

Establish Zoonotic Foci Sentinel Systems to Detect Biological Terrorism Events

NDIA 29th Environmental Symposium & Exhibition
Richmond, VA
Paper #131

8 April 2003

S. M. Presley, PhD, BCE
The Institute of Environmental and Human Health
Texas Tech University, Lubbock, Texas

ADM E.R. Zumwalt National Program for
Countermeasures to Biological and Chemical
Threats



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...*)
 - Vertebrates (*canines, bovines, avian, etc...*)
 - Person-to-person



Possible Dissemination Means



Zumwalt National Program for Countermeasures
to Biological and Chemical Threats



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

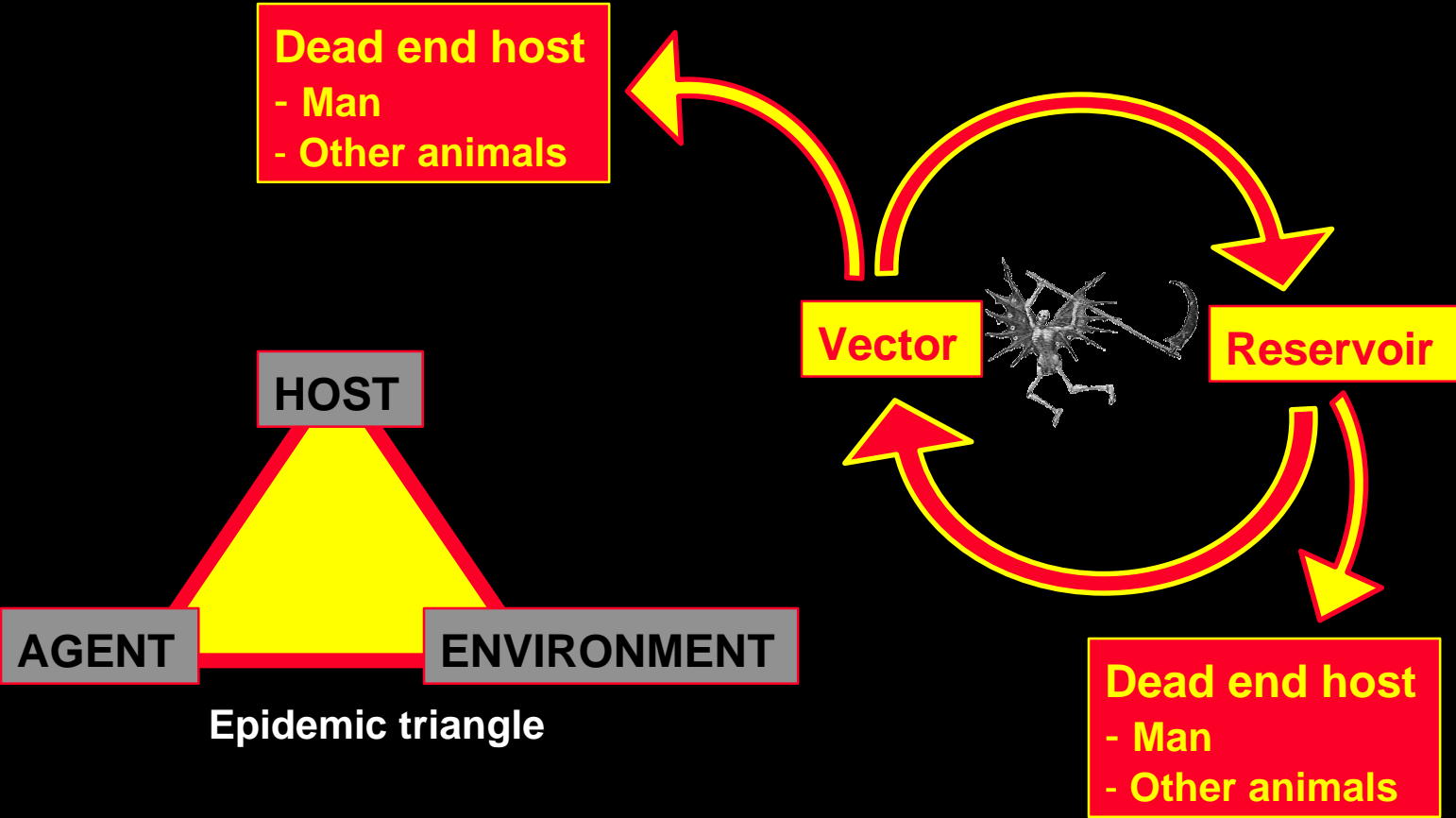


Naturally Occurring Bio-Th

- **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



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.

(Torok, et. al. 1997. *JAMA* 278(5):389-395)

Zumwalt National Program for Countermeasures
to Biological and Chemical Threats



Biological Weapons

▪ Bacteria

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

▪ Toxins

- Aflatoxin
- Ricin
- T2 mycotoxin
- Botulinum toxins

▪ 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



Vector-Borne Bacterial Bio-Agents

Anthrax (*Bacillus anthracis*)

Brucellosis (*Brucella spp.*)

Tularemia (*Francisella tularensis*)

Plague (*Yersinia pestis*)

Q-fever (*Coxiella burnetii*)



Zumwalt National Program for Countermeasures
to Biological and Chemical Threats



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**



USDA, ARS Image Gallery



USDA, ARS Image Gallery



Zumwalt National Program for Countermeasures
to Biological and Chemical Threats



Wh

Zoonoses?

- **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 th

- 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



Zumwalt National Program for Countermeasures
to Biological and Chemical Threats



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

