



*Self-Study Modules on
Tuberculosis, 1-5 Slide Sets
Facilitation Tips*

Module 1: Transmission and Pathogenesis of Tuberculosis

Facilitation Tips

Background

In this module, participants will learn about the history of tuberculosis (TB). Participants will also learn how TB is spread from person to person (transmission) and how TB disease develops in the body (pathogenesis). Understanding the transmission and pathogenesis of TB helps to guide the development of strategies for controlling the spread of TB and for treating latent TB infection (LTBI) and TB disease. Public health workers should understand these concepts so that they can educate the patients they serve.

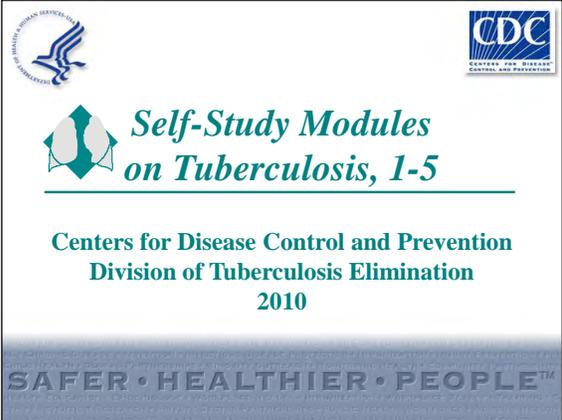
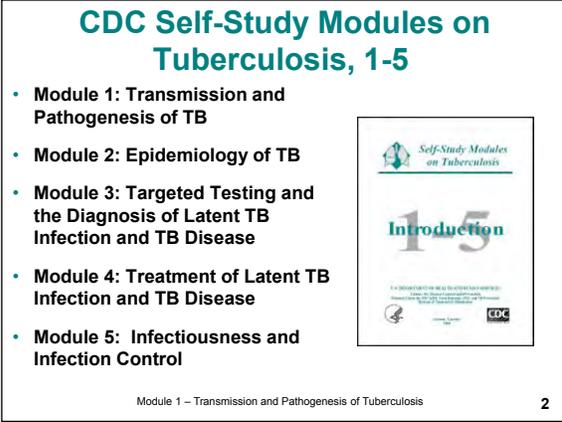
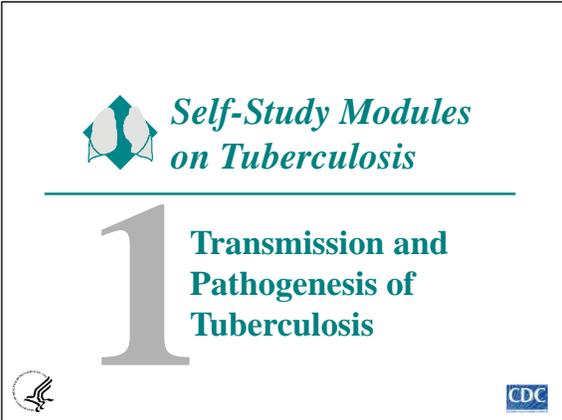
Learning Objectives

After this presentation, participants will be able to

1. Briefly describe the history of TB
2. Explain how TB is spread (transmission)
3. Define drug-resistant TB
4. Explain the difference between LTBI and TB disease
5. Explain how LTBI and TB disease develop (pathogenesis)
6. Describe the classification system for TB

Module Overview

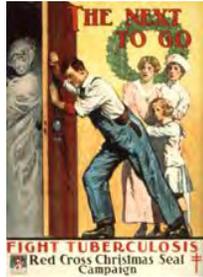
Time	Activity	Content	Resources Needed
10 min.	Presentation	Introduction	Slides 1-5
5 min.	Presentation	History of TB	Slides 6-15
5 min.	Presentation	TB Transmission	Slides 16-24
5 min.	Presentation	Drug-Resistant TB	Slides 25-30
10 min.	Presentation	TB Pathogenesis	Slides 31-46
10 min.	Presentation	Progression from LTBI to TB Disease	Slides 47-55
5 min.	Presentation	Sites of TB Disease	Slides 56-59
5 min.	Presentation	TB Classification System	Slides 60-63
5 min.	Case Studies	Case Studies	Slides 64-68
60 min.	Total Time		

		Facilitation Tips
Slide 1		<ul style="list-style-type: none"> - Introduce yourself to participants. Include your name and what organization you represent. - Ask participants to introduce themselves, stating their names and organizations - Provide information about the following: <ul style="list-style-type: none"> o Location of restrooms o Refreshments, if provided - Discuss ground rules and the parking lot - Ask participants to sign participant roster
Slide 2		<ul style="list-style-type: none"> - Explain to participants that the presentations were created using the print-based <i>Self-Study Modules on Tuberculosis, 1-5</i> - Review slide content <ul style="list-style-type: none"> o Mention that each module includes content about that topic - State that study questions and case studies are included in each module to help reinforce and apply content - Ask who has worked through the print-based modules before
Slide 3		<ul style="list-style-type: none"> - Introduce Module 1

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 4</p>	<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">Module 1: Objectives</p> <p>At completion of this module, learners will be able to:</p> <ol style="list-style-type: none"> 1. Briefly describe the history of tuberculosis (TB) 2. Explain how TB is spread (transmission) 3. Define drug-resistant TB 4. Explain the difference between latent TB infection (LTBI) and TB disease 5. Explain how LTBI and TB disease develop (pathogenesis) 6. Describe the classification system for TB <p style="font-size: small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis 4</p> </div>	<ul style="list-style-type: none"> - State objectives of presentation <p style="text-align: right;"><i>Background and Objectives - Module 1, p. 1</i></p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 5</p>	<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">Module 1: Overview</p> <ul style="list-style-type: none"> • History of TB • TB Transmission • Drug-Resistant TB • TB Pathogenesis • Progression from LTBI to TB disease • Sites of TB disease • TB Classification System • Case Studies <p style="font-size: small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis 5</p> </div>	<ul style="list-style-type: none"> - Review slide content
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 6</p>	<div style="border: 1px solid black; padding: 10px; text-align: center;"> <p style="font-size: 2em;">History of TB</p> <hr style="width: 30%; margin: auto;"/> <p style="text-align: right; font-size: small;">6</p> </div>	<ul style="list-style-type: none"> - Introduce section <p style="text-align: right;"><i>History of TB - Module 1, pp. 5-6</i></p>

History of TB (1)

- TB has affected humans for millennia
- Historically known by a variety of names, including:
 - Consumption
 - Wasting disease
 - White plague
- TB was a death sentence for many



Vintage image circa 1919
Image credit: National Library of Medicine

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Before showing slide, ask participants if they know of other names for TB
- Review slide content

History of TB - Module 1, p. 5
[Image credit: U.S. National Library of Medicine]

History of TB (2) Scientific Discoveries in 1800s

- Until mid-1800s, many believed TB was hereditary
- 1865 Jean Antoine-Villemin proved TB was contagious
- 1882 Robert Koch discovered *M. tuberculosis*, the bacterium that causes TB



Mycobacterium tuberculosis
Image credit: Janice Haney Carr

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Review slide content
- Note that the image is of *Mycobacterium tuberculosis*

History of TB - Module 1, p. 5
[Image credit: Janice Haney Carr]

History of TB (3) Sanatoriums

- Before TB antibiotics, many patients were sent to sanatoriums
- Patients followed a regimen of bed rest, open air, and sunshine
- TB patients who could not afford sanatoriums often died at home



Sanatorium patients resting outside

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Review slide content
- Explain that the image is of women at a sanatorium resting outside
- Note that it used to be believed that cool, fresh air was beneficial for TB patients

History of TB - Module 1, p. 5

Slide 10

Breakthrough in the Fight Against TB (1)

Drugs that could kill TB bacteria were discovered in 1940s and 1950s

- Streptomycin (SM) discovered in 1943
- Isoniazid (INH) and p-aminosalicylic acid (PAS) discovered between 1943 and 1952



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Module 1 – Transmission and Pathogenesis of Tuberculosis

- Review slide content

History of TB - Module 1, p. 5

Slide 11

Breakthrough in the Fight Against TB (2)

- TB death rates in U.S. began to drop dramatically
- Each year, fewer people got TB
- Most TB sanatoriums in U.S. had closed by mid 1970s

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Module 1 – Transmission and Pathogenesis of Tuberculosis

- Review slide content

- Mention that after this breakthrough, many people began to hope that TB could be eliminated from the U.S., like smallpox and polio

History of TB - Module 1, p. 5

Slide 12

TB Resurgence

- Increase in TB in mid 1980s
- Contributing factors:
 - Inadequate funding for TB control programs
 - HIV epidemic
 - Increased immigration from countries where TB is common
 - Spread in homeless shelters and correctional facilities
 - Increase and spread of multidrug-resistant TB



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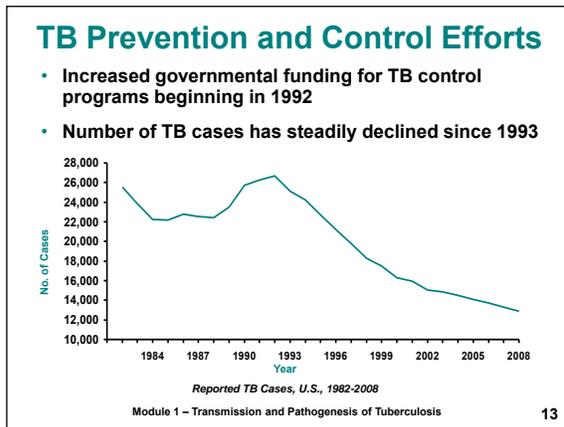
March 16, 1992 Newsweek Magazine Cover

Module 1 – Transmission and Pathogenesis of Tuberculosis

- Before showing the slide, ask why there was an increase in TB in the U.S. during the mid 1980s

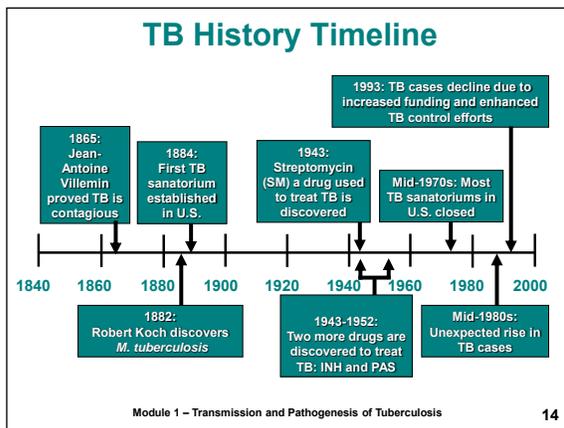
- Review slide content

*TB Resurgence -
Module 1, p. 6 and Module 2, p. 4*



- Review slide content
- Point out the increase (1980s) and decrease (after 1993) in TB cases on the graph
- Stress that prevention and control efforts must be maintained since TB continues to be reported in almost every state and not all states have seen a decrease in TB cases

TB Prevention and Control Efforts - Module 2, pp. 4-5



- Recap the major events in the history of TB

Note: Timeline is animated. Click "enter" for each text box to appear.

TB History Timeline - Module 1, p. 6

History of TB Study Question 1.1

In what year was each of the following discoveries made? (pg. 7)

- TB was proven to be contagious
1865
- The bacterium that causes TB was discovered
1882
- The first drug that could kill TB was discovered
1943

Module 1 – Transmission and Pathogenesis of Tuberculosis 15

- Introduce study questions
- Ask participants to turn to p. 7 (if participants have print-based modules)
- Ask for a volunteer to read question
- Ask participants for answers
- Click enter for the answer to appear

Note: All study questions and case studies are animated. The question appears first. Click "enter" and the answer will appear.

Answers – Module 1, p. 30

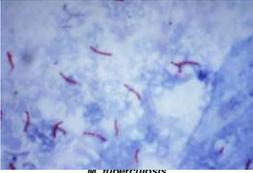
TB Transmission

1

- Introduce section
- Ask participants how TB is transmitted

TB Transmission (2)
Types of Mycobacteria

- *M. tuberculosis* causes most TB cases in U.S.
- Mycobacteria that cause TB:
 - *M. tuberculosis*
 - *M. bovis*
 - *M. africanum*
 - *M. microti*
 - *M. canetti*
- Mycobacteria that do not cause TB
 - e.g., *M. avium complex*



M. TUBERCULOSIS

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- State that mycobacteria are members of the bacteria family
- Explain that not all mycobacteria cause TB
- Review slide content

Types of Mycobacteria - Module 1, p. 8

TB Transmission (1)

Transmission is defined as the spread of an organism, such as *M. tuberculosis*, from one person to another.

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Ask for a volunteer to read the definition of transmission

Definition of Transmission – Module 1, p. 8

TB Transmission (3)

- TB is spread person to person through the air via droplet nuclei
- *M. tuberculosis* may be expelled when an infectious person:
 - Coughs
 - Sneezes
 - Speaks
 - Sings
- Transmission occurs when another person inhales droplet nuclei



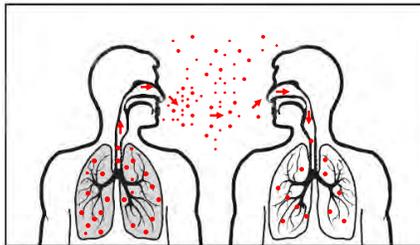
Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Review slide content
- Note that droplet nuclei are very small particles, less than 1/5000 of an inch, and can remain suspended in the air for several hours
- Emphasize that transmission is more likely to occur in poorly ventilated and enclosed areas

TB Transmission - Module 1 p. 8

TB Transmission (4)



Dots in air represent droplet nuclei containing *M. tuberculosis*

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Note that this image depicts airborne transmission. The individual on the left has infectious TB disease and is expelling it into the air. The individual on the right is inhaling the droplet nuclei into their lungs.

Note: Dots in the image are animated. Click “enter” once to start animation.

TB Transmission - Module 1, pp. 8-9

TB Transmission (5)

- Probability that TB will be transmitted depends on:
 - Infectiousness of person with TB disease
 - Environment in which exposure occurred
 - Length of exposure
 - Virulence (strength) of the tubercle bacilli
- The best way to stop transmission is to:
 - Isolate infectious persons
 - Provide effective treatment to infectious persons as soon as possible

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Emphasize that not everyone who is exposed to TB becomes infected; it depends on many factors
- Review slide content
- Note that the length of time required for a patient to be considered noninfectious after starting treatment varies

TB Transmission - Module 1, p. 9

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 22</p>	<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">TB Transmission Study Question 1.2</p> <p>What organism causes most TB disease in the U.S.? (pg. 11)</p> <p style="text-align: center;"><i>M. tuberculosis</i></p> <p>What are 4 other mycobacteria that cause TB disease? (pg. 11)</p> <p style="text-align: center;"><i>M. bovis, M. africanum, M. microti, and M. canetti</i></p> <p style="font-size: small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis 22</p> </div>	<ul style="list-style-type: none"> - Introduce study questions - Ask participants to turn to p. 11 (if participants have print-based modules) - Ask for a volunteer to read question - Ask participants for answers <p style="text-align: right;"><i>Answers – Module 1, p. 30</i></p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 23</p>	<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">TB Transmission Study Question 1.3</p> <p>How is TB spread? (pg. 11)</p> <p style="text-align: center;">TB is spread from person to person through the air via droplet nuclei containing <i>M. tuberculosis</i>.</p> <p style="font-size: small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis 23</p> </div>	<ul style="list-style-type: none"> - Read question - Ask participants for answers <p style="text-align: right;"><i>Answers – Module 1, p. 30</i></p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 24</p>	<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">TB Transmission Study Question 1.4</p> <p>The probability that TB will be transmitted depends on what four factors? (pg. 11)</p> <ul style="list-style-type: none"> • Infectiousness of person with TB disease • Environment in which exposure occurred • Length of exposure • Virulence (strength) of tubercle bacilli <p style="font-size: small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis 24</p> </div>	<ul style="list-style-type: none"> - Read question - Ask participants for answers <p style="text-align: right;"><i>Answers – Module 1, p. 30</i></p>

Drug-Resistant TB

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- Introduce section

Drug-Resistant TB (1)

- Caused by *M. tuberculosis* organisms resistant to **at least one** TB treatment drug

- Isoniazid (INH)
- Rifampin (RIF)
- Pyrazinamide (PZA)
- Ethambutol (EMB)



- Resistant means drugs can no longer kill the bacteria

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Review slide content
- Note that drug-resistant TB is more difficult to treat because there are fewer treatment options

Drug-Resistant TB - Module 1, p. 10

Drug-Resistant TB (2)

Primary Resistance	Caused by person-to-person transmission of drug-resistant organisms
Secondary Resistance	Develops during TB treatment: <ul style="list-style-type: none"> • Patient was not given appropriate treatment regimen OR • Patient did not follow treatment regimen as prescribed

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- State that drug-resistant TB can be caused in two ways, primary and secondary
- Review slide content
- Note that drug-resistant TB can be transmitted in the same way as drug-susceptible TB; however, because it takes longer to diagnose, patients with drug-resistant TB may be infectious for longer periods of time

Drug-Resistant TB - Module 1, p. 10

Drug-Resistant TB (3)	
Mono-resistant	Resistant to any one TB treatment drug
Poly-resistant	Resistant to at least any 2 TB drugs (but not both isoniazid and rifampin)
Multidrug resistant (MDR TB)	Resistant to at least isoniazid and rifampin, the 2 best first-line TB treatment drugs
Extensively drug resistant (XDR TB)	Resistant to isoniazid and rifampin, PLUS resistant to any fluoroquinolone AND at least 1 of the 3 injectable second-line drugs (e.g., amikacin, kanamycin, or capreomycin)

Module 1 – Transmission and Pathogenesis of Tuberculosis 28

- Review slide content
- Note that XDR TB is the most difficult type of drug-resistant TB to treat
- Explain that patients with drug-resistant TB should be closely monitored to see if they are responding to treatment; they should also remain in isolation until they are no longer infectious

Drug-Resistant TB - Module 1, p. 10

Drug-resistant TB Study Question 1.5

What is drug-resistant TB? (pg.11)

Drug-resistant TB is caused by *M. tuberculosis* organisms that are resistant to at least one TB treatment drug. Drug-resistant TB can be difficult to treat.

Module 1 – Transmission and Pathogenesis of Tuberculosis 29

- Introduce study questions
- Ask participants to turn to p. 11 (if participants have print-based modules)
- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 30

Drug-resistant TB Study Question 1.6

What is the difference between primary and secondary drug-resistant TB? (pg. 11)

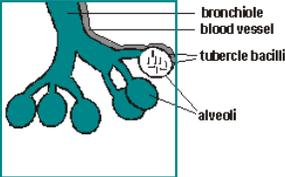
- **Primary resistance is caused by person-to-person transmission of drug-resistant organisms.**
- **Secondary resistance develops during TB treatment. Either the patient was not treated with the right TB drugs or the patient did not follow the prescribed treatment regimen.**

Module 1 – Transmission and Pathogenesis of Tuberculosis 30

- Read question
- Ask participants for answers

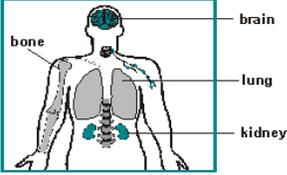
Answers – Module 1, p. 30

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 31</p>	<div data-bbox="240 233 803 657" style="border: 1px solid black; padding: 10px; text-align: center;"> <h2 style="color: #008080;">TB Pathogenesis</h2> <hr style="width: 30%; margin: 10px auto;"/> <p style="text-align: right; font-size: small;">31</p> </div>	<ul style="list-style-type: none"> - Introduce section - Ask participants if they can explain what pathogenesis is <p style="text-align: right; font-style: italic; font-size: small;">TB Pathogenesis - Module 1, pp. 12-21</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 32</p>	<div data-bbox="240 762 803 1186" style="border: 1px solid black; padding: 10px;"> <h3 style="color: #008080; text-align: center;">TB Pathogenesis (1)</h3> <p style="text-align: center; font-weight: bold;">Pathogenesis is defined as how an infection or disease develops in the body.</p> <p style="font-size: x-small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis</p> <p style="text-align: right; font-size: x-small;">32</p> </div>	<ul style="list-style-type: none"> - Ask for a volunteer to read the definition of pathogenesis <p style="text-align: right; font-style: italic; font-size: small;">TB Pathogenesis - Module 1, p. 12</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 33</p>	<div data-bbox="240 1293 803 1717" style="border: 1px solid black; padding: 10px;"> <h3 style="color: #008080; text-align: center;">TB Pathogenesis (2)</h3> <h4 style="color: #008080; text-align: center;">Latent TB Infection (LTBI)</h4> <ul style="list-style-type: none"> • Occurs when tubercle bacilli are in the body, but the immune system is keeping them under control • Detected by the Mantoux tuberculin skin test (TST) or by blood tests such as interferon-gamma release assays (IGRAs) which include: <ul style="list-style-type: none"> - QuantiFERON®-TB Gold test (QFT-G) - QuantiFERON®-TB Gold In-Tube (QFT-GIT) - T-Spot®.TB test (T-SPOT) • People with LTBI are NOT infectious <p style="font-size: x-small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis</p> <p style="text-align: right; font-size: x-small;">33</p> </div>	<ul style="list-style-type: none"> - Review slide content <p style="text-align: right; font-style: italic; font-size: small;">LTBI – Module 1, p. 13</p>

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 34</p>	<div data-bbox="240 233 803 657" style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">TB Pathogenesis (3) TB Disease</p> <ul style="list-style-type: none"> • Develops when immune system <u>cannot</u> keep tubercle bacilli under control <ul style="list-style-type: none"> – May develop very soon after infection or many years after infection • About 10% of all people with normal immune systems who have LTBI will develop TB disease at some point in their lives • People with TB disease are often infectious <p style="font-size: small; margin-top: 5px;">Module 1 – Transmission and Pathogenesis of Tuberculosis 34</p> </div>	<ul style="list-style-type: none"> - Review slide content <p style="text-align: right; margin-top: 20px;"><i>TB Disease – Module 1 p. 17</i></p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 35</p>	<div data-bbox="240 745 803 1169" style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">TB Pathogenesis (4)</p> <p style="text-align: center;">1</p>  <p style="text-align: center;">Droplet nuclei containing tubercle bacilli are inhaled, enter the lungs, and travel to small air sacs (alveoli)</p> <p style="font-size: small; margin-top: 5px;">Module 1 – Transmission and Pathogenesis of Tuberculosis 35</p> </div>	<ul style="list-style-type: none"> - Review slide content - Explain that the dots in the air represent droplet nuclei being inhaled into the person's lungs <p style="text-align: right; margin-top: 20px;"><i>TB Pathogenesis – Module 1 p. 17</i></p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 36</p>	<div data-bbox="240 1276 803 1701" style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">TB Pathogenesis (5)</p> <p style="text-align: center;">2</p>  <p style="text-align: center;">Tubercle bacilli multiply in alveoli, where infection begins</p> <p style="font-size: small; margin-top: 5px;">Module 1 – Transmission and Pathogenesis of Tuberculosis 36</p> </div>	<ul style="list-style-type: none"> - Review slide content <p style="text-align: right; margin-top: 20px;"><i>TB Pathogenesis – Module 1 p. 17</i></p>

TB Pathogenesis (6)

3



bone brain
lung
kidney

A small number of tubercle bacilli enter bloodstream and spread throughout body

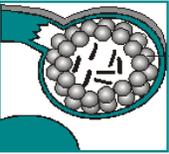
Module 1 – Transmission and Pathogenesis of Tuberculosis 37

- Review slide content
- State that tubercle bacilli can reach any part of the body, but areas where TB disease is more likely to develop include:
 - lungs
 - kidneys
 - brain
 - bones

TB Pathogenesis – Module 1 p. 18

TB Pathogenesis (7) LTBI

4



special immune cells form a barrier shell (in this example, bacilli are in the lung)

- Within 2 to 8 weeks the immune system produces special immune cells called macrophages that surround the tubercle bacilli
- These cells form a barrier shell that keeps the bacilli contained and under control (LTBI)

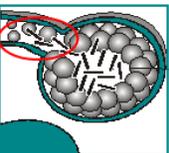
Module 1 – Transmission and Pathogenesis of Tuberculosis 38

- Review slide content
- Call attention to the barrier shell around the bacilli that is keeping the tubercle bacilli contained (upper left corner of figure)

TB Pathogenesis – Module 1 p. 18

TB Pathogenesis (8) TB Disease

5



shell breaks down and tubercle bacilli escape and multiply (in this example, TB disease develops in the lung)

- If the immune system CANNOT keep tubercle bacilli under control, bacilli begin to multiply rapidly and cause TB disease
- This process can occur in different places in the body

Module 1 – Transmission and Pathogenesis of Tuberculosis 39

- Review slide content
- Explain that the barrier shell around the bacilli has broken (upper left corner of figure)

Note: The red circle around broken barrier shell is animated. Click “enter” for the circle to appear.

TB Pathogenesis – Module 1 p. 18

LTBI vs. TB Disease

Latent TB Infection (LTBI)	TB Disease (in the lungs)
Inactive, contained tubercle bacilli in the body	Active, multiplying tubercle bacilli in the body
TST or blood test results usually positive	TST or blood test results usually positive
Chest x-ray usually normal	Chest x-ray usually abnormal
Sputum smears and cultures negative	Sputum smears and cultures may be positive
No symptoms	Symptoms such as cough, fever, weight loss
Not infectious	Often infectious before treatment
Not a case of TB	A case of TB

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Review each row of the table, comparing LTBI and TB disease

LTBI vs. TB Disease – Module 1, p. 14

TB Pathogenesis Study Question 1.7

When a person inhales air that contains droplet nuclei containing *M. tuberculosis*, where do the droplet nuclei go? (pg. 15)

- Most of the larger droplet nuclei become lodged in the upper respiratory tract, where infection is unlikely to develop
- However, droplet nuclei may reach the small air sacs of the lung (the alveoli), where infection begins

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Introduce study questions
- Ask participants to turn to p. 15 (if participants have print-based modules)
- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 31

TB Pathogenesis Study Question 1.8

After the tubercle bacilli reach the small air sacs of the lung (the alveoli), what happens to them? (pg. 15)

- Tubercle bacilli multiply in alveoli and some enter the bloodstream and spread throughout the body
- Bacilli may reach any part of the body
- Within 2 to 8 weeks, the immune system usually intervenes, halting multiplication and preventing further spread

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 31

Slide 43

**TB Pathogenesis
Study Question 1.9**

In people with LTBI (but not TB disease), how does the immune system keep the tubercle bacilli under control? (pg. 15)

The immune system produces special immune cells that surround the tubercle bacilli. These cells form a shell that keeps the bacilli contained and under control.

Module 1 – Transmission and Pathogenesis of Tuberculosis 43

- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 31

Slide 44

**TB Pathogenesis
Study Question 1.10**

How is LTBI detected? (pg. 16)

LTBI is detected by the Mantoux tuberculin skin test (TST) or blood tests such as interferon-gamma release assays (IGRA), which include the QuantiFERON®-TB test (QFT-G), QuantiFERON®-TB Gold In-tube (QFT-GIT), or T-SPOT.

Module 1 – Transmission and Pathogenesis of Tuberculosis 44

- Ask participants to turn to p. 16 (if participants have print-based modules)
- Read question
- Ask participants for answers

Answers – Module 1, p. 31

Slide 45

**TB Pathogenesis
Study Question 1.11**

What are the major similarities and differences between LTBI and TB disease? List characteristics of each. (pg. 16)

Latent TB Infection (LTBI)	TB Disease (in the lungs)
Inactive, contained tubercle bacilli in the body	Active, multiplying tubercle bacilli in the body
TST or blood test results usually positive	TST or blood test results usually positive
Chest x-ray usually normal	Chest x-ray usually abnormal
Sputum smears and cultures negative	Sputum smears and cultures may be positive
No symptoms	Symptoms such as cough, fever, weight loss
Not infectious	Often infectious before treatment
Not a case of TB	A case of TB

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- Read question
- Ask participants for answers

Answers – Module 1, pp. 31-32

Slide 46	<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">TB Pathogenesis Study Question 1.12</p> <p>What happens if the immune system cannot keep the tubercle bacilli under control and the bacilli begin to multiply rapidly? (pg. 16)</p> <p style="color: #00BFC4;">When this happens, TB disease develops. The risk that TB disease will develop is higher for some people than for others.</p> <p style="font-size: small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis 46</p> </div>	<ul style="list-style-type: none"> - Read question - Ask participants for answers <p style="text-align: right;"><i>Answers – Module 1, p. 32</i></p>
Slide 47	<div style="border: 1px solid black; padding: 10px; text-align: center;"> <p>TB Pathogenesis</p> <hr style="width: 30%; margin: auto;"/> <p>Progression from LTBI to TB Disease</p> <p style="font-size: small; text-align: right;">47</p> </div>	<ul style="list-style-type: none"> - Introduce section <p style="text-align: right;"><i>Progression from LTBI to TB Disease – Module 1, pp. 19-20</i></p>
Slide 48	<div style="border: 1px solid black; padding: 10px;"> <p>Progression to TB Disease (1)</p> <ul style="list-style-type: none"> • Risk of developing TB disease is highest the first 2 years after infection • People with LTBI can be given treatment to prevent them from developing TB disease • Detecting TB infection early and providing treatment helps prevent new cases of TB disease <p style="font-size: small; text-align: center;">Module 1 – Transmission and Pathogenesis of Tuberculosis 48</p> </div>	<ul style="list-style-type: none"> - Review slide content - Explain that since the risk of progressing to TB disease is the highest in the first two years after infection, it is important to detect TB infection early <p style="text-align: right;"><i>Progression to TB Disease – Module 1, p. 19</i></p>

Progression to TB Disease (2)

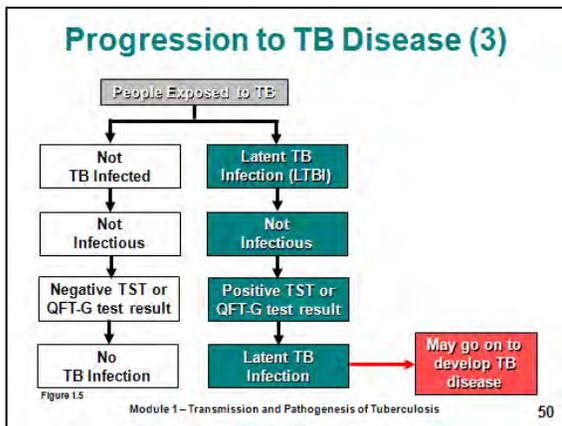
Some conditions increase probability of LTBI progressing to TB disease

<ul style="list-style-type: none"> • Infection with HIV • Chest x-ray findings suggestive of previous TB • Substance abuse • Recent TB infection • Prolonged therapy with corticosteroids and other immunosuppressive therapy, such as prednisone and tumor necrosis factor-alpha [TNF-α] antagonists 	<ul style="list-style-type: none"> • Organ transplant • Silicosis • Diabetes mellitus • Severe kidney disease • Certain types of cancer • Certain intestinal conditions • Low body weight
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- Review slide content
- Tell participants that some of these terms can be found in the glossary of print-based Module 1, pp. 2-4

Progression to TB Disease – Module 1, p. 20



- Review slide content
- Emphasize that not everyone exposed to TB becomes infected with TB, and not everyone that becomes infected with TB develops TB disease

Progression to TB Disease – Module 1, p. 19

Progression to TB Disease (4)

TB and HIV

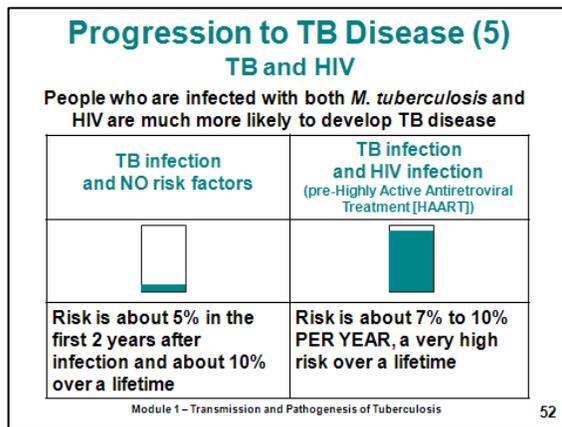
In an HIV-infected person, TB can develop in one of two ways:

- Person with LTBI becomes infected with HIV and then develops TB disease as the immune system is weakened
- Person with HIV infection becomes infected with *M. tuberculosis* and then rapidly develops TB disease

Module 1 – Transmission and Pathogenesis of Tuberculosis 51

- Before showing slide, ask participants what is the strongest known risk factor for the progression of TB disease in people with TB infection
- Note that worldwide TB is responsible for the deaths of 1 in 3 people living with HIV/AIDS; making it the leading cause of death for people infected with HIV
- Review slide content

TB and HIV – Module 1, p. 21
[Image credit: Mississippi State Department of Health]



- Review slide content
- Ask why the risk is so much greater with HIV infection

TB and HIV – Module 1, p. 21

Progression to TB Disease
Study Question 1.13

What percentage of people with LTBI (but not HIV infection) usually develop TB disease? (pg. 22)

- About 10% of all people with LTBI will develop disease at some point
 - In U.S., about 5% of recently infected will develop TB disease in first year or two after infection
 - Additional 5% will develop disease later in life
- Remaining 90% will stay infected, but free of disease, for the rest of their lives

Module 1 – Transmission and Pathogenesis of Tuberculosis 53

- Introduce study questions
- Ask participants to turn to p. 22 (if participants have print-based modules)
- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 32

Progression to TB Disease
Study Question 1.14

What conditions appear to increase the risk that LTBI will progress to TB disease? (pg. 22)

<ul style="list-style-type: none"> • Infection with HIV • Chest x-ray findings suggestive of previous TB • Substance abuse • Recent TB infection • Prolonged therapy with corticosteroids and other immunosuppressive therapy, such as prednisone and tumor necrosis factor-alpha [TNF-α] antagonists 	<ul style="list-style-type: none"> • Organ transplant • Silicosis • Diabetes mellitus • Severe kidney disease • Certain types of cancer • Certain intestinal conditions • Low body weight
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Module 1 – Transmission and Pathogenesis of Tuberculosis 54

- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 32

Slide 55

**Progression to TB Disease
Study Question 1.15**

How does being infected with both *M. tuberculosis* and HIV affect the risk for TB disease? (pg. 22)

- Much more likely to develop TB disease
- Risk of developing TB disease is 7% to 10% EACH YEAR (pre-HAART)
- In an HIV-infected person, TB disease develops when:
 1. Person with LTBI becomes infected with HIV and then develops TB disease as the immune system is weakened
 2. Person with HIV infection becomes infected with *M. tuberculosis* and then rapidly develops TB disease

Module 1 – Transmission and Pathogenesis of Tuberculosis 55

- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 32

Slide 56

TB Pathogenesis

Sites of TB Disease

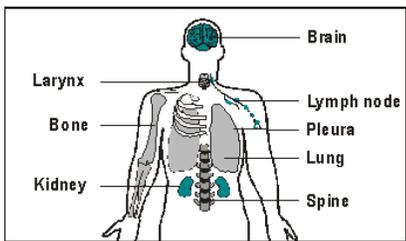
56

- Introduce section

Slide 57

Sites of TB Disease (1)

Bacilli may reach any part of the body, but common sites include:



Module 1 – Transmission and Pathogenesis of Tuberculosis 57

- Review slide content

Sites of TB Disease – Module 1, p. 25

Sites of TB Disease (2)		
	Location	Frequency
Pulmonary TB	Lungs	Most TB cases are pulmonary
Extrapulmonary TB	Places other than lungs such as: • Larynx • Lymph nodes • Pleura • Brain • Kidneys • Bones and joints	Found more often in: • HIV-infected or other immunosuppressed persons • Young children
Miliary TB	Carried to all parts of body, through bloodstream	Rare

Module 1 – Transmission and Pathogenesis of Tuberculosis 58

- Review slide content
- Note that miliary TB is rare, but very serious
- Explain that it is called miliary TB because the chest x-ray has the appearance of millet seeds scattered throughout the lungs

Sites of TB Disease – Module 1, p. 24

Sites for TB
Study Question 1.16

What part of the body is the most common site for TB disease? (pg. 27)

Lungs are the most common site

What are some other sites?

- Larynx
- Lymph nodes
- Pleura (membrane around the lungs)
- Brain
- Kidneys
- Bones and joints

Module 1 – Transmission and Pathogenesis of Tuberculosis 59

- Introduce study questions
- Ask participants to turn to p. 27 (if participants have print-based modules)
- Ask for a volunteer to read question
- Ask participants for answers

Answers – Module 1, p. 33

TB Pathogenesis

TB Classification System

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- Introduce section

TB Classification System Module 1, pp. 25-26

TB Classification System (1)		
Based on pathogenesis of TB		
Class	Type	Description
0	No TB exposure Not infected	No history of TB exposure Negative result to a TST or IGRA
1	TB exposure No evidence of infection	History of TB exposure Negative result to a TST (given at least 8-10 weeks after exposure) or IGRA
2	TB infection No TB disease	Positive result to a TST or IGRA Negative smears and cultures (if done) No clinical or x-ray evidence of active TB disease

Module 1 – Transmission and Pathogenesis of Tuberculosis 61

- Review slide content
- Note that many health departments and private health care providers still use this system, so it is important for public health workers to be familiar with it

TB Classification System – Module 1, p. 26

TB Classification System (2)		
Based on pathogenesis of TB		
Class	Type	Description
3	TB, clinically active	Positive culture (if done) for <i>M. tuberculosis</i> Positive result to a TST or IGRA, and clinical, bacteriological, or x-ray evidence of TB disease
4	Previous TB disease (not clinically active)	Medical history of TB disease Abnormal but stable x-ray findings Positive result to a TST or IGRA Negative smears and cultures (if done) No clinical or x-ray evidence of active TB disease
5	TB suspected	Signs and symptoms of TB disease, but evaluation not complete

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- Review slide content
- State that any TB patient with a classification of 3 or 5 should receive treatment for TB, and should be reported to the health department

TB Classification System – Module 1, pp. 25-26

TB Classification System

Study Question 1.17

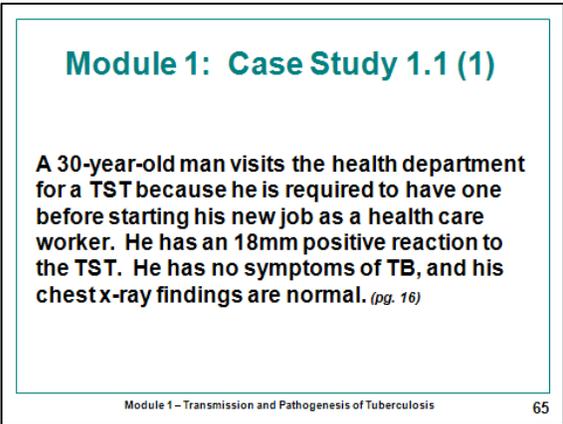
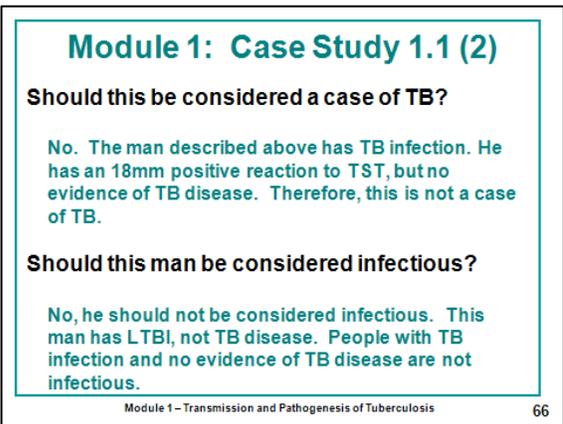
What is the classification system for TB based on? What is it used for? (pg. 27)

Current classification system is based on the pathogenesis of TB. Many health departments and private health care providers use this system when describing patients.

Module 1 – Transmission and Pathogenesis of Tuberculosis 63

- Ask participants to turn to p. 27 (if participants have print-based modules)
- Read question
- Ask participants for answers

Answers – Module 1, p. 33

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 64</p>	 <p style="text-align: center;">Case Studies</p> <p style="text-align: right;">64</p>	<ul style="list-style-type: none"> - Introduce case studies
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 65</p>	 <p style="text-align: center;">Module 1: Case Study 1.1 (1)</p> <p>A 30-year-old man visits the health department for a TST because he is required to have one before starting his new job as a health care worker. He has an 18mm positive reaction to the TST. He has no symptoms of TB, and his chest x-ray findings are normal. <i>(pg. 16)</i></p> <p style="text-align: center;"><small>Module 1 – Transmission and Pathogenesis of Tuberculosis</small></p> <p style="text-align: right;">65</p>	<ul style="list-style-type: none"> - Ask participants turn to p. 16 (if participants have print-based modules) - Read case study <p style="text-align: right;"><i>Case Study 1.1 – Module 1, p. 16</i></p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Slide 66</p>	 <p style="text-align: center;">Module 1: Case Study 1.1 (2)</p> <p>Should this be considered a case of TB?</p> <p>No. The man described above has TB infection. He has an 18mm positive reaction to TST, but no evidence of TB disease. Therefore, this is not a case of TB.</p> <p>Should this man be considered infectious?</p> <p>No, he should not be considered infectious. This man has LTBI, not TB disease. People with TB infection and no evidence of TB disease are not infectious.</p> <p style="text-align: center;"><small>Module 1 – Transmission and Pathogenesis of Tuberculosis</small></p> <p style="text-align: right;">66</p>	<ul style="list-style-type: none"> - Read questions - Ask participants for answers <p style="text-align: right;"><i>Answers – Module 1, p. 34</i></p>

Module 1: Case Study 1.2 (1)

A 45-year-old woman is referred to the health department by her private physician because she was found to have LTBI as part of an employee testing program. She is obese, with high blood pressure. Upon further questioning, she reports that she has injected illegal drugs in the past, but has never been tested for HIV infection. (pg. 23)

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Ask participants turn to p. 23 (if participants have print-based modules)
- Read case study

Case Study 1.2 – Module 1, p. 23

Module 1: Case Study 1.2 (2)

What conditions does this woman have that increase the risk that she will develop TB disease?

Injection of illegal drugs increases the risk that LTBI will progress to TB disease. This woman may also be at risk for HIV infection, which is the strongest known risk factor for developing TB disease. This woman should be offered HIV counseling, testing, and referral.

Obesity and high blood pressure are NOT risk factors for TB disease.

Module 1 – Transmission and Pathogenesis of Tuberculosis

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- Read case study question
- Ask participants for answers
- Ask if there are any questions about Module 1 before moving on to Module 2

Answers – Module 1, p. 34