

Training on *Mycobacterium tuberculosis* drug susceptibility testing (first and second line LJ DST)

Module 3: Biosafety in DST laboratories

Venue:

Presenter:

Date:

Introduction

- This module details the Laboratory biosafety measures required in a TB DST laboratory.
- The module provides information on the administrative controls, containment principles, safe work practices and procedures, safety equipment, emergency preparedness, and facilities to enable laboratory staff to work safely with potentially infectious microorganisms.
- Biosafety measures mentioned also aim at preventing unintentional exposure to pathogens or their accidental release.

Learning Objectives

By the end of the module, participants should:

- Understand the Mode of Transmission for TB
- Acquire knowledge on the Biohazards in a DST laboratory
- Have knowledge on conducting Risk assessments in a DST lab
- Understand the Minimum WHO recommendations for TB culture / DST facilities
- Be able to practice standard safe practice in a TB laboratory
- Knowledge on appropriate use of PPE in TB culture / DST lab.
- Acquire knowledge on Disinfectants active against *MTB*

Content Outline

- Transmission of TB
- Biohazards in a DST laboratory
- Risk assessment in a DST lab
- Minimum WHO recommendations for TB culture / DST facilities
- Standard safe practice in a TB laboratory
- Personal protective equipment
- Disinfectants active against *M. tuberculosis*
- Emergence preparedness Plan

Transmission of tuberculosis

Mycobacterium tuberculosis is almost always transmitted by patients with active pulmonary disease:

- TB patient expels bacilli in small droplets of respiratory secretions.
- Secretions quickly evaporate leaving “droplet nuclei” less than 5 μm in diameter.
- Droplet nuclei of this size, containing 1-3 bacilli, can remain suspended in the air.
- Following inhalation, droplet nuclei are able to reach deep into the lungs to produce infection.

Biohazards in the DST laboratory

- **Inhalation hazards: handling of liquids containing TB bacilli generates infectious aerosols:**
 - Pipetting
 - Working with loops
 - Vortexing suspensions
 - Inoculation hazards
 - Shaking
 - Centrifugation
 - Grinding
 - Pouring
 - Opening tubes at non-ambient temperatures or pressures

Risk assessment in a DST lab

- Risk is the combination of the likelihood that:
 - A specific hazard will be encountered and
 - The consequences of an event related to that specific hazard.

The analysis of aerosolization risks has led to the development of minimum biosafety requirements necessary for performing procedures in TB laboratories.

Factors to consider for Risk assessment

- Factors relevant to all TB laboratories
 - Pathogenicity, dose and transmission route
 - Infectious dose, risk group persons
 - High-burden settings (MDR and XDR)
- Factors related to procedure or type of laboratory
 - Direct sputum-smear microscopy
 - Processing specimens for culture
 - Manipulate cultures

How to conduct risk assessment for TB laboratory

- Identify the inherent hazards
- Decide who might be harmed and how
- Evaluate the risks and decide on precautions
- Record your findings and implement them.
- Review your assessment and update it if necessary.

Minimum WHO recommendations for TB culture / DST facilities

All TB laboratories should enact a set of essential biosafety measures to minimize risks.

The complexity of the measures enacted depend on the specific tests done and the results of the procedural risk assessment done.

These measures should take into account:

1. Codes of practice in a mycobacteriology lab (PPE, Lab access e.t.c)

Minimum WHO recommendations for TB culture / DST facilities

2. Equipment e.g.

- ☞ Adopt equipment that prevent or limit contact between the operator and the infectious material
- ☞ Equipment should provide primary containment of infectious aerosols generated by certain procedures (the BSC).

3. Laboratory design and facilities

4. Health surveillance

5. Training

6. Waste handling

Standard safe practice in a TB laboratory

- Medical fitness of laboratory staff
- Disinfection
- Appropriate use of Personal Protective Equipment (PPE)

Disinfectants active against *M. tuberculosis*

Disinfectants recommended for a DST lab are those containing:

- Phenol: 5% in water;
- Chlorine: Sodium hypochlorite 1 or 5 g/l;
- Alcohol: ethanol (denatured ethanol, methylated spirits) or isopropanol are used at 70%.

These are usually selected depending on the material to be disinfected.

Medical fitness of laboratory staff

- In accordance with national laws and practices, health surveillance of TB laboratory workers should be performed:
 - 🌐 before enrolment in the TB laboratory;
 - 🌐 at regular intervals thereafter;
 - 🌐 after any biohazard incident.

Medical fitness of laboratory staff

- Workers should be educated about the symptoms of TB and provided with ready access to free medical care if symptoms arise.
- Confidential HIV counselling and testing should be offered. Reassignment of HIV-positive workers away from high-risk environments should be considered.

Personal Protective Equipment (PPE)

- Laboratory coats:
 - long sleeves and fasten in the front to cover street clothes
 - where there is a low-risk of becoming infected with TB
- Laboratory gowns
 - long sleeves and an elasticized cuff (at least 30 mm long)
 - open in the back and should cover street clothing
- Respirators
 - N95 and FFP2
- Gloves
 - Disposable microbiologically approved latex, vinyl or nitrile.

Respirators



PPE

- **Respirators**

- Not required in low- and moderate-risk TB laboratories
- May be required in high-risk TB laboratories following risk assessment

- **Surgical masks**

- Not designed to protect the user from inhaling infectious aerosols and therefore should not be used for respiratory protection

- **Gloves**

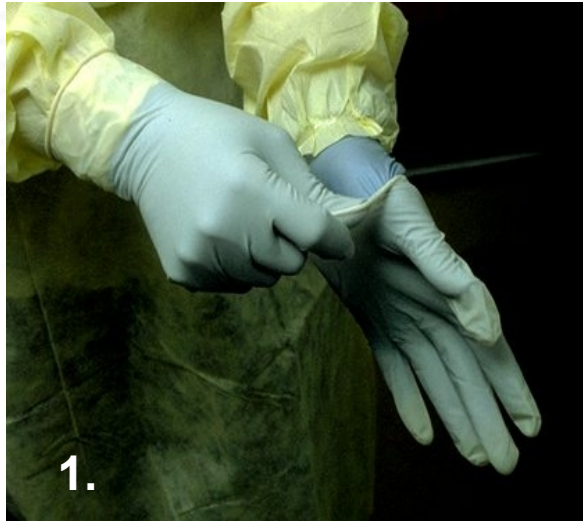
- Required in low- , moderate- and high-risk TB laboratories

Laboratory Gown

- Gowns should be worn for specimen processing, TB culture and DST
- Gowns should close and tie in the back
- Gowns must be long-sleeved and cuffed
- Gloves should be pulled over the cuff for maximum protection
- Fabric should be water-resistant



Example: Doffing Gloves



Emergency preparedness plan

The plan should provide operational procedures for:

- responses to natural disasters, such as fires, floods, earthquakes or explosions
- risk assessments associated with any new or revised procedure
- managing exposures and decontamination
- emergency evacuation of people from the premises
- emergency medical treatment of exposed and injured persons
- medical surveillance and management of persons exposed to an incident
- epidemiological investigation
- continuing operations after an incident.

Emergency preparedness plan

- In developing this plan the following items should be considered for inclusion:
 - location of high-risk areas and identification of at-risk personnel and populations
 - identification of procedures according to the level of risk
 - identification of responsible personnel and their duties
 - treatment and follow-up facilities that can receive exposed or infected persons
 - transport for exposed or infected persons
 - how emergency equipment will be provided

Exercise

- Define a biological spill?
- David a laboratory technologist has accidentally dropped down an *Mtb* positive LJ isolate in BSL 3 containment laboratory. Describe the procedure he would follow to manage such an incidence?

Spill clean-up kit

- Two spill response kits should be prepared: one placed outside the containment laboratory and one placed inside the laboratory. The kits should include the items listed below:
 - Hypochlorite, 70% Ethanol respirators (1 box), gloves (1 box)
 - Laboratory gowns (4-6 disposable gowns)
 - Dustpan and brush (for disposal if necessary)
 - Chloramine tablets (10 tablets), paper towels
 - Soap, sharps container, biohazard bags and goggles (2pairs).

Assessment

- How is TB transmitted?
- List some of the sources of biohazards in DST lab?
- Describe the steps you would take to carry out a risk assessment in a DST lab?
- What disinfectants are used in a DST lab?
- What are the components of a spill kit?

Summary

- TB is transmitted through aerosols
- Conduct an appropriate risk assessment for a DST TB lab prior to selection of the appropriate PPE.
- 5% Lysol should freshly be prepared.
- Good lab practice should be maintained at all times.
- Having an emergence preparedness plan in place is key in effective occurrence management.

References

- GLI TB training package
<http://www.stoptb.org/wg/gli/trainingpackages.asp>
- Tuberculosis laboratory biosafety manual, WHO 2012

Acknowledgments

