmonary presentations most common in outbreak)
- Multiple epizootics and crossover infections
- No disease in persons in isolated environments, but same area of outbreak
- Casualties only downwind or downstream (trends)
- Large numbers of dead livestock or wildlife
- Large numbers of non-indigenous arthropods
Recognizing the potential threat that exists from zoonotic pathogens, particularly enzootic foci as maintenance and delivery “vectors” for weaponized agents, is critical to response planning and effective control.
Sentinels

- Establish periodic surveillance of known or suspected enzootic foci
  - Determine naturally-occurring pathogen strains/serotypes/biovars (genetic characterization)
  - Monitor indigenous arthropod vectors
- Establish close coordinated relationships between public health system and regional veterinarians
  - Syndromic surveillance
  - Unusually large rodent populations
  - Wildlife morbidity and mortality