

## Overview of Bioscience Laboratory Risks

*Risk Assessment for Laboratory Biosecurity and Biosafety*  
Nashville, TN  
6 October 2007

[www.biosecurity.sandia.gov](http://www.biosecurity.sandia.gov)

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-04OR21400.





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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

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







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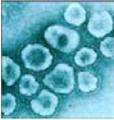
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## Severe Acute Respiratory Syndrome (SARS)

- 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







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### 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




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### 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




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### 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




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### 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




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### 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 been infected early in February 2004




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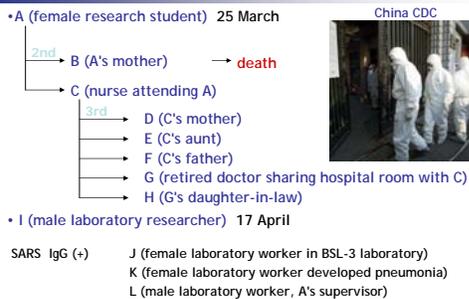
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### Laboratory-Acquired SARS Outbreak in China, March-April 2004




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## 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



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## Laboratory-Acquired Cases of Ebola and Tularemia

- **Ebola**
  - 1994 Outbreak in Cote d'Ivoire
  - Swiss zoologist performs necropsy 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



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## Laboratory Accidents

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



From: Pike, R.M. 1976. Laboratory-associated infections: Summary and analysis of 3,921 cases. *Hlth Lab Sci* 13:105-114.



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## Bioterrorism, Biocrimes and the Medical Profession

- **Tubocurarine: 1966**
  - Dr. Mario Jascavevich, New Jersey doctor, accused of poisoning 5 patients with this plant-derived toxin
- **Curacit: May 1977 – November 1980**
  - Arnfinn Nasset, 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




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## 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




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## Illustrative Case: Diane Thompson, October 1996



LTC Kay D Burkman  
Officer Basic Courses: Veterinary Corps Track  
Food Security Risks  
[http://www-pub.med.navy.mil/downloads/06Conference/ENFood\\_Security\\_Risks\\_OBC\\_Sep05.ppt](http://www-pub.med.navy.mil/downloads/06Conference/ENFood_Security_Risks_OBC_Sep05.ppt)

- **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




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## 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; Mottadi, 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.




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## Bioterrorism: Rajneeshees – August 1984

- **Location:** The Dalles, Oregon
- **Perpetrator:** Rajneeshe 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
- **Outcome:**
  - 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




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## 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




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## Bioterrorism: Anthrax, October 2001

- **Location:** More than 60 sites in the US
- **Perpetrator:** Unknown
- **Objective:** Unknown
- **Organism:**
  - *Bacillus anthracis*
- **Dissemination**
  - 4-7 letters sent through postal system
  - 22 confirmed cases of anthrax
    - 11 Cutaneous
    - 11 Inhalational (5 Deaths)
- **Outcome:**
  - Perpetrator not yet identified

"Amerithrax"



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## 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



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