



The Infectious Disease Threat and Laboratory Biosafety

SNL Biosecurity Team
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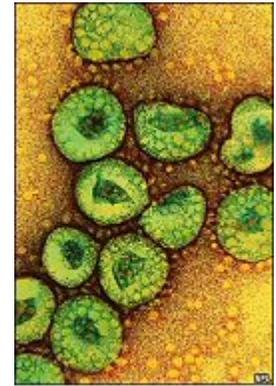


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The Infectious Disease Threat

- 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

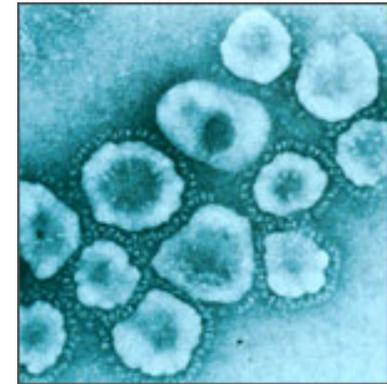


Today, the infectious disease threat is a global problem that requires global solutions



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





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





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





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

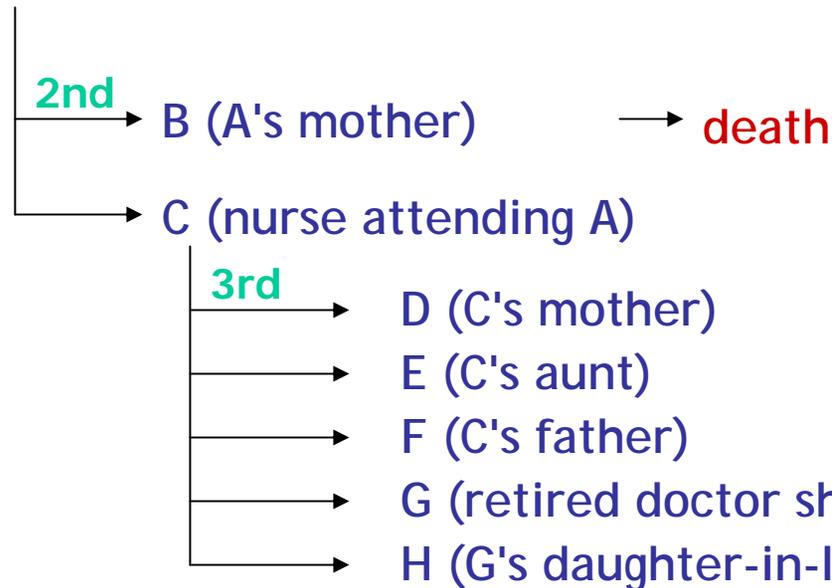
- Occurred in Beijing and Anhui Province, linked to the National Institute of Virology, China CDC
- The source of the outbreak was failed or incomplete inactivation of SARS-CoV (cold inactivation)
- Involved two verified chains of SARS-CoV transmission
 - Three generations, resulting in 9 cases
- Serological analysis on the laboratory staff revealed three more seroconverted cases and one of them is most likely to have been infected early in February 2004





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

- A (female research student) 25 March



China CDC



- I (male laboratory researcher) 17 April

SARS IgG (+)

J (female laboratory worker in BSL-3 laboratory)

K (female laboratory worker developed pneumonia)

L (male laboratory worker, A's supervisor)



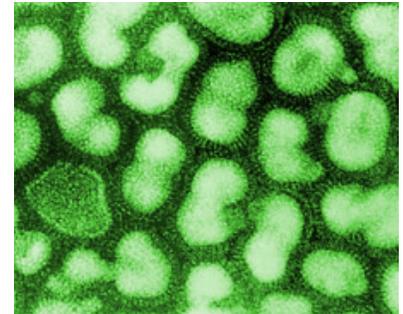
Common Problems

- **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**

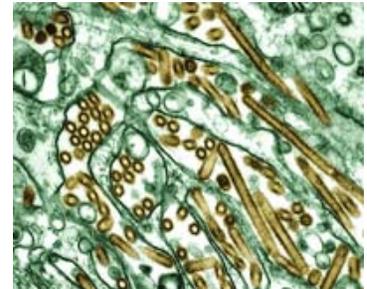


Highly Pathogenic Avian Influenza

- Millions of poultry culled in response to outbreaks in South East Asia
- Over 50 humans dead since late 2003, elevated mortality rates
- Experts fear that if human-to-human transmission becomes more efficient, a pandemic looms
- Push to construct clinical and diagnostic laboratories for H5N1 throughout Southeast Asia
 - Imperative to establish sound biosafety practices
 - To prevent accidental release of the virus
 - To minimize workers becoming infected, providing opportunities for virus adaptation to humans



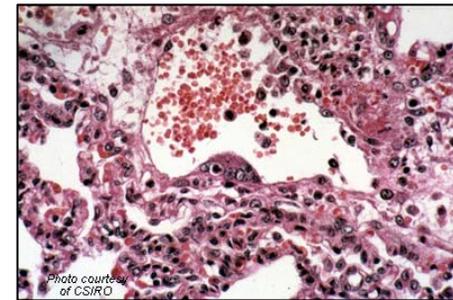
Avian influenza virus



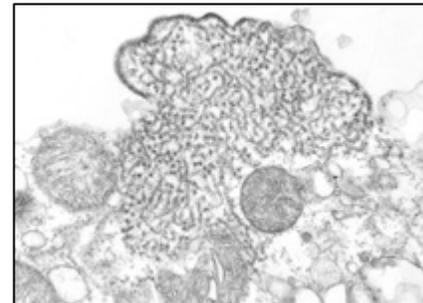


Nipah

- **1999 Outbreak in Malaysia killed 105 people and thousands of pigs**
 - Over 900,000 pigs culled
 - FAO estimates total cost close to \$450 million
- **Concern that the Nipah virus could mutate to a more deadly form**
- **Potential to devastate agricultural industries worldwide**



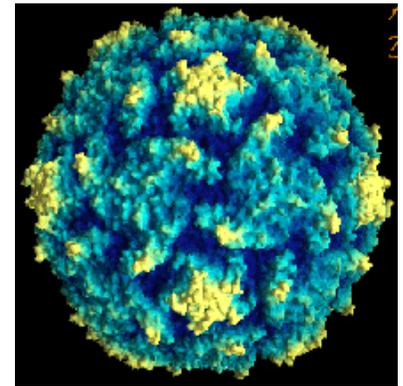
Nipah virus in pig lung





Polio

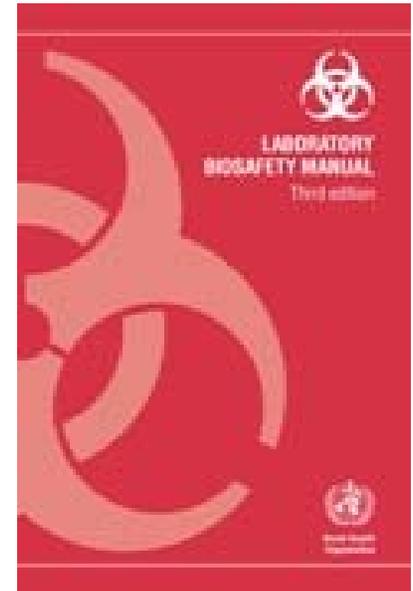
- **The debilitating childhood disease continues to plague developing countries**
 - Currently being tackled by WHO's Global Polio Eradication Initiative
 - Vaccination remains the only effective eradication method
- **Recent re-emergence of polio in Indonesia, Yemen**
- **Imperative to prevent re-establishment in countries where the disease has been eradicated**
 - Laboratory Biosafety practices contribute to this goal





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



*Laboratory Biosafety Manual,
3rd Edition*

Strengthening Biological Risk Management



Vision for Integrated BioRisk Management:

- ✓ Increased focus on "awareness" to change current culture
- ✓ Clarify terminology
- ✓ Development of targeted "training strategies"
- ✓ Securing "commitment" from key stakeholders, including government officials, who must be on board
- ✓ Continue increasing "capacity" based on Regional/Country needs and establish accountability through development of Country "report cards"



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**