Module 2: Epidemiology of Tuberculosis

Facilitation Tips

Background
Epidemiology is the study of diseases and other health problems in groups of people. Epidemiologists determine the frequency and pattern of health problems in different communities. In other words, they find out who has a specific health problem, how often the problem occurs, and where the problem occurs. Using this information about who, when, and where, epidemiologists try to determine why the health problem is occurring.

Public health officials use epidemiologic information to design ways to prevent and control diseases in the community. By finding out who is at risk for a specific health problem, they can target their prevention and control strategies to people who are at risk.

This module examines recent trends in TB in the United States and describes groups of people who are at higher risk for latent TB infection (LTBI) and TB disease. Groups of people who are at higher risk for TB varies from area to area; state and local health departments are responsible for determining specifically who is at risk in their area.

Learning Objectives
After this presentation, participants will be able to
1. Describe how the number of TB cases reported in the United States has changed over the last 50 years
2. List five factors that contributed to the increase in the number of TB cases between 1985 and 1992
3. List three improvements TB programs were able to make with increased federal, state, and other funds and resources that have contributed to a decrease in TB cases since 1993
4. List the groups of people who are more likely to be exposed to or infected with *M. tuberculosis*
5. List the groups of people who are more likely to develop TB disease once infected with *M. tuberculosis*

Module Overview

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Content</th>
<th>Slides</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 min.</td>
<td>Presentation</td>
<td>Introduction</td>
<td>Slides 1-3</td>
</tr>
<tr>
<td>10 min.</td>
<td>Presentation</td>
<td>Epidemiology of TB</td>
<td>Slides 4-19</td>
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<td>5 min.</td>
<td>Presentation</td>
<td>TB Case Rate</td>
<td>Slides 20-25</td>
</tr>
<tr>
<td>25 min.</td>
<td>Presentation</td>
<td>People at High Risk for Becoming Infected with <em>Mycobacterium tuberculosis</em></td>
<td>Slides 26-53</td>
</tr>
<tr>
<td>10 min.</td>
<td>Presentation</td>
<td>People at High Risk for Developing TB Disease After Infection with <em>Mycobacterium tuberculosis</em></td>
<td>Slides 54-64</td>
</tr>
<tr>
<td>5 min.</td>
<td>Case Studies</td>
<td>Case Studies</td>
<td>Slides 65-67</td>
</tr>
<tr>
<td>60 min.</td>
<td><strong>Total Time</strong></td>
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<tr>
<td>Slide 1</td>
<td>Facilitation Tips</td>
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</tbody>
</table>
| Self-Study Modules on Tuberculosis | - Introduce Module 2  
- Ask participants if they know what epidemiology is |

<table>
<thead>
<tr>
<th>Slide 2</th>
<th>Facilitation Tips</th>
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<tbody>
<tr>
<td>Module 2: Objectives</td>
<td>- State objectives of presentation</td>
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</tbody>
</table>

At completion of this module, learners will be able to:

1. Describe how the number of TB cases reported in the U.S has changed over the last 50 years
2. List 5 factors that contributed to the increase of TB cases between 1985 and 1992
3. List 3 improvements TB programs made with increased funds that have contributed to a decrease in TB cases since 1993
4. List groups of people who are more likely to be exposed to or infected with *M. tuberculosis*
5. List groups of people who are more likely to develop TB disease once infected with *M. tuberculosis*

*Background and Objectives - Module 2, p. 1*

<table>
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<tr>
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<th>Facilitation Tips</th>
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<tr>
<td>Module 2: Overview</td>
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</tbody>
</table>

- Epidemiology of TB
- TB Case Rate
- People at High Risk for Becoming Infected with *M. tuberculosis*
- People at High Risk for Developing TB Disease after Infection with *M. tuberculosis*
- Case Studies

*Module 2 – Epidemiology of Tuberculosis*
Epidemiology of TB

- Introduce section

Epidemiology (1)
Epidemiology is the study of the distribution and causes of disease and other health problems in different groups of people.

Epidemiology (2)
- Epidemiologists:
  - Determine frequency and pattern of health problems in communities
  - Try to figure out why health problems are occurring

- Ask for a volunteer to read the definition of epidemiology

- Review slide content
- Before showing slide, ask how many people in the world are infected with TB
- State that 1/3 of the world’s population is infected with TB
- Review slide content

**Global Epidemiology of TB**

- TB is one of the leading causes of death due to infectious disease in the world
- Almost 2 billion people are infected with *M. tuberculosis*
- Each year about:
  - 9 million people develop TB disease
  - 2 million people die of TB

*Module 2 – Epidemiology of Tuberculosis*

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- Review slide content

**TB Reporting in U.S.**

- The Report of Verified Case of Tuberculosis (RVCT) is the national TB surveillance data collection form and is used for reporting all verified TB cases to CDC
  - The 50 states, District of Columbia, New York City, Puerto Rico, and 7 other jurisdictions in the Pacific and Caribbean report TB cases to CDC
- Health care providers are required by law to report TB cases to state or local health departments

*Module 2 – Epidemiology of Tuberculosis*

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- Review slide content

**U.S. Epidemiology of TB 1953 - 1986**

- 1953:
  - More than 84,000 cases of TB
- 1953-1984:
  - TB cases declined about 6% each year
- 1985:
  - TB cases reached a low of 22,201
- 1986:
  - Significant increase in TB cases began

*Module 2 – Epidemiology of Tuberculosis*

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*Note: Information regarding the RVCT is not provided in the Self-Study Modules. For more information, please visit: [www.cdc.gov/tb/publications/factsheets/statistics/rvct.htm](http://www.cdc.gov/tb/publications/factsheets/statistics/rvct.htm)*

**TB Reporting in the U.S. - Module 2, p. 3**

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*U.S. Epidemiology of TB - Module 2, p. 3*
- Review slide content
- Call attention to the increase in TB cases on the graph (1980s)
- Ask participants why they think there was 20% increase in TB cases in the 1980s

**U.S. TB Resurgence - Module 2, p. 4**

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- Explain that there were several contributing factors to the TB resurgence in the U.S.
- Review slide content

**U.S. TB Resurgence - Module 2, p. 4**

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- Review slide content
- Stress that prevention and control efforts must be maintained in order to prevent another resurgence

**U.S. TB Control and Prevention - Module 2, p. 5**
- Call attention to the decrease in TB cases on the graph (after 1993)

- Explain that TB cases have steadily declined each year since 1993

- State that there were 12,904 TB cases in the U.S. in 2008

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- Explain that despite national trends reflecting a steady decline in the number of TB cases reported annually, there remain several areas of ongoing challenges in TB control

- Review slide content

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- Introduce study questions

- Ask participants to turn to p. 6 (if participants have print-based modules)

- Ask for a volunteer to read question

- Ask participants for answers

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**U.S. TB Control and Prevention - Module 2, p. 5**

**Continuing Challenges in TB Control**

- TB is reported in almost every state and is increasing in some areas

- More than half of all TB cases in the U.S. are among foreign-born residents

- TB affects racial/ethnic minorities disproportionately

- MDR TB and extensively drug-resistant TB (XDR TB)

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**Epidemiology of TB Study Question 2.1**

*What happened to the number of TB cases in the United States between 1953 and 1984? (pg. 6)*

From 1953 - 1984, the number of TB cases reported in the U.S. decreased by an average of 6% each year.

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**Answers - Module 2, p. 26**
Slide 16

Epidemiology of TB Study Question 2.2
What happened to the number of TB cases in the United States between 1985 and 1992?

From 1985 - 1992, the number of new TB cases increased by 20%.

Answers - Module 2, p. 26

Slide 17

Epidemiology of TB Study Question 2.3
Name 5 factors that may have contributed to the increase in the number of TB cases between 1985 and 1992. (pg. 6)

- Inadequate funding for TB control and other public health efforts
- HIV epidemic
- Increased immigration from countries where TB is common
- Spread of TB in certain settings (e.g., correctional facilities and homeless shelters)
- Spread of MDR TB

Answers - Module 2, p. 26

Slide 18

Epidemiology of TB Study Question 2.4
What has been happening to the number of TB cases in the United States since 1993?

Since 1993, there has been a steady decline in the number of TB cases reported annually in the United States.

Answers - Module 2, p. 26
Epidemiology of TB

Study Question 2.5

Name 3 improvements TB programs were able to make with increased federal funds that contributed to the decrease in TB cases since 1993. (pg. 6)

- Promptly identify persons with TB
- Start appropriate initial treatment for TB cases
- Ensure patients complete treatment

Answers - Module 2, p. 26

TB Case Rate

- Introduce section
- Ask what a TB case rate is and how it is calculated

TB Case Rate - Module 2, pp. 7-8

TB Case Rate (1)

- A case rate is the number of TB cases at a certain place and time, divided by size of the population at that time
- Often expressed in terms of a population size of 100,000 persons

TB Case Rate - Module 2, p. 7
Module 2 – Epidemiology of Tuberculosis

Slide 22

TB Case Rate (2)

Example:
• In the U.S. in 2008, there were 12,904 new TB cases in a population size of 304,059,724
  \[
  \frac{12,904}{304,059,724} \times 100,000 = 4.2
  \]
• In 2008, the U.S. TB case rate was 4.2 TB cases per 100,000 persons

Note: Slide reflects 2008 surveillance data.
TB Case Rate - Module 2, p. 7

Slide 23

TB Case Rates by State, 2008

- Explain that this map shows TB case rates by state
- Ask which states had higher rates and which had lower rates
- Point out the case rates for your area

Note: Slide reflects 2008 surveillance data.
TB Case Rate - Module 2, p. 7

Slide 24

TB Case Rate (3)

• Health departments, CDC, and others can compare the occurrence of TB in different places, time periods, and groups of people using case rates
• Comparisons have shown that rates of TB are higher in certain groups than in others
  – Groups with higher rates of TB are considered “high-risk” groups

TB Case Rate - Module 2, p. 8
High-Risk Groups

• High-risk groups can be divided into two categories:
  – High risk for becoming infected with *M. tuberculosis*
  – High risk for developing TB disease after infection with *M. tuberculosis*

People at High Risk for Becoming Infected with *Mycobacterium tuberculosis*

People at High Risk for TB Infection

- Close contacts
- Foreign-born persons
- Low-income groups and homeless persons
- Individuals who live and/or work in special settings
- Health care workers who serve high-risk groups
- Racial and ethnic minorities
- Infants, children, and adolescents
- People who inject drugs

Review slide content

Introduce section

Ask participants who they think should be considered at high risk for TB infection

Review slide content
High-Risk Groups for TB Infection (1)
Close Contacts
- Close contacts are people who spend time with someone who has infectious TB disease
- May include:
  - Family members
  - Coworkers
  - Friends
- On average, 20 – 30% of close contacts become infected with TB

Close Contacts – Module 2, p. 9

High-Risk Groups for TB Infection (2)
Foreign-Born/Immigrants
In the U.S., LTBI and TB disease often occur among people born in areas of the world where TB is common:
- Asia
- Africa
- Russia
- Eastern Europe
- Latin America

Foreign-Born/Immigrants – Module 2, p. 9

High-Risk Groups for TB Infection (3)
Foreign-Born/Immigrants


1992
- U.S.-born 73%
- Foreign-born 27%

2008
- U.S.-born 41%
- Foreign-born 59%

Note: Slide reflects 2008 surveillance data.
Foreign-Born/Immigrants – Module 2, p. 9
High-Risk Groups for TB Infection (4)
Foreign-Born/Immigrants

- To address high rates of TB in foreign-born persons, CDC and other public health organizations are:
  - Improving the screening process for immigrants and refugees
  - Strengthening the notification system that alerts health departments about the arrival of immigrants and refugees with suspected TB disease
  - Testing recent arrivals from countries where TB is common for LTBI and ensuring completion of treatment

Module 2 – Epidemiology of Tuberculosis
Slide 31

High-Risk Groups for TB Infection (5)
Foreign-Born/Immigrants

- Individuals applying for immigration and refugee status from overseas:
  - Must be screened for TB by panel physicians before entering U.S.
  - Must have completed treatment before entering U.S. if diagnosed with active TB

Module 2 – Epidemiology of Tuberculosis
Slide 32

High-Risk Groups for TB Infection (6)
Foreign-Born/Immigrants

- Immigrants in U.S. applying for permanent residence or citizenship:
  - Must be tested for LTBI and evaluated for TB disease by U.S.-based civil surgeons

Module 2 – Epidemiology of Tuberculosis
Slide 33

Foreign-Born/Immigrants – Module 2, pp. 9-10

Foreign-Born/Immigrants – Module 2, p. 10

Foreign-Born/Immigrants – Module 2, p. 10

Module 2 – Epidemiology of Tuberculosis
High-Risk Groups for TB Infection (7)
Low-Income and Homeless

- Low-income is linked to higher risk of exposure
- Possible reasons include factors associated with low-income:
  - Inadequate living conditions
  - Crowding
  - Malnutrition
  - Poor access to health care
- In 2008, about 6% of TB patients were homeless

Module 2 – Epidemiology of Tuberculosis

- Review slide content

Low-Income and Homeless – Module 2, p.10

High-Risk Groups for TB Infection (8)
Special Settings

- Special settings include congregate and residential settings:
  - Nursing homes
  - Correctional facilities
  - Health care facilities
  - Homeless shelters
  - Drug treatment centers

Module 2 – Epidemiology of Tuberculosis

- Review slide content

Special Settings – Module 2, p. 11

High-Risk Groups for TB Infection (9)
Special Settings

- Risk of exposure to TB is higher than in other settings
- Risk is higher if facility is crowded

Module 2 – Epidemiology of Tuberculosis

- Review slide content

Special Settings – Module 2, p. 11
Before showing slide, ask why groups in correctional settings are at higher risk for TB infection

- Review slide content
- Explain that being infected with HIV puts individuals at a higher risk of developing TB disease

**Correctional Facilities – Module 2, p. 11**

- Review slide content

**People Who Inject Drugs – Module 2, p. 11-12**

- Before showing slide, ask participants which factors can increase the risk for health care workers
- Review slide content
- Explain that facilities with a high risk of TB transmission should ensure appropriate TB prevention and control measures are taken
- Note that infection control procedures are discussed more in Module 5

**Health Care Workers – Module 2, p. 12**
- Review slide content

- Note that the number of reported TB cases in children have been decreasing since 1993

\[ \text{Note: In Module 2, print-based version, Children and Adolescents are after the Racial and Ethnic Minorities section.} \]

- Review slide content

- Ask why TB rates might be higher for certain racial and ethnic minorities

\[ \text{Racial and ethnic minorities – Module 2, p. 12} \]

- Explain that this pie chart shows the reported TB cases in the U.S. in 2008 by race and ethnicity

- Ask participants which groups made up the greatest percentage of TB cases, and which groups made up the least

\[ \text{Note: Slide reflects 2008 surveillance data.} \]

\[ \text{Racial and Ethnic Minorities – Module 2, p. 13} \]
- Explain that this pie chart shows the U.S. population broken down by race and ethnicity.

- Ask participants what they notice when comparing this pie chart to the one of the previous slide (e.g., even though non-Hispanic whites make-up more than 60% of the U.S. population, they only account for 17% of the TB cases).

- Explain that this means that the percentage of TB cases that occur in minorities is higher than expected based on their percentages in the U.S. population.

Note: Slide reflects 2008 surveillance data.

Racial and Ethnic Minorities – Module 2, p. 13

- Review slide content.

- Ask for a volunteer to read the definition of relative risk.

Relative risk is a ratio of the probability of disease occurring in one group versus another group.

Racial and Ethnic Minorities – Module 2, p. 15

Relative Risk for TB - Module 2, p. 14
- Use the example on this slide to demonstrate how to calculate relative risk.

\[
\frac{25.6 \text{ (TB case rate for Asians)}}{1.1 \text{ (TB case rate for non-Hispanic whites)}} = 23
\]

Note: Slide reflects 2008 surveillance data

Relative Risk for TB – Module 2, p. 14

- Explain that in this table all case rates are compared to the case rate for non-Hispanic whites because non-Hispanic whites have the lowest case rate.

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>TB Case Rate (per 100,000 persons)</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asians</td>
<td>25.6</td>
<td>23</td>
</tr>
<tr>
<td>Native Hawaiians or Other Pacific Islanders</td>
<td>15.9</td>
<td>14</td>
</tr>
<tr>
<td>Blacks or African Americans</td>
<td>8.8</td>
<td>8</td>
</tr>
<tr>
<td>Hispanics or Latinos</td>
<td>8.1</td>
<td>7</td>
</tr>
<tr>
<td>American Indians or Alaskan Natives</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Non-Hispanic Whites</td>
<td>1.1</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: Slide reflects 2008 surveillance data

Relative Risk for TB – Module 2, p. 14

- Introduce study questions

- Ask participants to turn to p. 16 (if participants have print-based modules)

- Ask for a volunteer to read question

- Ask participants for answers

Answers - Module 2, p. 27
High-Risk Groups for TB Infection

Study Question 2.7

What are public health agencies doing to address the high rate of TB in foreign born persons? (pg. 16)

- Improving overseas and domestic screening process of immigrants and refugees
- Strengthening the current notification system that alerts health departments about immigrants or refugees with suspected TB
- Testing recent arrivals from countries where TB is common for LTBI and ensuring completion of treatment

Answers - Module 2, p. 27

High-Risk Groups for TB Infection

Study Question 2.8

Why is the risk of being exposed to TB higher in certain settings, such as nursing homes or correctional facilities? (pg. 16)

- Many people in these facilities are at risk for TB disease
- Risk of exposure is higher if facility is crowded

Answers - Module 2, p. 27

High-Risk Groups for TB Infection

Study Question 2.9

What are some reasons why rates of TB disease are higher in correctional facilities? (pg. 16)

- Many inmates already have TB infection and are at a higher risk to develop TB disease
- An increasing number of inmates are infected with HIV, which means they are more likely to develop TB disease if they become infected with TB
- Overcrowded facilities promotes the spread of TB

Answers - Module 2, p. 27
- Ask for a volunteer to read question
- Ask participants for answers

High-Risk Groups for TB Infection Study Question 2.10

Which racial and ethnic groups are disproportionately affected by TB? (pg. 17)

- Asians
- Native Hawaiians or Other Pacific Islanders
- Non-Hispanic blacks
- Hispanics
- American Indians or Alaska Natives

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

High-Risk Groups for TB Infection Study Question 2.11

When a child has TB infection or disease, what does it tell us about the spread of TB in the child’s home or community? Name 3 things. (pg. 17)

- TB was transmitted recently
- Person who transmitted TB to the child may still be infectious
- Other adults and children in the home or community have probably been exposed to TB

Module 2 – Epidemiology of Tuberculosis 53

- Introduce section
- Ask who is at high risk for developing TB disease after infection

People at High Risk for Developing TB Disease After Infection with *Mycobacterium tuberculosis*

Module 2, pp. 19-20

Answers - Module 2, p. 27

Answers - Module 2, p. 28
- Explain that anyone who has LTBI can develop TB disease, but that some people are at higher risk than others
- Review slide content

High-Risk Groups for TB Disease (1)
- People living with HIV
- People with medical conditions known to increase the risk for TB
- People infected with *M. tuberculosis* within past 2 years
- Infants and children younger than 4 years old
- People who inject drugs

High Risk Groups for TB Disease – Module 2, p. 19

- Review slide content
- Explain that because HIV weakens the immune system, people with TB infection and HIV infection are at a very high risk of developing TB disease
- Explain that the risk of developing TB disease is only 10% over a lifetime for people infected only with *M. tuberculosis*

People Living With HIV – Module 2, p. 19-20

- Review slide content
- Prolonged therapy with corticosteroids, and other immunosuppressive therapy, such as tumor necrosis factor-alpha [TNF-α] antagonists
- Silicosis
- Diabetes

Individuals with Certain Medical Conditions – Module 2, p. 19
High-Risk Groups for TB Disease (4)
Individuals with Certain Medical Conditions

- Severe kidney disease
- Certain types of cancer
- Certain intestinal conditions

Module 2 – Epidemiology of Tuberculosis

High-Risk Groups for TB Disease (5)
Recently Infected

- Individuals infected within the past 2 years are more likely to develop TB disease
- Risk of developing disease in first 2 years is 5%
- Risk over entire lifetime is 10%

Module 2 – Epidemiology of Tuberculosis

High-Risk Groups for TB Disease (6)
Infants and Children Younger than 4 Years

- Higher risk due to underdeveloped immune system

Module 2 – Epidemiology of Tuberculosis

- Review slide content

Individuals with Certain Medical Conditions – Module 2, p. 19

Recently Infected – Module 2, p. 19

Infants and Children – Module 2, p. 19
• Higher risk of developing TB disease once infected due to:
  – Greater possibility of HIV infection
  – Injecting drugs may weaken immune system

- Introduce study questions
- Ask participants to turn to p. 21 (if participants have print-based modules)
- Ask for a volunteer to read question
- Ask participants for answers

- Ask for a volunteer to read question
- Ask participants for answers
High-Risk Groups for TB Disease

Study Question 2.14

If a person is infected with both *M. tuberculosis* and HIV, what are his or her chances of developing TB disease? How does this compare to the risk for people who are infected only with *M. tuberculosis*? (pg. 21)

- 7% - 10% each year if infected with both *M. tuberculosis* and HIV
- 10% over a lifetime if only infected with *M. tuberculosis*

Answers - Module 2, p. 28

Case Studies

Module 2: Case Study 2.1

For each of the following people, indicate the factor(s) known to increase the risk of being exposed to or infected with TB (p. 18)

<table>
<thead>
<tr>
<th>Person</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Mr. LeFevre</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td></td>
<td>![Checkmark]</td>
</tr>
<tr>
<td></td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>b) Ms. Montoya</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td></td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>c) Ms. Parker</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td></td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>d) Mr. Dudley</td>
<td>![Checkmark]</td>
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<tr>
<td></td>
<td>![Checkmark]</td>
</tr>
</tbody>
</table>

Answers – Module 2, p. 29

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

- Introduce case studies

- Ask participants to turn to p. 18 (if participants have print-based modules)
- Read case study
- Ask participants which factors would be considered risk factors for each person
- Ask participants to turn to p. 22 (if participants have print-based modules)

- Read case study

- Ask participants which factors would be considered risk factors for each person

- Ask if there are any questions about Module 2 before moving on to Module 3

*Answers – Module 2, p. 30*