Safety Risk Assessment of HIV, JEE, and *B. anthracis*

Risk Assessment for Laboratory Biosecurity and Biosafety
Nashville, TN
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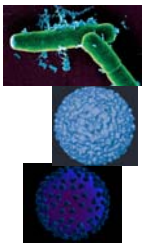
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

International BIOLOGICAL THREAT REDUCTION

Outline

- **History of Laboratory Acquired Infections**
- **Health Hazards**
- **Viability**
- **Laboratory Hazards**
- **Recommended biosafety precautions/practices**
  - Containment
  - PPE
  - Decontamination
  - Inactivation
  - Incident response
- **Medical surveillance***



*** these are the surveillance measures recommended by the US CDC. CSIR needs to determine how medical surveillance should be implemented within each laboratory and what the requirements should be.**

International BIOLOGICAL THREAT REDUCTION

Human Immunodeficiency Virus (HIV)

- **History of Laboratory Acquired Infections**
  - Splashing of infected materials
  - Apparent skin exposure
  - Puncture wounds
- **Health Hazards**
  - Transmitted from person to person through direct exposure to infected body fluids (blood, semen) sexual contact, sharing unclean needles etc
  - Epidemiologic evidence suggests that duration from exposure to onset of symptoms has a minimum range from 6 months to more than 7 years
- **Viability**
  - Drying in environment causes rapid (within several hours) 90-99% reduction in HIV concentration
  - Infected serum samples in liquid form showed a loss of concentration within a few days; at one month there was no detectible virus (the samples were still in liquid form at one month)
- **Laboratory Hazards**
  - Direct contact with skin and mucous membranes
  - Accidental parenteral inoculation
  - Ingestion
  - Hazard of aerosols exposure unknown

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Human Immunodeficiency Virus (HIV)

- **Recommended biosafety precautions/practices based upon the Risk Assessment**
  - Containment
    - Biosafety level 2 practices, containment equipment and facilities for activities involving clinical specimens and non-cultured procedures and for activities involving non-human primates and any animals experimentally infected or inoculated with HIV
    - Biosafety level 3 practices, containment equipment and facilities for all work culturing HIV
  - PPE
    - Gloves should be worn when handling potentially infectious specimens, cultures or tissues
    - Laboratory coats, gowns or suitable protective clothing should be worn
    - Goggles or face masks should be worn in areas of high potential for splash
  - Decontamination
    - Surface Decontamination
      - 1% sodium hypochlorite
      - 2% glutaraldehyde, formaldehyde, or ethanol
    - Waste Decontamination
      - Steam sterilization
      - Incineration
      - Chemical disinfection

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Human Immunodeficiency Virus (HIV)

- **Inactivation**
  - 30 min at 56°C reduces residual infectivity to below detectable levels
  - All inactivation should be validated
- **Incident response**
  - Alert Co-workers and your supervisor
  - Ask for help
  - Seek Medical Consultation
  - Follow Up
  - Spill response
    - Allow aerosols to settle
    - Wear protective clothing, gently cover spill with paper towels and apply 1% sodium hypochlorite, starting at perimeter and working towards the centre
    - Allow sufficient contact time before clean up
    - Decontaminate before disposal
- **Medical surveillance**
  - Serological monitoring for evidence of HIV infection
  - Post Exposure treatment and follow up
    - Specific measures for the opportunistic diseases that result from AIDS
    - "Cocktail" multidrug treatment for HIV
    - *Experimental prophylaxis with AZT/DDI or other appropriate drug*

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Japanese Encephalitis (JEE)

- **History of Laboratory Acquired Infections**
  - 22 cases reported up to 1980 and no fatalities in Canada
  - Reported causes accidental puncture and vector transmission
- **Health Hazards**
  - Transmitted by the bite of infectious mosquitoes
  - Incubation period 5-15 days
  - Not directly transmitted from person-to-person
  - Virus is not usually demonstrable in the blood of human after onset of disease, but can be isolated from the CSF in 1/3 of acute cases
- **Viability**
  - Survives for long periods in mosquito eggs;virus can be maintained over winter in eggs
  - The virus is not viable in dead mosquitoes after 24 hours (RNA can still be extracted 14 days after death)
  - *Stability of JEE in dried or stored CSF unknown, but other arboviruses like VEE are infectious when in dried CSF or blood*
- **Laboratory Hazards**
  - Direct contact with broken skin or mucous membranes
  - Accidental parenteral inoculation
  - Exposure of infectious aerosols
  - Bites or scratches from experimental animals, including arthropods (mosquitoes)
    - Special SOPs required for insectary workers and researchers

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Japanese Encephalitis (JEE)

- **Recommended biosafety precautions/practices based upon the Risk Assessment**
  - Containment
    - Biosafety level 3 practices, containment equipment, and facilities are recommended for all activities involving potentially infectious materials and infected tissue cultures, animals, or arthropods
  - PPE
    - Laboratory coat
    - Gloves and gown (tie in back and tight wrists) must be worn when working with infectious materials
    - Vaccination of personnel working directly and regularly with the JEE is recommended by CDC and Health Canada
  - Proper sharps handling and disposal
  - Decontamination
    - Surface Decontamination
      - 70% ethanol
      - 2% glutaraldehyde
      - 3-8 % formaldehyde
      - 1% sodium hypochlorite, iodine, phenol iodophors and organic solvents/detergents
    - Waste Decontamination
      - Steam sterilization
      - Incineration
      - Chemical disinfection

Japanese Encephalitis (JEE)

- **Inactivation**
  - Inactivated by heat
    - 50% reduction in 10 min at 50° C
    - Complete inactivation in 30 min at 56° C
    - Sensitive to UV and gamma irradiation
  - All inactivation should be validated
- **Incident response**
  - Alert Co-workers and your supervisor
  - Ask for help
  - Seek Medical Consultation
  - Follow Up
  - Spill Response
    - Allow aerosols to settle
    - Wear protective clothing, the spillage must be covered promptly with a paper towel and disinfectant poured gently on towel, working from the outside to inwards
  - Accidental Exposure
    - *Health Canada suggests to passively protect accidentally exposed laboratory workers by human or animal immune serum*
- **Medical surveillance**
  - Monitor for symptoms
  - Serological studies
  - Isolation of virus from blood, CSF or other body fluid
  - IMMUNIZATION: Formalin inactivated vaccine (JE-VAX)

B. anthracis

- **History of Laboratory Acquired Infections (from US armed force laboratories)**
  - 45 cases with 5 deaths occurring primarily in facilities conducting anthrax research
  - 25 reported cases of cutaneous anthrax among armed forces personnel
- **Health Hazards**
  - Infection of skin by contact with infected animal tissues and possibly by biting flies feeding on such animals, or by contaminated hair, wool, hides or products made from them
  - Inhalation anthrax results from inhalation of spores in contaminated soil areas, dried or processed skins and hides of infected animals
  - Intestinal anthrax from ingestion of contaminated undercooked meat
  - Incubation period within 7 days of exposure, usually 2 to 5
  - Infectious dose: 8,000 to 50,000 organisms by inhalation*
- **Viability**
  - Spores remain viable in soil, skins and hides of infected animals and contaminated air and wool for decades
  - Survival in milk ~ 10 years;
  - Dried on filter paper ~ 40 years
  - Dried on silk threads ~ 70 years
  - Pond water ~ 2 years
- **Laboratory Hazards**
  - Direct and indirect contact of skin with cultures and contaminated laboratory surfaces
  - Accidental parenteral inoculation
  - Exposure to infectious aerosols

* ID_{50} may be much less

B. anthracis

- **Recommended biosafety precautions/practices based upon the Risk Assessment**
  - Containment
    - US BMBL Recommends: Biosafety level 2 practices and facilities for clinical material and diagnostic quantities.
    - Biosafety level 3 practice and facilities for production quantities, high concentration of cultures, unknown but suspected samples or a high potential for aerosolization
  - PPE
    - Gloves, gowns with tight wrists and ties in back
    - Frequent hand washing
    - Care of skin abrasions and proper handling of potentially contaminated articles
  - Decontamination
    - Surface Decontamination
      - 2% glutaraldehyde or formaldehyde
      - 5% formalin (overnight soak preferable)
    - Waste Disposal
      - Incineration
      - Steam sterilization of cultures and infected materials
      - Animals that have died from anthrax should be incinerated

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B. anthracis

- **Inactivation**
  - Spores are highly resistant to drying, heat, and sunlight
  - Adequate sterilization requires direct exposure to 121°C for at least 30 min
  - All inactivation should be validated
- **Incident response**
  - Alert Co-workers and your supervisor
  - Ask for help
  - Seek Medical Consultation
  - Follow Up
  - Spill Response
    - Allow aerosols to settle
    - Wear protective clothing, gently cover spill with paper towels and apply suitable disinfectant (glutaraldehyde, formalin), starting at the perimeter and working towards the centre
    - Allow sufficient contact time before clean up
  - Accidental Exposure
    - Prompt treatment with high-dose antibiotics
- **Medical surveillance**
  - Monitor for suspicious skin lesions and other symptoms
  - Laboratory confirmation through direct microscopy, culture, immunological techniques
  - IMMUNIZATION: Vaccine is recommended for those workers with frequent exposure to clinical specimens and cultures
  - Vaccination of cattle or other livestock may be justified in anthrax-endemic areas

International BIOLOGICAL THREAT REDUCTION

General Safety Precautions

- **Blood and Bodily Fluid Precautions should be taken when working with samples regardless of transmission and infectious route of suspected agent**
  - Samples may contain other infectious agents like Hepatitis
- **General PPE**
  - Gloves should be worn when handling potentially infectious specimens, cultures or tissues
  - Laboratory coats, gowns or suitable protective clothing should be worn
  - Goggles or face masks should be worn in areas of high potential for splash
- **Proper sharps handling**
- **Proper spill response**
- **Proper waste management**
- **When in doubt, ASK!**
- **Use CS!**

International BIOLOGICAL THREAT REDUCTION

References

- **Health Canada Material Safety Data Sheets**
- **US Centers for Disease Control Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th Edition:**
  - http://www.cdc.gov/od/ohs/biosfty/bmbl5/bmbl5toc.htm