Scenario B
Multi-Drug-Resistant Tuberculosis (MDR-TB)

Summary of Experiment

Sputum specimens are obtained from infected patients and sent to the laboratory for analysis. In the lab, the sputum is mixed with sodium hydroxide solution (NaOH) to break up the mucous and vigorously mixed (vortexed). Then the solution is poured into a 250 mL conical tube and 15 mL of sterile water is added and mixed well. This suspension is then centrifuged at 3000 x g for 15 minutes. After which the tubes are removed from the centrifuge and the supernatant fluid is poured down the drain. 50 mL of sterile water is added to the sediment to wash the pellet. The supernatant is then decanted with a pipette and poured down the drain. A long sterile wooden toothpick is then used to collect a small amount of the pellet which is spread onto the slope of selective growth media agar in a slant tube. After several weeks of incubation, a small amount of culture is smeared together with an emulsifier on a glass slide and dried over a small alcohol candle burner flame to heat fix it to the slide. A special staining procedure and microscopy is used to verify the presence of the MDR Tuberculosis bacteria. Once MDR-TB is confirmed, sub-cultures are transferred to agar petri dishes, exposed to a variety of drugs and then incubated to determine susceptibility.

Equipment

- Laminate bench top (old, cracked, some holes and peeling up in some places)
- Basic centrifuge (no sealed rotor or safety cups)
- Vortexer
- Incubator 37^{o}C
- Sterile wooden toothpicks
- Agar culture plates (petri dishes)
- 250 mL plastic conical centrifuge tubes
- Wire inoculating loops
- Alcohol flame candle (for sterilizing wire loops and fixing glass slides)
- Glass flasks
- Glass screw cap tubes with LJ agar slants
- Microscope with glass slides
- Sink for disposing of liquid waste and hand washing
- Plastic bag for collecting solid waste (no trash can)

Lab Environment

- Open window ventilation (screens fitted to window but some screens have unrepaired holes)
- Ceramic tiled floor
- Humid environment
- Urban setting
- Crowded laboratory with limited work space

Please Note: The information contained in these pages is intended for training purposes ONLY.

PPE

- Lab coats are worn in the lab and occasionally taken home for laundry
- Surgical masks and gloves are worn occasionally

Personnel Practices

- TB vaccine is available (Bacille Calmette-Guérin (BCG)). However, it is not always effective in preventing infection. It is not known whether or not researchers have had the vaccine.
- No vaccination or occupational health services available
- Hand washing done occasionally
- Lab waste is untreated and collected by municipal (local government) waste services
- Occasional (~weekly) cleaning done by a building custodian.

Security Practices

- Interior doors are unlocked and propped open during the day
- Exterior doors are only locked at night
- Cultures not secured or inventoried
- No personnel verification program

Agent Facts

Infectious Dose: 10 bacilli by inhalation for humans and animals

Stability:

SUSCEPTIBILITY TO DISINFECTANTS: Greater resistance to disinfectants and require long contact times for most disinfectants to be effective; 5% phenol, 1% sodium hypochlorite (only if low organic matter and longer contact times), iodine solutions (high concentration of available iodine required), glutaraldehyde and formaldehyde (longer contact time) are effective

PHYSICAL INACTIVATION: Sensitive to moist heat (121° C for at least 15 min), light

SURVIVAL OUTSIDE HOST: Guinea pig carcasses - 49 days; carpet - up to 70 days; dust - 90 to 120 days; cockroaches - 40 days; manure 45 days; paper book - 105 days; sputum (cool, dark location) - 6 to 8 months; clothing - 45 days

Incubation Period: 4-12 weeks from infection to primary lesion or significant tuberculin reaction. The risk of progressive pulmonary or extrapulmonary tb is greatest within 1 to 2 years after infection. It may persist for a lifetime as a latent infection.

Mortality Rate: 50-70% of untreated patients with active pulmonary tb, within 2 years. Rates are higher for those with concurrent HIV infection.

Please Note: The information contained in these pages is intended for training purposes ONLY.

Morbidity:

Duration of Illness: as an active disease, 6 months to 2 years. Survival ranges from 1.5 months in immune compromised HIV patients to 14.3 months in normal patients with drug susceptible TB.

Severity of Illness: High.

Duration of Infection: Possibly lifetime.

Long term effects after infection: Active disease can be triggered at any time after the establishment of a latent infection, though the probability of developing active disease is higher 1-2 years after infection, in immune compromised patients, small children, young adults, and the very old.

The morbidity rate in bovines is around 40%. Agent known to infect other species but is most prevalent in bovines.

Allergen (yes/no): No

Carcinogenic/mutagenic (yes/no): No

Abortogenic (yes/no): No

Toxin Production (yes/no): No

Immune Suppression (yes/no): No

Ability to Mutate in Host or Environment (yes/no): Yes

Infection Mitigation Measures:

For human pathogens

Immunization: Yes

Prophylaxis: No (standard TB prophylaxis of isoniazid is ineffective for MDR-TB)

Post Infection Treatment: First line TB drugs isoniazid and rifampin are ineffective for MDR-TB. A variety of second-line drugs are available to treat MDR-TB, usually done so in combination with each other, though they are less effective than the first line options. One common combination for suspected MDR-TB patients includes streptomycin, isoniazid, rifampin, ethambutol, pyrazinamide, MXF & cycloserine (Isoniazid and rifampin are maintained due to their effectiveness against regular TB).

Existence of Diagnostic tests: Yes. Traditional skin test or TST, and newer interferon release assays (IGRA)

Routes of Infection in Humans:

Please Note: The information contained in these pages is intended for training purposes ONLY.

Inhalation: Yes

Ingestion: Possible

Percutaneous: No

Contact: No

Vector-Borne: No

Sexual Transmission: No

Vertical Transmission: No

Routes of Infection in Bovine:

Inhalation: Yes

Ingestion: Possible

Percutaneous: No

Contact: No

Vector-Borne: No

Sexual Transmission: No

Vertical Transmission: No

Communicability:

Human to Human: Yes, though unusual for MDR-TB compared to normal TB

Human to Animal: No Evidence

Animal to Animal: No Evidence

Animal to Human: No Evidence

Multiple Species: Yes.

Where is it present: Worldwide. It is highly endemic in the population surrounding the laboratory.

Perception of malicious use: LOW

Culture: Sputum from patients suspected of having TB can be cultured for evidence of *TB* in several different media, the most common of which is Lowenstein-Jensen medium. While not particularly difficult to culture, *TB* has an unusually slow growth rate, and it takes 6-8 weeks to grow enough bacteria for diagnosis and drug susceptibility testing.
