The Risks from Infectious Disease

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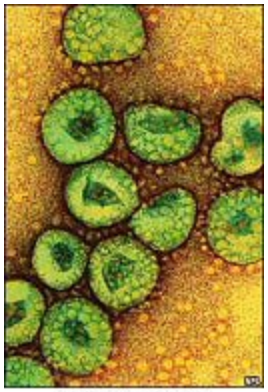
The Infectious Disease Threat

- **Recent outbreaks of emerging infectious disease awakened the international community to threats to public and agricultural health**
- **Most threat mitigation strategies have focused on outbreak management**
- **Measures must also be developed to *prevent* outbreaks of highly infectious disease**
- **Laboratory biosafety is one aspect of the solution**
  - Ensures the safety and well being of workers in the laboratory
  - Safeguards public and agricultural health by preventing the accidental release of harmful biological agents



SARS virus

Today, the infectious disease threat is a global problem that requires global solutions

Severe Acute Respiratory Syndrome (SARS)

- **In 2003, SARS infected over 8,000 people and killed almost 800**
- **The disease ravaged economies in the Pacific Rim and Canada and struck fear across the globe**
- **Laboratory acquired SARS outbreaks occurred in Singapore, Taiwan, and mainland China**
  - Singapore—September 2003
  - Taiwan (China)—December 2003
  - Beijing and Anhui (China)—March 2004

International BIOLOGICAL THREAT REDUCTION

Laboratory-Acquired Case of SARS Singapore, September 2003

- **Patient: 27-year-old male graduate student**
- **Place of infection: BSL-3 laboratory, Environmental Health Institute**
- **Onset of illness: August 26, 2003**
- **Hospitalization: September 3, 2003**
- **Confirmed day: September 8, 2003**

International BIOLOGICAL THREAT REDUCTION

Summary of the WHO Investigation, Singapore

- **The graduate student acquired the infection in the BSL-3 laboratory in the Environmental Health Institute where he worked**
- **Inappropriate laboratory procedures and a cross-contamination of West Nile virus samples with SARS-CoV in the laboratory led to the infection**
- **No evidence could be found of any other source of infection**
- **Isolated event: no evidence of secondary transmission**

Laboratory-Acquired Case of SARS Taiwan (China), December 2003

- **Patient: 44-year-old male laboratory scientist**
- **Place of infection: BSL-4 laboratory, Institute of Preventative Medicine (IPM), National Defense Medical Center (NDMC)**
- **Onset of illness: December 11, 2003**
- **Hospitalization: December 16, 2003**
- **Confirmed day: December 17, 2003**

International BIOLOGICAL THREAT REDUCTION

Summary of WHO Investigation, Taiwan (China)

- **Scientist was working on SARS-CoV in a BSL-4 facility at the IPM-NDMC**
- **He found a spillage of material in the transportation chamber and disinfected it with 70% ethanol and cleaned it manually**
- **The environment specimens collected from the handle of an alcohol spray bottle from the transportation chamber and the switch panel of the cabinet yielded positive results for SARS-CoV**
- **Isolated event: no evidence of secondary transmission**

Laboratory-Acquired SARS Outbreak in China, March-April 2004

- Occurred in Beijing and Anhui Province, linked to the National Institute of Virology, China CDC
- The source of the outbreak was failed or incomplete inactivation of SARS-CoV (cold inactivation)
- Involved two verified chains of SARS-CoV transmission
  - Three generations, resulting in 9 cases
- Serological analysis on the laboratory staff revealed three more seroconverted cases and one of them is most likely to have

Laboratory-Acquired SARS Outbreak in China, March-April 2004

- A (female research student) 25 March

2nd
- B (A's mother) → death
- C (nurse attending A)

3rd
- D (C's mother)
- E (C's aunt)
- F (C's father)
- G (retired doctor sharing hospital room with C)
- H (G's daughter-in-law)

- I (male laboratory researcher)

SARS IgG (+)
- J (female laboratory worker in BSL-3 laboratory)
- K (female laboratory worker developed pneumonia)
- L (male laboratory worker, A's supervisor)

China CDC

International BIOLOGICAL THREAT REDUCTION

Common Problems

- **Bad practice in laboratory management**
- **Poor supervision of less experienced professionals**
- **A lack of accountability for occupational health and safety**
- **A lack of biosafety policy**
- **A lack of biosafety procedures and staff training in biosafety practice**
- **A lack of internal and external quality assurance**

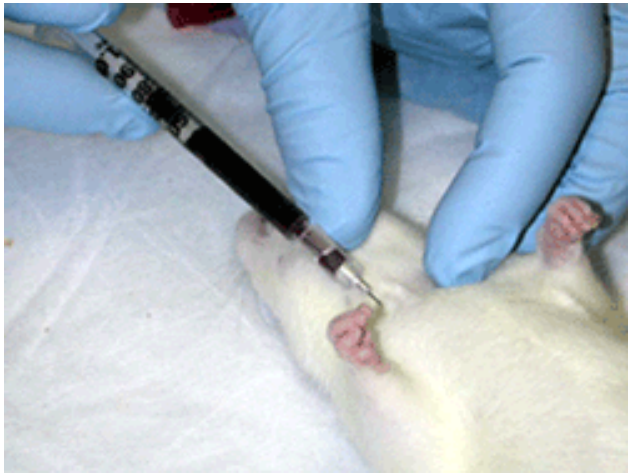
Laboratory-Acquired Cases of Ebola and Tularemia

- **Ebola**
  - 1994 Outbreak in Cote d'Ivoire
  - Swiss zoologist performs autopsy on wild chimpanzee
  - Accidental infection occurs; zoologist contracts Ebola

- **Tularemia**
  - In 2004, three laboratory workers at Boston University contracted tularemia
  - Concern that lax illness reporting practices could lead to outbreaks of infectious disease among the local community

Laboratory Accidents

- 27% - splashes and spills
- 25% - needlesticks
- 16% - cuts from sharp objects
- 14% - animal bite/scratches
- 13% - mouth pipetting
- 6% - other, unknown



Laboratory-Acquired Infections

TABLE 1 Comparison of 10 most common overt laboratory-associated infections over time

1930–1978[a]			1979–1999		
Agent or disease[b]	**Cases**	**Deaths**	**Agent or disease**	**Cases**	**Deaths**
Brucellosis	426	5	*M. tuberculosis*	223	0
Q fever	280	1	Q fever	176	0
Hepatitis	268	3	Hantavirus	169	1
Typhoid fever	258	20	Arboviruses	164	3
Tularemia	225	2	Hepatitis B virus	84	1
Tuberculosis	194	4	*Brucella* sp.	81	4[c]
Dermatomycosis	162	0	*Salmonella* sp.	66	2[d]
Venezuelan equine encephalitis	146	1	*Shigella* sp.	56	0
Psittacosis	116	10	Hepatitis non-A, non-B	28	0
Coccidioidomycosis	93	2	*Cryptosporidium* sp.	27	0
Total	2,168	48	Total	1,074	11

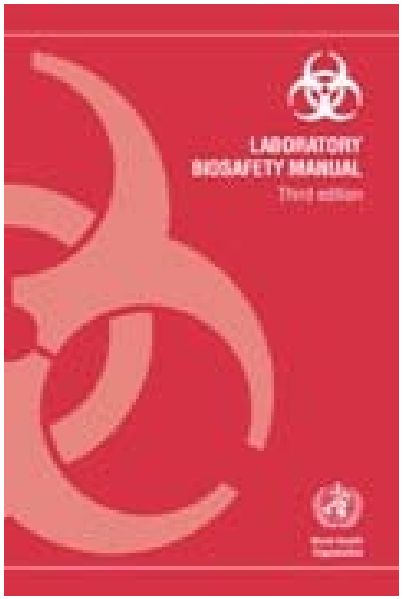
[a]Adapted from Pike, 1978.
[b]Not included are 113 cases of hemorrhagic fever contracted from wild rodents in one laboratory in Russia in 1962 (Kulagin, 1962).
[c]Aborted fetuses.
[d]One death associated with a secondary exposure case.

Laboratory Biosafety

- **Provides a means to reduce outbreaks of highly infectious diseases**

- **WHO biosafety:**
  - "Laboratory biosafety" describes containment principles, technologies, and practices implemented to prevent unintentional exposure to pathogens and toxins, or their accidental release

- **Achieving biosafety**
  - Important to develop national biosafety policies
  - Critical to develop a culture of biosafety



Bioterrorism, Biocrimes and the Medical Profession

- **Tubocurarine: 1966**
  - Dr. Mario Jascalevich, New Jersey doctor, accused of poisoning 5 patients with this plant-derived toxin
- **Curacit: May 1997 – November 1980**
  - Arnfinn Nesset, nursing home operator in Norway, killed 27 residents at a nursing home with curacit
- **HIV: 1987 – 1990**
  - Dr. David Acer, Florida dentist, infects 6 patients with HIV,
  - Unclear if deliberate act
- **Ricin: August 1995**
  - Dr. Ray W. Mettetal, Jr., a neurologist in Virginia, was found in possession of ricin after arrest on another issue
  - Debora Green, a physician, convicted of trying to murder her estranged husband with ricin

Illustrative Case: Dr. Mitsuru Suzuki, Dec 1964 – Mar 1966

- **Location: Japan**
- **Perpetrator: Dr. Mitsuru Suzuki**
  - Physician
  - Training in bacteriology
- **Objective: Revenge due to deep antagonism to what he perceived as a prevailing seniority system**
- **Organisms:**
  - *Shigella dysenteriae* and *Salmonella typhi*:
- **Dissemination:**
  - Sponge cake, other food sources
  - Later implicated in 200 – 400 illnesses
    - **4 deaths**
- **Official investigation started after anonymous tip to Ministry of Health and Welfare**
- **Outcome:**
  - Charged, but was not convicted of any deaths

Illustrative Case: Diane Thompson, October 1996

- **Location: Hospital in Dallas, TX**
- **Perpetrator: Diane Thompson**
  - Clinical laboratory technician
- **Objective: Unclear, possibly revenge against former boyfriend and cover-up by infecting co-workers**
- **Organism: *Shigella dysenteriae* Type 2**
  - Acquired from clinical laboratory
- **Dissemination**
  - Contaminated pastries in the office break room
  - Infected 12 of her coworkers
- **Outcome**
  - Arrested, convicted, 20 year sentence

LTC Kay D Burkman
Officer Basic Course: Veterinary Corps Track
Food Security Risks
http://www-nehc.med.navy.mil/downloads/06Conference/EH/Food_Security_Risks_OBC_Sep05.ppt

Bioterrorism, Biocrimes and the Medical Profession (continued)

- **HIV: October 1998**
  - Richard Schmidt, a gastroenterologist in Louisiana, convicted of attempted second degree murder for infecting nurse Janice Allen, with HIV by injecting her with blood from an AIDS patient
- **HIV: January 1999**
  - Brian T. Stewart, a phlebotomist, sentenced to life in prison for deliberately infecting his 11-month-old baby with HIV-infected blood to avoid child support payments
- ***Mycobacterium tuberculosis*: June 1999**
  - Physician reports theft of a vial

References: Carus WS. 1998. Bioterrorism and Biocrimes: The Illicit Use of Biological Agents in the 20th Century. Washington (DC): Center for Counterproliferation Research, National Defense University; Mohtadi, H. and Murshid, A. 2006. A Global Chronology of Incidents of Chemical, Biological,Radioactive and Nuclear Attacks: 1950-2005, National Center for Food Protection and Defense.

Bioterrorism: Rajneeshees – August 1984

- **Location: The Dalles, Oregon**
- **Perpetrator: Rajneesh Cult**
- **Objective: Gain control of the Wasco County Court by affecting the election**
- **Organism: *Salmonella typhimurium***
  - Purchased from commercial supplier
- **Dissemination**
  - Restaurant salad bars
  - 751 illnesses
- **Early investigation by CDC suggested the event was a naturally occurring outbreak**
- **Cult member arrested on unrelated charge confessed involvement with the event**

Bhagwan Shree Rajneesh

Bioterrorism: Aum Shinrikyo – 1990s

Aerosolization of Bacillus anthracis and botulinum toxin by Aum Shinrikyo

- Location: Tokyo, Japan
- Perpetrator: Aum Shinrikyo Cult
- Objective:
- Organisms:
  - *Bacillus anthracis*
    - Vaccine strain
  - *Clostridium botulinum*
    - Environmental isolate
    - Avirulent strain
  - Ebola virus
    - Attempted to acquire from Zaire outbreak under guise of an "Humanitarian mission"
- Dissemination
  - Aerosolization in Tokyo
    - *B. anthracis*
    - Botulinum toxin
- Outcome:
  - Leader Asahara was convicted of criminal activity

Conclusions

- **Infectious diseases pose significant threats to public and agricultural health**
- **Research on harmful biological agents is crucial to mitigate the threat**
  - However, release and theft of biological agents must be avoided
  - Imperative to protect public and agricultural health, and safeguard laboratory workers
- **Managing risks in the laboratory is dependent on both biosafety and biosecurity**
  - Helps reduce the threat of infectious disease