Module 1

Overview: Tuberculosis, the Global Emergency

Purpose	To provide an overview of tuberculosis (TB) in the world and in your country
Prerequisite Modules	None
Learning Objectives	At the end of this module, participants will be able to ▪ Explain the TB epidemic and the annual global TB burden ▪ Describe the forms of TB and how TB is transmitted ▪ Define and compare various methods of TB diagnosis, noting where each is most effective ▪ Explain the term NTP ▪ Describe the DOTS component of STOP TB strategy ▪ Explain the importance of AFB microscopy in the DOTS program ▪ Describe levels of TB lab services.
Content Outline	▪ What is TB? ▪ Transmission and forms of TB ▪ Risk of disease ▪ TB diagnosis ▪ The role of the National TB Program ▪ Building and enhancing DOTS within the framework of the STOP TB strategy ▪ The importance of AFB microscopy in DOTS programs ▪ Organization of laboratory services
Handout and Exercises	None
Appendix	None

Module 1: Overview: Tuberculosis, the Global Emergency

Worldwide, 2.3 million people die of tuberculosis each year.

In this early decade of the 21st century, the world remains challenged by infectious disease and tuberculosis (TB) in particular. TB is the typical disease of poverty. Of the 22 countries that have 80% of the world's TB burden, 17 are classified as a low-income country. Annually, 2.3 million people still die from the disease, while increased deaths due to drug-resistant TB, as well as co-infections of TB and human immunodeficiency virus (HIV), produce even higher threats to world health.

WHAT IS TUBERCULOSIS?

Tuberculosis is an infectious and transmissible disease caused by ***Mycobacterium tuberculosis*** and occasionally by ***M. bovis***; these two are the main pathogenic species within the ***M. tuberculosis*** complex. These bacteria are also known as tubercle bacilli because they produce characteristic lesions called tubercles. When sputum specimens or other clinical specimens containing mycobacteria are examined microscopically (after staining smears with carbol fuchsin solution followed by acid decolorizing solution), the tubercle bacilli and other mycobacteria retain the primary staining reagent and appear red. This is due to their 'acid-fastness,' and hence are referred to as acid-fast bacilli (AFB).

TRANSMISSION AND FORMS OF TUBERCULOSIS

Tuberculosis affects the lungs in more than 80% of cases (these are called pulmonary TB or PTB). TB spreads from the primary lung lesions to other parts of the body via the blood stream and lymphatic and bronchial systems or by direct extension. In this way it may affect any organ, causing extra-pulmonary TB. Diagnosis of extra-pulmonary TB (EPTB) is often difficult and should be made by a physician. Not all of the cases of EPTB are sputum smear-negative. It is, therefore, recommended to check the sputum of EPTB patients.

Transmission of the bacilli from person to person occurs almost exclusively by air. The primary source of infection is a person with PTB who coughs and spreads the infected droplets. Pulmonary lesions may contain on the order of a billion AFB. Transmission of tuberculosis generally occurs in poorly ventilated closed areas. After an infected person coughs, microaerosols known as droplet nuclei can remain suspended in the air for long periods of time. Adequate ventilation removes these nuclei. Direct sunlight (ultraviolet rays, or UV) kills tubercle bacilli, but the bacilli can survive in darkness or in a humid environment for several hours, and even days.

The higher the number of infectious sources spreading bacilli within a community, the greater the transmission.

A susceptible individual has a higher risk of infection when there is continual and prolonged exposure to a person with sputum smear-positive PTB in a confined space. The risk of transmission of the infection from person with smear-negative PTB is lower.

RISK OF DISEASE

Development of disease following infection also depends on the individual's susceptibility. Overall, only about 10% of infected people get sick with TB, half of them within the first year after infection; the other half will become sick years later.

TB DIAGNOSIS

Smear microscopy

Early laboratory diagnosis of tuberculosis still relies on the examination of stained smears. For universal application in resource-limited countries, microscopy of sputum smears is the best choice among diagnostic methods. The technique is simple, inexpensive, and efficient in detecting those cases of pulmonary tuberculosis that are most infectious. Since its yield is highly dependent on execution, the technician or even auxiliary personnel performing smear microscopy is the most important element in the fight against TB for the majority of the population in these countries. In high HIV prevalence countries, patients may have disseminated disease with fewer AFB in their sputum. Smears may be negative or may require even more careful screening to identify low numbers of AFB.

Culture

Bacteriological culture provides a definitive diagnosis of tuberculosis. The primary advantage of culture over sputum microscopy is that culture can detect far fewer numbers of bacilli (~10 bacilli/ml of sputum for culture versus ~5,000 bacilli/ml of sputum for microscopy). This method increases the potential of diagnosing treatment failures, EPTB, and TB in children where numbers of bacilli may be very small. In addition, culture distinguishes between viable and non-viable bacilli.

In settings where capacity exists and microscopy is optimized, culture procedures should be introduced. Where HIV/TB is high in incidence, culture is recommended. Culture is essential to obtain the necessary growth required for drug susceptibility testing.

Limitations of culture include the following:

- Getting results takes a long time (weeks)
- It is technically more difficult than smear microscopy
- In comparison to smear microscopy, increased resources are needed
- Increased safety measures, including the use of biological safety cabinets, are essential.

THE ROLE OF THE NATIONAL TUBERCULOSIS PROGRAM (NTP)

The National Tuberculosis Control Program (NTP) is a joint effort of the government and the community aimed at reducing, and in the long term eliminating, suffering due to TB. The objectives of the NTP are to reduce mortality, morbidity, and disease transmission while avoiding the development of drug resistance. This is accomplished by using technical knowledge and health resources available in the country.

The NTP accomplishes its objectives by

- Early detection of infectious cases, and
- Appropriate treatment until the illness is cured.

NTP goals:

- Detect at least 70% of new smear-positive cases
- Cure at least 85% of newly-detected cases of smear-positive TB
- Reduce prevalence and deaths due to TB.

In countries with a high TB burden, the fight against TB can be successfully conducted within the setting of a National Tuberculosis Program using the WHO recommended building and enhancing DOTS within the framework of the STOP TB strategy. The WHO TB strategy should be integrated into the country's general health service.

ROLE OF THE LABORATORY – Laboratories form the foundation of the national tuberculosis control programme and are one of the first points of contact for tuberculosis suspects. Confidence or mistrust of TB suspects and patients in the health system and the NTP will be initiated at this point. A well performing laboratory network plays a crucial role in TB control. By responding quickly and providing quality services, the laboratory network will enable the early diagnosis of TB, hence decreasing transmission, enabling appropriate treatment of disease, monitoring treatment outcome and minimizing the risk of possible complications, including death.

NO LABS = NO DIAGNOSIS = NO TREATMENT = NO DOTS = NO TB CONTROL

DOTS COMPONENT OF STOP TB STRATEGY

DOTS is the internationally recommended strategy for TB control in response to the global TB emergency.

This plan combines the following five elements:

- Sustained political commitment to increase human and financial resources and make TB control a nationwide priority integral to the national health system;
- Access to quality-assured TB bacteriology services for case detection among persons presenting with, or found through screening to have, symptoms of TB (most importantly, prolonged cough);
- Standardized short-course chemotherapy for all patients with TB under proper case management conditions, including patient support during the treatment;
- An uninterrupted supply of quality-assured drugs and laboratory reagents; and
- A recording and reporting system that provides an outcome assessment of all patients and an assessment of the program's overall performance.

IMPORTANCE OF ACID-FAST BACILLI (AFB) MICROSCOPY IN DOTS PROGRAMS

The DOTS program uses AFB microscopy as the main technique for diagnosis of tuberculosis, as well as follow-up of patients during treatment. Other techniques are considered complementary and should be based on the specific TB epidemiological situation.

1. Diagnosis

The emphasis on AFB-microscopy for diagnosis of TB is justified for individuals as well as for the community (disease control). Persons with smear-positive pulmonary TB (PTB) are usually sick and seek treatment. These patients will rarely be cured without proper treatment. Therefore, smear-positive cases are the primary sources of infection in communities.

2. Treatment follow-up

The evolution of the disease during treatment, declaration of cure or failure, and also relapse can best be monitored by bacteriological methods. Clinical criteria are unreliable. It is seldom possible to diagnose relapse by means of X-ray.

For follow-up, culture is more reliable than AFB microscopy because microscopy will show all AFB, alive or dead, while culture will detect only living bacilli that form colonies. Declaration of failure on smear evidence will be more accurate when it is based on repeated positive smears. Smear diagnosis of relapsing cases will, in general, be reliable.

Culture cannot easily replace smears for follow-up since *M. tuberculosis* grows very slowly. Repeating a smear examination after 2 weeks (in case of a doubtful result) will yield an answer before a culture could.

Smear microscopy will continue to be used for diagnosis and follow-up in DOTS programs. It is an excellent tool for these purposes when it is correctly performed and the results are properly interpreted and used. This requires excellent technique and laboratory services delivering correct and interpretable (i.e., quantified) results, which will depend mainly on the sincere effort of technicians performing this simple but so important task. Of equal importance is close collaboration between AFB microscopy laboratories and the TB program (NTP) as well as the involvement of clinicians to support and promote laboratories and to make optimal use of the results.

ORGANIZATION OF LABORATORY SERVICES

Levels of laboratory services

Tuberculosis laboratory services should be included within the integrated tuberculosis control programs, which in turn should form part of the overall primary health care programs of countries.

Therefore, TB laboratory services should be organized according to the three levels of general health services:

- Peripheral laboratory
- Intermediate laboratory
- Central laboratory

In terms of complexity, the activities performed at each level are different:

Peripheral laboratories should be capable of performing smear microscopy using the Ziehl-Neelsen (ZN) staining reagent technique for sputum specimens.

Intermediate laboratories, in addition to performing the laboratory functions of the peripheral laboratories, should be capable of providing supervision, monitoring, training and quality assurance to peripheral laboratories. If resources permit, they may also do culture.

Central laboratories are the highest level of service and should be capable of performing microscopy, mycobacterial culture, and drug susceptibility testing as well as species identification.

Responsibilities of the central laboratory include the following:

- Organizing and providing training for laboratory staff
- Organizing and providing quality assurance and proficiency testing for intermediate and peripheral laboratories
- Conducting surveillance of tuberculosis drug resistance
- Participating in epidemiological and operational research

Key message

- Tuberculosis is an infectious disease affecting millions of people annually.
- Transmission is via the air, and mainly from smear-positive cases, whose detection and treatment is essential for control of the disease.
- Microscopy is the main diagnostic technique in resource-limited countries. Although simple to do, it requires highly committed staff to reach its full efficiency.
- DOTS is the global strategy to control TB. One of the main elements of the strategy is detection of disease by quality-assured mycobacteriology.
- TB control is organized in the NTP, which integrate laboratory services at peripheral, intermediate, and central levels.

Module Review: Module 1

Find out how much you have learned by answering these questions.

What is TB and how is it transmitted?

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What are the international targets to control TB?

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Why is microscopy the most effective diagnostic technique in resource-limited settings?

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What is DOTS?

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What is the role of the National Tuberculosis Control Program?

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