

Session #3 Principles of TST – Part 1

INTRODUCTION This session will introduce participants to the main principles of tuberculin skin testing (TST), beginning with the purpose of TST and different types of tests. An overview of each step of the Mantoux method of TST will be described, including a list of TST supplies and the proper handling and storage of tuberculin. Essential information about universal precautions is covered, as well as an explanation of how TST reactions are interpreted. Finally, participants will learn how false-positive and false-negative reactions can occur, the purpose of two-step testing, and the effect of BCG on TST. Material in this session is reinforced by participants' viewing of the CDC video, *Mantoux Tuberculin Skin Test* (2003).

MATERIALS SUPPLIED FOR THIS SESSION

- Outline for trainers
- Participant workbook (1 reproducible master copy)
- Handout: *All About Acronyms and Abbreviations* (1 reproducible master copy)
- Masters for overhead transparencies and PowerPoint slides:
 - *Purpose of TST*
 - *Types of Tests*
 - *Mantoux Test*
 - *Universal Precautions*
 - *Interpretation of TST*
 - *Classifying TST Reactions*
 - *False-positive and False-negative*
 - *Two-step Testing*
 - *BCG*
 - *Review Questions*

MATERIALS YOU NEED TO SUPPLY

- Duplicate participant workbooks
- Duplicate handouts: *All About Acronyms and Abbreviations*
- Poster paper, chalkboard, or dry-erase board
- Poster pens, chalk, or dry-erase markers
- Overhead projector or laptop and LCD projector
- VCR and television monitor
- Video: *Mantoux Tuberculin Skin Test* (CDC, 2003)

Material in this session is adapted from:

- *Core Curriculum on Tuberculosis, 4th ed.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2000.
- *Mantoux Tuberculin Skin Test* (video). Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2003.
- *Self-Study Modules on Tuberculosis: Module 3, Diagnosis of Tuberculosis Infection and Disease.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 1995.
- *Tuberculin Skin Testing: A Model for Trainers.* San Francisco, CA: Francis J. Curry National Tuberculosis Center; 2001.
- *Tuberculosis Update.* Presented by the Francis J. Curry National Tuberculosis Center on April 23, 2003, in Oakland, CA.

Session Outline for Trainers

35 min Opening activities

Session agenda

Review with participants. Your agenda may be customized with other items or additional details. Consider presenting the agenda on poster paper or displaying it on a chalk- or dry-erase board as a visual reference throughout the session.

- Pre-test (if applicable; see page 2 of *Participant's Workbook*)
- Review of agenda and learning objectives
- Review of key concepts from Session 2
- Purpose of the TST and types of tests: Mantoux, QuantiFeron, MPT (tine)
- Three main steps of the Mantoux test
- TST supplies; storage and handling of tuberculin
- Video: Mantoux TST
- Activity: Acronyms and Abbreviations
- Universal precautions
- Interpretation of TST results
- False-positive, false-negative reactions
- Two-step testing and BCG
- Review questions or post-test
- Participant evaluation

Pre-test

Ask participants to complete the session pre-test on page 2 of their workbooks.

Learning objectives

Review with participants. Refer participants to page 1 of their workbooks.

Upon completion of this training session, participants will be able to:

1. Describe the three main steps involved in the Mantoux method of TST.
2. Name at least six supplies needed to perform TST.
3. List at least three ways that tuberculin is properly handled and stored.
4. Explain the meaning of "universal precautions" and list at least four examples.
5. Describe two situations when a TST reaction of ≥ 5 mm is considered "positive."
6. Define "false-negative reaction" and provide two situations when a false-negative can occur.
7. Explain the purpose of two-step testing.
8. Describe how the effect of BCG should be considered when interpreting TST.

Review of key concepts from Session 2

Review with participants the key concepts from the topics covered in Session 2. Consider organizing the discussion around the following questions.

1. What factors determine the infectiousness of a TB patient?
2. Describe the following types of infection control:
 - Administrative controls
 - Engineering controls
 - Personal respiratory protection
3. What steps are involved in TB case management?
4. Which groups should receive high priority for targeted testing?
5. What steps are involved in a contact investigation?
6. What are reasons a patient might be non-adherent to his/her TB treatment?
7. What is the role of DOT in patient adherence?
8. Which groups are the highest priority to receive DOT?

10 min Purpose of TST and types of tests

I. Purpose of TST (Tuberculin Skin Test)

Review with participants, using overheads/PowerPoints: Purpose of TST.

- A. The purpose of TST is to detect latent TB infection (LTBI).
- B. TST is useful in the following situations:
 1. Examining close contacts to cases of active TB disease
 2. Targeted testing of groups of people at high risk for TB infection
 3. Examining a person who has symptoms of active TB disease
- C. Facts about tuberculin
 1. Tuberculin is a protein derived from tubercle bacilli that have been killed by heating.
 2. Tuberculin is injected under the first layer of skin (intradermally). In most people with TB infection, the immune system will recognize the tuberculin as being similar to the tubercle bacilli already in the body. These people will have a reaction to the TST. The reaction is the swelling around the injection site (not the redness).
 3. TST is not a vaccine. TST will not give a person TB infection or active TB disease.
 4. TST is both safe and reliable during pregnancy.
 5. Tubersol and Aplisol are two available brands of tuberculin. A CDC study found them to be equally effective.

II. Types of tests

Review with participants, using overheads/PowerPoints: Types of Tests.

- A. The **Mantoux** tuberculin skin test has been used in the U.S. since the 1930s and is the most widely used method for identifying LTBI because it is the most accurate. "TST technicians" are trained and certified to use the Mantoux method. [Note: The Mantoux method will be described in detail later in this session.]
- B. **QuantiFeron-TB** is a relatively new method of detecting TB infection that is not yet widely available. It is a blood test. Advantages of this method over TST include speed (results can be obtained in one day), convenience (only one patient visit is needed), and possible increased accuracy of detecting TB infection. However, until further studies are performed, the CDC does not yet recommend QuantiFeron-TB for TB suspects, contacts, children under 17 years, pregnant women, and HIV-infected persons.
- C. The **multiple puncture test** (MPT), sometimes called the "**tine**" test, is an outdated method of TST that should no longer be used because it is unreliable. This method involves puncturing the skin with a device with 3 prongs (or "tines") that have been pre-coated with tuberculin.

20 min **The Mantoux test**

Review with participants, using overheads/PowerPoints: Mantoux Test.

III. The Mantoux test

- A. **Administering** the TST is the first step in the Mantoux method
 1. The Mantoux test is administered by injecting 0.1 ml of five tuberculin units of liquid tuberculin between the layers of the skin (intradermally) on the inner aspect of the forearm.
 2. The tuberculin solution used in the Mantoux method is also known as "purified protein derivative" (**PPD**). In the past, the TST was known as a "PPD" and you may hear some people still refer to the TST as a PPD skin test. [Note: Complete details about how to administer TST will be covered in the *Mantoux TST* video and during Session 5: Practicum.]
- B. **Measuring** the reaction at the injection site is the second step
 1. 48-72 hours after the injection, the patient's arm is examined for a reaction. In most cases, if more than 72 hours has passed, the TST should be readministered.
 2. A reaction is an area of swelling (induration) around the injection site, which is measured and recorded in millimeters (mm).
 3. Patients should never "read" their own reactions; the reaction must be read by a trained health worker. [Note: Complete details about how to measure TST reactions will be covered in the *Mantoux TST* video and during Session 5: Practicum.]

- C. **Interpreting/classifying** the reaction results is the third step
1. The third and final step in the Mantoux method of TST is to interpret/classify the measurement of the reaction.
[Note: By law (SB 843) TST technicians may not be certified to interpret, and may not interpret, the results of a TST.]
 2. "Positive reactions" occur in many, but not all, patients who are infected with *M. tb.* (Information about how TST reactions are classified as "positive" or "negative" is presented later in this session.)
- D. **Supplies** used in the Mantoux method of TST
1. Tuberculin
 2. Single-dose disposable tuberculin needle and syringe
 3. Gauze pads or cotton balls
 4. Alcohol swabs
 5. Puncture-resistant sharps disposal container
 6. Patient and provider forms; patient education materials; appointment cards
 7. Pen
 8. Ruler with millimeters (mm)
 9. Insulated cooler (for testing in the field)
 10. Gloves

Complete instructions for how to use TST supplies will be covered in the *Mantoux TST* video and during Session 5: Practicum.

- E. **Storage and handling of tuberculin**
1. Multidose vials contain tuberculin for either 10 or 50 tests.
 2. Tuberculin should be stored inside a refrigerator at temperatures between 35-46 degrees Fahrenheit (or between 2-8 degrees Centigrade). In the field, tuberculin should be stored in appropriate coolers with ice packs.
 3. Tuberculin can lose its potency when exposed to light, and should be stored and transported in the dark as much as possible.
 4. When opening a new vial, check to ensure that it contains the tuberculin unit strength that you want to use. Mark the date and your initials on the vial.
 5. Find the expiration date on the label of the tuberculin vial. Discard any vial with an expired date or that has been open for more than 30 days.
 6. Tuberculin should be drawn into the needle just prior to injection.

Complete instructions about how to store, handle, and inject tuberculin will be covered in the *Mantoux TST* video and during Session 5: Practicum.

50 min Video: *Mantoux Tuberculin Skin Test*

View the 30-minute video, *Mantoux Tuberculin Skin Test*. The Facilitator Guide accompanying the video provides opportunities to stop the video at various points to discuss additional details and local policies. Please choose the discussion points that best fit your instructional needs. The video's content will reinforce material already presented in this session, as well as present new information. Please note that many of the techniques demonstrated in the video will be repeated and emphasized during Session 5: Practicum. Also, important information about **patient education** and **documentation**, not covered in Session 3, will be presented in Sessions 4 and 5.

30 min Activity: All about acronyms (and abbreviations)

Ask participants to close their workbooks. Explain that many acronyms and abbreviations have been presented in Sessions 1-3, and it may be a challenge to remember them all. Divide participants evenly into two teams. Distribute copies of the handout, *All About Acronyms and Abbreviations*. [See page 14 for a reproducible master of the handout.] Explain that each team has 10 minutes to spell out the list of acronyms and abbreviations. Ask that teams not look in their workbooks for the answers. After 10 minutes, ask for a volunteer reporter from each team. Ask the reporter from Team A to explain how his/her group answered the first item. Ask the reporter from Team B to explain how his/her group answered the second item, etc., taking turns until all the items are covered. Each correct answer is worth one point. Ask each team to respond to the optional follow-up questions for the chance to gain bonus points. The team with the highest number of points "wins." Consider providing a choice of two simple prizes to the winning team (i.e., hard candies, TB program key chains or pencils, etc.); give the non-chosen prize to the "second place" team.

Acronym/ Abbreviation	Answer	Optional follow-up question for bonus point
TB	tuberculosis	
TST	tuberculin skin test	
LTBI	latent tuberculosis infection	What is the difference between LTBI and TB disease?
CDC	Centers for Disease Control and Prevention	Where is the CDC located?
DOT	directly observed therapy	Why is DOT so important?
PPD	purified protein derivative	How is PPD used?
HCW	health care worker	
HEPA (filter)	high-efficiency particulate air (filter)	What do HEPA filters do?
WHO	World Health Organization	
<i>M. tb</i>	<i>Mycobacterium tuberculosis</i>	What is <i>M. tb</i> ?
MDR-TB	multidrug-resistant tuberculosis	
INH	isoniazid	What is INH used for?
AFB	acid-fast bacilli	How is AFB used?
UV	ultraviolet (light)	What does UV have to do with TB?

15 min **Universal precautions**

IV. Universal precautions

Refer participants to page 8 of their workbooks. Discuss with participants, using overheads/PowerPoints: Universal Precautions.

A. "**Universal precautions**" is a term that describes an approach to infection control for health care workers, developed by the CDC. This approach treats all blood and body fluids as potentially hazardous. Health care workers who follow universal precautions when performing TST and other procedures can reduce their risk of exposure to dangerous blood-borne pathogens.

B. Universal precautions include measures such as:

1. Handling any needles or sharp objects with extreme care
2. Always disposing of needles and other sharp items in a puncture-resistant container kept within easy reach
3. Ensuring that sharps containers are closable, leakproof, and labeled
4. Washing hands or other skin surfaces immediately and thoroughly if they become contaminated with blood or other bodily fluids
5. Treating all biomedical waste as potentially hazardous, and disposing of used bandages, dressings, and gloves in biohazard bags
6. Minimizing direct contact with body fluids by wearing protective eyewear
7. Washing hands after giving care
8. Wearing gloves whenever a possibility of exposure to blood or other bodily fluids exists
9. Washing hands immediately after removing gloves

Review with participants your department's policies regarding universal precautions, particularly as they relate to TST. Discuss your department's specific policies for wearing gloves during TST.

Specific instructions for practicing universal precautions during the administration of TST will be demonstrated during Session 5: Practicum.

30 min **Interpretation of TST; false-positive and false-negative results**

V. **Interpretation** of TST results

Explain once more to participants that TST technicians will administer TST and measure TST results, but by law (SB 843) TST technicians may not be certified to interpret, and may not interpret, the results of a TST. The following information is presented for their general knowledge.

A. What makes a TST reaction **positive** or **negative**?

Discuss with participants, using the overheads/PowerPoints: Interpretation of TST.

1. Two factors determine whether a TST result is considered "positive" or "negative": **the size of the induration** (swelling) around the injection site, and the **person's risk factors** for TB.
2. In short, persons with more serious risk factors are considered positive with smaller-sized reactions.

Ask participants:

Which groups do you remember as being "high risk" for TB infection and/or active disease?

Record participants' answers on a chalkboard, poster sheet, or overhead transparency. When participants have no more ideas, fill in missing items as needed.

- a. Close contacts of persons known or suspected to have active TB disease
- b. Foreign-born persons from areas that have high rates of TB
- c. Residents and employees of high-risk settings (correctional facilities, nursing homes, mental institutions, homeless shelters, etc.)
- d. Infants, children, and adolescents exposed to adults in high-risk categories
- e. Substance users
- f. Persons with HIV infection
- g. Persons with certain medical conditions (such as diabetes)
- h. Persons with a history of inadequately treated active TB disease

B. Classifying TST reactions

Refer participants to page 9 of their workbooks. Discuss with participants, using overheads/PowerPoints: Classifying TST Reactions.

1. **≥ 5 mm** is classified as positive in:

- a. HIV-positive persons
- b. Recent contacts of an active pulmonary TB case
- c. Persons with chest radiographs that suggest old healed TB disease
- d. Patients with organ transplants and other immunosuppressed patients

2. **≥ 10 mm** is classified as positive in:

All other persons, not listed above.

C. False-positive and false-negative reactions

Refer participants to page 9 of their workbooks. Discuss with participants, using overheads/PowerPoints: False-Positive and False-Negative.

1. The Mantoux tuberculin skin test is not a perfect instrument. Rarely, a person who is **not** infected with *M. tb* will display a positive reaction (a "false-positive.") Reasons include:
 - a. Infection with a nontuberculous mycobacteria
 - b. History of BCG vaccination (see page 11 for more information about BCG)

2. Likewise, a person who is truly infected with *M. tb* will sometimes show a negative reaction (a "false-negative"). Reasons include:
 - a. TB infection was too recent for the body to respond to tuberculin (generally, it takes a window of 10-12 weeks after exposure for the infection to "show up" on the TST)
 - b. TB infection occurred too long ago for the immune system to "remember" it (in this case, two-step testing is more accurate)
 - c. Anergy: the body is too weak from immunosuppression (from AIDS or certain other medical conditions or medications) to mount a response to the tuberculin
 - d. Very young age (less than 6 months old)
 - e. Recent live-virus vaccine (such as the measles vaccine)
 - f. Errors in storage or administration (too deep) of the tuberculin solution or in the reading of the TST

3. Because these factors can interfere with an accurate diagnosis, the **absence of a positive TST reaction should never rule out infection or active disease.**

20 min **Two-step testing and BCG**

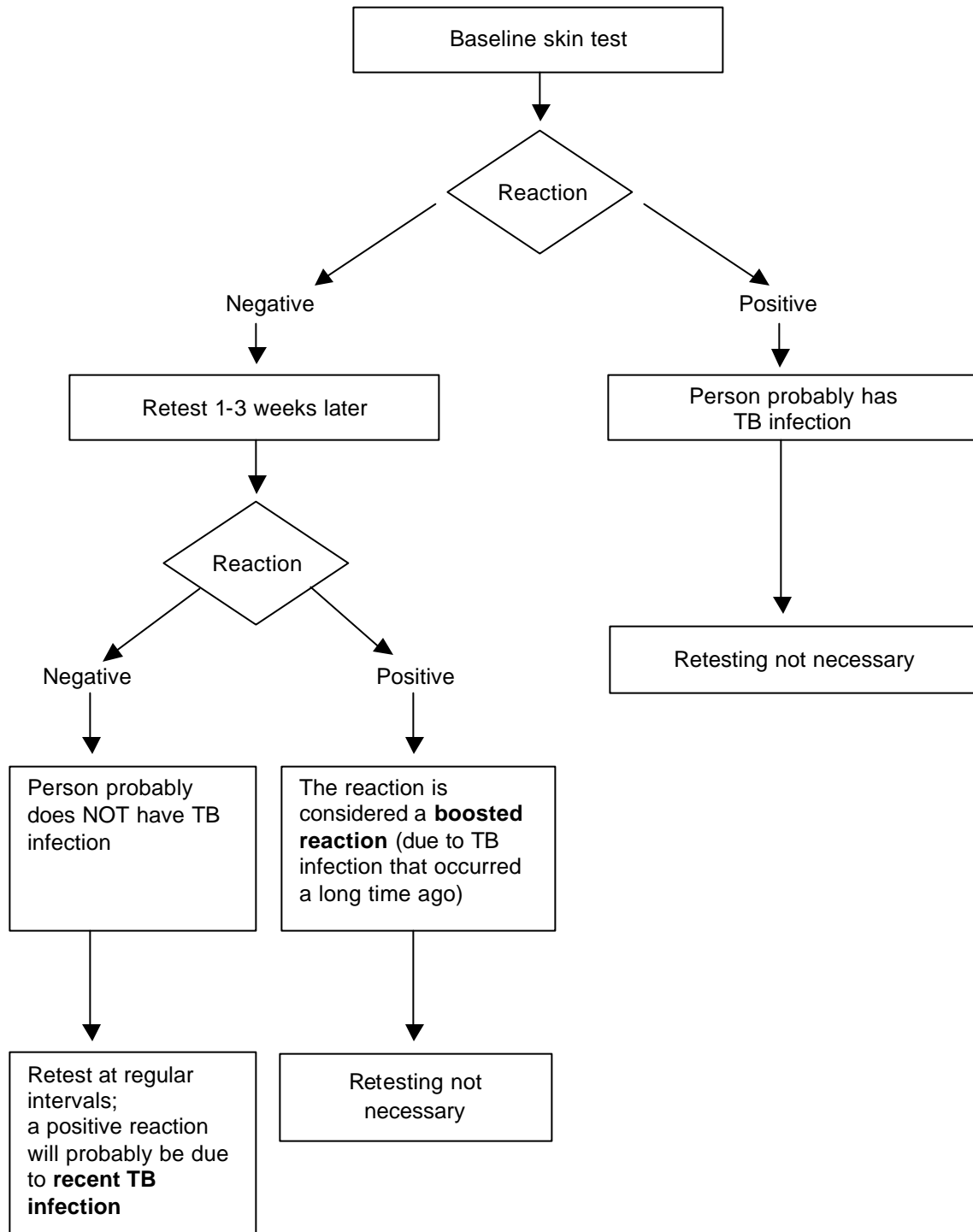
VI. Two-step testing

Refer participants to page 10 of their workbooks. Discuss with participants, using overheads/PowerPoints: Two-step Testing.

- A. Sometimes, when a person has been infected with LTBI for several years, he/she may not produce a reaction to the baseline TST. Over time the immune system has lost some of its sensitivity to the tuberculin. The first TST will "boost" the immune system's ability to react. So if these persons are re-tested 1-3 weeks later, a positive reaction can occur. This reaction should not be confused for new infection.

- B. "**Two-step testing**" is a procedure recommended for adults who will be given TST periodically, such as health care staff who work in high-risk settings for TB transmission. When staff first start to work for such a facility, a baseline TST is taken using two-step testing to ensure that a true baseline is obtained, without confusion from "boosting." That way, when the person is retested at a later interval, the results can be compared to see if the results represent a new infection, indicating that transmission has recently occurred.

SOURCE: *SELF-STUDY MODULES ON TUBERCULOSIS: MODULE 3, DIAGNOSIS OF TUBERCULOSIS INFECTION AND DISEASE*. ATLANTA, GA: U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, CENTERS FOR DISEASE CONTROL AND PREVENTION; 1995, P. 29.



VII. BCG

Refer participants to page 12 of their workbooks. Discuss with participants, using overheads/PowerPoints: BCG.

- A. **BCG** (bacilli Calmette-Guerin) is a type of vaccination against tuberculosis that is not generally administered in the United States, but is routinely given to children and adults in other countries with a high incidence of TB. Studies have shown that BCG has some protective value for children against the most serious forms of active TB disease in children, but does not protect from TB infection. However, the threat of TB for most children in the U.S. is not high enough to warrant widespread inoculation. How well BCG can prevent TB in adults is highly uncertain.
- B. A history of BCG vaccination can occasionally result in a positive TST, when no LTBI is present (a "false-positive").
- C. Due to the shortcomings of BCG, the CDC recommends that BCG be considered only in the following situations:
 - 1. When an infant or child will be continually exposed to an untreated or only partially treated patient with infectious pulmonary TB or MDR-TB (with no possibility of being removed from the situation)
 - 2. When health care workers are continually exposed to MDR-TB in situations where infection control precautions have not been successful
- D. Someone with a history of BCG vaccination may resist TST, insisting that the BCG will provoke a "false-positive" reaction. However, in most cases, a history of BCG will not affect how the body responds to TST, unless the BCG was given repeatedly or within the last year. Studies have shown that BCG in infancy does not cause a positive TST in adults. Therefore, the CDC advises clinicians to **ignore BCG history during the interpretation of TST results.**

30 min **Closing activities**

Review questions or post-test

The following questions can be used for a group discussion to review the session's main points (use overheads/PowerPoint slides, Review Questions), or they can be utilized as a post-test for participants (see page 13 in Participant's Workbook.)

1. Complete this sentence: TST technicians use the _____ method of TST.
2. What are the three main steps of the Mantoux method?
3. List six supplies needed to perform TST.
4. Which of the following is FALSE about tuberculin?
 - a. It should be stored at temperatures between 35-46 degrees F (2-8 degrees C).
 - b. It should be protected from light when not being used.
 - c. Open vials should be discarded after 30 days.
 - d. It is unsafe for pregnant women.
5. What are four examples of "universal precautions"?
6. True or false: A TST reaction of ≥ 5 mm is considered "positive" in a person who is a recent contact to an active case of TB.
7. What is a situation in which a "false-negative reaction" can occur?
8. True or false: A person who has a history of BCG vaccination should not receive TST.

Participant evaluation

Ask participants to share their feedback about this training session on the evaluation form (see page 14 in Participant's Workbook).

Activity: All about acronyms (and abbreviations)

What do the following acronyms and abbreviations mean?

Acronym/ Abbreviation	Meaning	Bonus question
TB	_____	
TST	_____	
LTBI	_____	What is the difference between LTBI and TB disease?
CDC	_____	Where is the CDC located?
DOT	_____	Why is DOT so important?
PPD	_____	How is PPD used?
HCW	_____	
HEPA (filter)	_____	What do HEPA filters do?
WHO	_____	
<i>M. tb</i>	_____	What is <i>M. tb</i> ?
MDR-TB	_____	
INH	_____	What is INH used for?
AFB	_____	How is AFB used?
UV	_____	What does UV have to do with TB?