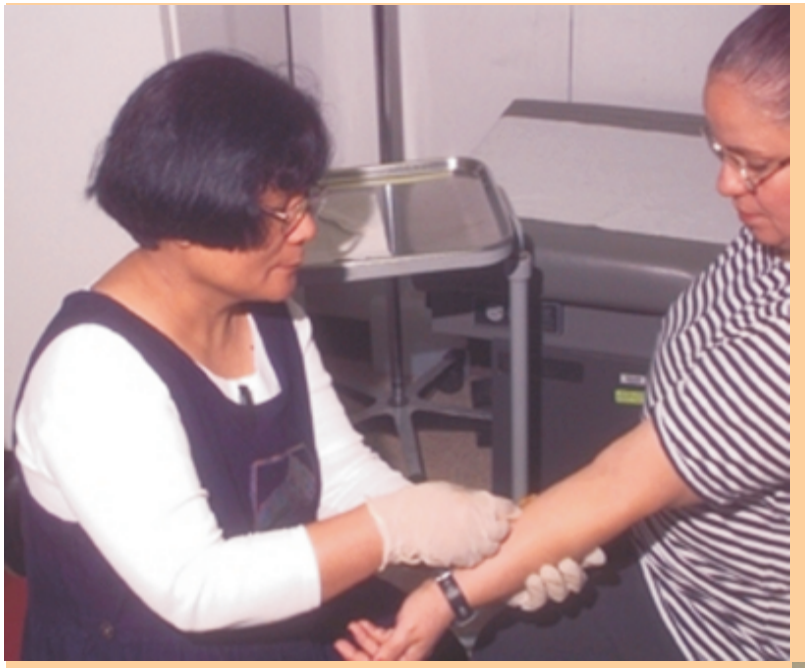

Mantoux Tuberculin Skin Testing

A Training Guide

NEW JERSEY MEDICAL SCHOOL
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*Click here to download modifiable versions of appendices. Internet connection required. Appendices can be viewed offline.

Preface

Since 1993, tuberculosis (TB) case rates have been declining, suggesting that the nation is recovering from the resurgence of TB that occurred in the mid-1980s and is back on track toward the goal of TB elimination. While the decrease in TB case rates is encouraging, TB cases continue to be reported in every state. A population of particular concern is the large number of people with latent TB infection (LTBI). It is estimated that 10 to 15 million persons in the United States are infected with *Mycobacterium tuberculosis*. Without identification and intervention, approximately 10% of these people will develop TB disease at some point in their lives. Targeted testing of high-risk groups with the Mantoux tuberculin skin test is, therefore, essential for identifying those who would benefit from treatment for LTBI.

Introduction

Effective training, whether provided in a group workshop or a one-on-one format, requires that you have a clear picture of how your learners will need to use the information after the training. It also requires that people practice what they have learned before they apply it. This practice step is not required in non-training situations, since the learners are not necessarily going to use the information subsequent to the training

The *Mantoux Tuberculin Skin Testing Training Guide* outlines the steps in planning and conducting skin test training. It provides an opportunity for health care workers who are proficient in targeted testing to share their knowledge and skills with others, which can be done by presenting a full-length or abbreviated skin testing training workshop to a group or one-on-one instruction to a single individual. This resource is intended for educators and trainers who conduct skin test workshops for health care workers.

Training for the Adult Learner

The importance of adult learning plays a key role in health care professional training. As a facilitator, you need to be aware of the unique needs of the adult learner to hold an effective training program. Adults, unlike children, base their learning on past experiences and relevance to current or future experiences. The outcome of a training program is important to the adult learner. Therefore, how a training experience applies to real-life situations is vital. This places a value on the learning activities involved in the training. In this case, a TB-related training program should address:

- Past and current handling of TB medications
- Tuberculin skin testing
- TB-related policies and protocols

Some effective teaching methods for adult learners include the use of examples and practice exercises. Since learners also bring life and job experiences related to discussion topics, participants should be encouraged to actively take part in the training by asking questions related to specific and realistic situations. Brainstorming with colleagues about solutions to challenging situations should be allowed to occur as well. Training should also provide time to absorb ideas, which may be a change to the current thinking of the participants.

The Mantoux Tuberculin Skin Testing Training Guide is geared toward practical, not theoretical, education. The TB information provided is specific to occupational needs of health care workers. Any presentation, using the materials provided in this training resource, must be relevant to the health care workers' experiences and job-related tasks. Adult learners are a unique learning resource for both the instructor and one another.

Need for Training

You will most likely become aware of a need for training because another person has brought the need to your attention and requested a formal training workshop. Perhaps there has been a request from a nursing home, health department, or other health care facility to provide skin test training for their staff. In such situations, the first step is to contact the requestor, confirm the request, and obtain answers to the following questions:

- Requestor's name and title
- Why the training is being requested?
- Who are the prospective trainees?
- What knowledge/skills do they need to learn?
- When and where will the training take place?

Verify that the individual making the request is able to provide or designate a contact person, who you will communicate with should you have any questions, require additional information, need to postpone/cancel, etc. Be sure to record their name and how they can be reached. The contact person should also be the one who will distribute, collect, and return the completed needs assessment forms (discussed below) to you by a mutually agreed upon date.

After the initial contact has been made, it is essential to conduct a needs assessment of the prospective participants to guide you in the development of a training program. Generally speaking, a needs assessment form consists of a series of questions designed to gauge how much your prospective trainees know about certain topic areas.

In this section, you are provided with a needs assessment form (Appendix 1 *Word* *PDF*)* that can be photocopied and used "as is." However, should you decide to modify it or create your own needs assessment form, the next page highlights some guidelines to consider while doing so.

When the completed needs assessment forms are returned to you, you will need to tally and analyze the results. This will provide you with a general idea of the level of familiarity your trainees have with the topic areas. It will also allow you to see if they have similar or very different levels of knowledge and experience. This information will help you with the next step in planning your training, determining learning objectives.

*Internet connection required.

Guidelines for Creating a Needs Assessment Form

□ Keep it simple, keep it short

□ Write clear, straightforward directions and questions

□ Aim for a maximum of 15 questions which, in total, should take no more than 10 to 15 minutes to complete

□ Ensure that each question addresses only one topic

□ Avoid abbreviations

□ Avoid negatives and double negatives

□ Keep most questions close-ended, in which the respondents simply choose from pre-selected answers that are usually arranged along a scale (e.g., “very much,” “somewhat,” “not at all,” etc.)

□ Optional: include one or two open-ended questions (answer choices not provided, usually beginning with “What,” “How,” etc.) and/or an opportunity for “additional comments”

□ Emphasize that responses are anonymous

Developing Learning Objectives

Learning objectives are the necessary foundation of any effective training. They spell out exactly what it is you expect your learners to be able to do at the end of the training sessions, focusing both you and your learners on the achievement of specific results.

Additionally, objectives help you by sketching out a kind of road map that tells you where you need to go in your presentation, what subject areas you need to cover. You can think of the objectives as representing knowledge or skill destination points for your learners. Once you have identified your objectives, you can then begin to outline all the necessary information you will need to provide to enable your learners to arrive at the set destination points.

Identifying learning objectives also helps your learners by letting them know, from the beginning, what is expected of them, in very specific terms. They can look over the list of objectives and instantly get an overview of what knowledge and skills they are going to learn as a result of this training. Learning objectives are also essential when it comes to having your learners evaluate the quality of the training.

It is important that the learning objectives for your training come as close as possible to describing the actual behaviors your learners will be expected to perform on the job. When you are describing these desired behaviors, use verbs that describe observable behavior. This will come easily when you are writing learning objectives for physical skills, such as administering the Mantoux tuberculin skin test, since an action like administration is something that can be observed.

However, when the behavior relates to learner knowledge or attitudes, you might be tempted to used words like “know,” “understand,” or “appreciate.” These words describe something that is happening internally and, written in this way, there is no way to measure whether or not the objective has been met. Instead, you should write learning objectives using verbs that describe behavior that can be observed, and hence, assessed.

For example, important knowledge for health care workers working in TB control is the difference between TB infection and TB disease. While you want the worker to “know” the difference, when writing learning objectives, you must state this in such a way that the learner’s acquisition of this knowledge could actually be observed by someone else. So, rather than stating that the health care worker will “know the difference between TB infection and disease,” it would be better to phrase it as “be able to explain the difference between TB infection and disease.”

The next page provides a list of behaviorally worded learning objectives that are typically used in skin testing workshops. You can select objectives from this list when designing your training or develop your own objectives using these guidelines.

Commonly Used Learning Objectives

At the end of this workshop, the participant will be able to:

1. State the tuberculosis case rates for the United States, the state, and the county of …
2. Identify the cause of tuberculosis
3. Describe how tuberculosis is spread
4. Explain the pathogenesis of tuberculosis
5. Identify persons for whom targeted tuberculosis skin testing is indicated
6. Explain the difference between tuberculosis infection and tuberculosis disease
7. List the signs and symptoms of tuberculosis disease
8. Discuss the basic tools used to diagnose tuberculosis
9. Describe the factors that determine the infectiousness of a person with tuberculosis
10. Describe the standard treatment for latent tuberculosis infection
11. Describe the standard treatment for tuberculosis disease
12. Correctly administer a Mantoux tuberculin skin test
13. Correctly read, measure, and interpret the results of a Mantoux tuberculin skin test
14. Correctly document the results of a Mantoux tuberculin skin test

Guidelines for Writing Learning Objectives

Learning objectives should be:

1. Expressed from the learner's point of view. You are defining what you want the participant to be able to do as a result of the training, not what you, as the trainer, want to accomplish. Starting all your objectives with the phrase, "By the end of this training, participants will be able to…" will help to keep this in mind

2. Formulated using verbs that describe observable behavior:

Words to Use (Observable Behavior)		**Words to Avoid (Non-observable Behavior)**	
describe	explain	know	appreciate
define	demonstrate	comprehend	understand
list	identify	be aware of	learn
administer	measure	be familiar	consider
document	record	discern	grasp
distinguish	state	remember	recall
discuss	select	ascertain	believe

   Note: This is just a sample list. Whatever words you choose, remember that the critical issue is to communicate clearly the behavior that can be shown by the learner, so that the learner and the trainer each can assess that learning has taken place.

3. Measurable

4. Realistic and attainable

5. Specific

6. Time-framed ("By the end of this training…")

Developing an Agenda

Once you have identified the learning objectives for your training session, you need to develop an agenda (Appendix 2 *Word* *PDF*),* or program schedule, which provides an overview of the topic areas and training activities in a timetable format.

Time is a very important consideration in training. Usually you will have a limited amount of time to conduct your training. The time you have available (e.g., 3 hours versus 6 hours) makes a difference, not only in the amount of information you can present but in the types of training methods and materials you select.

Begin by considering the total time allotted to you to conduct your training; then apportion the time across the various topic areas and activities you will be including in your program, as outlined by your learning objectives. As a general rule, allocate more time to the hands-on exercise segments than to any other single area of the training. When conducting a tuberculin skin testing workshop, the exercise portion of the training is crucial. During this segment of the workshop, learners can watch demonstrations of proper skill technique on how to administer and read skin tests and then have an opportunity to practice these techniques through return demonstrations.

When you are developing your agenda, if you find that you either have too much time to fill or you do not have enough time to cover everything, you need to re-examine your learning objectives; you may need to modify your list (e.g., identify more/delete some).

On the following page, a sample outline is provided for the trainer planning to conduct a group training workshop. This outline contains very broad estimates of the time that you will have to tailor to fit your needs. The suggested time allotments will have to be modified according to:

- ✓ How much overall time you are given
- ✓ The number of participants
- ✓ What the participants' needs are
- ✓ Whether you will conduct the entire training alone or there will be other instructors who can assist you, especially during the exercise segments

*Internet connection required.

Sample Agenda

Lecture and Discussion

10–15 minutes	Welcome, Introduction, and Learning Objectives
15 minutes	Distribute, complete, and collect Pre-Test
45–60 minutes	Overview of Tuberculosis Epidemiology Transmission and Pathogenesis LTBI vs Disease Diagnosis Treatment of LTBI and TB Disease Questions and Answers
12–20 minutes	Mantoux Tuberculin Skin Test Video (You can vary how much of the video is shown)

Practicum

10–15 minutes	Demonstrating Skin Test Administration (Trainer demonstrates proper technique on participant or co-workers while learners observe)
15–30 minutes	Skin Test Administration Exercise (All participants practice on each other while being given feedback on their skills)
10–15 minutes	Demonstrating Skin Test Reading (Trainer demonstrates proper reading and measuring techniques on plastic arm; how to document)
45 minutes	Skin Test Reading Exercise (Participants practice on plastic arms and document results while receiving feedback)
15–20 minutes	Post-Test and Answers (Collect post-tests and review answers with the participants)
10 minutes	Evaluations

Remember to always allow time for:

Introductions (yours and the participants')
Overview of training and learning objectives
Pre-test
Post-test
Evaluations
Ample breaks (15 minutes for every 1½ to 2 hours)
Questions and answers

Selecting Materials for Training Sessions

You have been provided with three different types of materials or training aids to facilitate and enhance your presentation:

- ✓ **The Participant Handout *Fundamentals of TB***
  (Appendix 11 *Word* *PDF*)* This handout is for you to distribute to your participants. It provides a comprehensive overview of general knowledge on TB. Whether you will have time to cover all the topics in the manual or not, it will provide your learners with a convenient reference.

- ✓ **PowerPoint Presentation: *Fundamentals of TB***
  (Appendix 12 *PowerPoint* *PDF*)* This presentation can be used (in total or selectively) during the lecture and discussion portion of your training session.

- ✓ **Centers for Disease Control and Prevention (CDC) Visual Aid and Tools: *Mantoux Tuberculin Skin Test Training Materials Kit***
  This training kit includes a videotape, facilitator guide, and a ruler. The videotape provides a very brief overview of tuberculosis and illustrates skin test administration and interpretation. The entire tape runs about 30 minutes. You can elect to show all of it or just the part that illustrates skin testing. To order this kit click here:
  https://www2.cdc.gov/nchstp_od/piweb/tborderform.asp*

Other Materials

Other materials can be selected from the CDC Order Form, which can be downloaded at: http://www.cdc.gov/tb/pubs/tbfactsheets/orderform.pdf* as well as the CDC Tuberculosis Training and Education Resource Guide available at: http://www.cdcnpin.org/scripts/tb/guide/toc.asp.* You may also find other useful information and reference materials on the TB Education and Training Resources Web Site at www.findtbresources.org*

*Internet connection required.

Preparation Checklist

Training Facility: After you have spoken with your contact person and obtained all the necessary information, it is a good idea to visit the facility and actually see the training room in advance to determine:

- ❑ Are there enough tables and chairs (are tables bolted to the floor or can they be moved for afternoon exercise)?
- ❑ How are the acoustics in the room?
- ❑ Are there any annoying background noises or potential for interruptions?
- ❑ Are there any room obstructions such as posts or mirrors?
- ❑ Are restrooms nearby?
- ❑ Is there convenient parking?

Materials and Handouts: You can use the following list as you think through and plan all the things you need to prepare before your training workshop, by placing a check mark in the boxes next to all items you may need. This should be done in the days prior to the training.

- ❑ Copies of the participant materials (Appendix 11 *Word* *PDF*)*
- ❑ PowerPoint slides (Appendix 12 *PowerPoint* *PDF*)*
- ❑ Pre- and Post-Tests (remember to bring twice as many tests as the number of trainees and color code each set to distinguish the two tests, the Mantoux Tuberculin Skin Test (Appendix 8 *Word* *PDF*)* from Fundamentals of TB (Appendix 9 *Word* *PDF*)*)
- ❑ Training objectives (copies to distribute or present on an overhead)
- ❑ Transparency covers (for notes), if using
- ❑ Blank transparencies and transparency markers, if needed
- ❑ Copies of your Agenda to distribute, if not included in participant materials (Appendix 2 *Word* *PDF*)*
- ❑ Evaluation forms (Appendix 10 *Word* *PDF*)*
- ❑ CDC *Mantoux Tuberculin Skin Test* videotape
- ❑ Blank name badges that trainees can fill in
- ❑ Any other written material/handouts you want to provide
- ❑ Sign-in sheets (if not provided by facility requesting training, construct a simple one)

*Internet connection required.

Audio-Visual Equipment: If the facility requesting the training is not providing the following audio-visual equipment, you may need to make arrangements ahead of time to bring:

- ❑ Overhead projector
- ❑ Laptop computer & LCD projector
- ❑ Screen
- ❑ VCR and monitor/TV
- ❑ Extension cord(s)
- ❑ Microphone

Practicum Supplies

- ❑ Bottles of sterile saline (or if administering skin test on actual patients, vials of tuberculin – 5 tuberculin units (TU) purified protein derivative (PPD) solution)
- ❑ Single-dose disposable tuberculin syringes
- ❑ Alcohol swabs
- ❑ 2x2 gauze pads or cotton balls
- ❑ Puncture-resistant sharps disposal containers
- ❑ Gloves
- ❑ Hand washing agent
- ❑ Artificial arms (if using)
- ❑ Guidelines for Administering the Mantoux Tuberculin Skin Test (Appendix 3 *Word* *PDF*)*
- ❑ Guidelines for Reading the Mantoux Tuberculin Skin Test (Appendix 4 *Word* *PDF*)*
- ❑ Mantoux Tuberculin Skin Test Record Form (Appendix 5 *Word* *PDF*)*
- ❑ CDC *Mantoux Tuberculin Skin Test* videotape

On the day of the training, it is a good idea to arrive an hour early so that you can set up and test all the equipment you will be using, arrange the furniture if needed, lay out sign-in sheets, and take care of any other details.

*Internet connection required.

Planning and Conducting a Practicum

A practicum is a "hands-on" opportunity for participants to apply the skills that they have been taught in a training course. After providing the lecture portion on tuberculosis fundamentals and Mantoux tuberculin skin testing, it is important for participants to perform the learned skills. The practicum, described here, consists of administration of the Mantoux tuberculin skin test and reading the results of that test.

It is essential that the individual conducting the practicum be proficient in skin testing in order to teach, demonstrate, and evaluate the learners in an effective manner. Depending on the number of participants, the more instructors there are available, the better. Generally, the ratio for training should be 1 instructor to 6 participants. Instructors should be able to present and answer a variety of questions related to skin testing under many circumstances.

Skin Test Administration

Prior to conducting the practicum, you will need to obtain the supplies listed under "Practicum Supplies" on the previous page. The amount of supplies needed is based on the number of participants in your training workshop.

As a first activity in the practicum, the group should watch the videotape from the CDC *Mantoux Tuberculin Skin Test Training Materials Kit*. This tape provides an overview of tuberculosis, the method of administration, and reading and interpretation of the skin test. After viewing the tape, you should invite any questions before proceeding to the next activity.

The following steps provide you with an overview of the demonstration and administration of the Mantoux tuberculin skin test. It highlights both the instructor and participants' activities.

1. The participants should gather around a table. If there are more than 6 participants, additional stations for demonstration should be set up to provide ideal viewing for all.

2. The instructor should choose either a colleague or a participant at the table to demonstrate skin test administration.

3. The instructor should follow the steps of the "Guidelines for Administering the Mantoux Tuberculin Skin Test" exactly and talk through each point while completing it (Appendix 3 *Word* *PDF*).* The procedure should be done slowly so that all participants can see the process as each step occurs. Before and after skin test is administered, the instructor should also demonstrate techniques for providing patient education on the following: purpose of the skin test, what is involved in the procedure, instructions on how to care for the injection site, and when to come back for the reading.

4. After the demonstration is complete, the instructor should invite any questions.

5. The participants should be grouped into pairs. Participants should be informed in advance that they will be practicing administration of the skin test on each other's arms.

*Internet connection required.

6. Each pair will administer the skin test under the supervision of an instructor. As participants await their turn, they can either observe as others administer skin tests or move on to the reading practicum.

7. The instructor should observe the pairs perform the skin test on each other's arms. After administering the tests, the participants should also complete the "Mantoux Tuberculin Skin Test Record Form," to become accustomed to the proper documentation of skin test results (Appendix 5 *Word* *PDF*).*

8. In evaluating participants' skills, the instructor may use the "Skills Assessment for Administering the Mantoux Tuberculin Skin Test" (Appendix 6 *Word* *PDF*).*

Skin Test Reading

You will require the following supplies prior to the skin test reading practicum, the amount of supplies depends on the number of participants in your training workshop:

- ✓ Flexible plastic rulers (can be ordered at https://www2.cdc.gov/nchstp_od/piweb/tborderform.asp)*
- ✓ Artificial arms** (can be ordered at http://www.healthylungs.org/programs_services/infectious/TBArms.htm, https://www.healthedco.com/servlet/ProductList?sq=seqHealth%2FWellness%26teqModels-Training, http://www.enasco.com/top/272/Intradermal)*
- ✓ Signs for labeling arms
- ✓ Forms for reading answers

You should have participants in the skin test practicum complete the following steps:

1. The plastic skin test demonstration arms should be set up on a table in a row, with labels in front of each arm (e.g., if there are 4 different arms, each arm should have a sign in front of it marked A, B, C, or D).

2. The instructor should follow the steps of the "Guidelines for Reading the Mantoux Tuberculin Skin Test" exactly and talk through each point while completing it (Appendix 4 *Word* *PDF*).* Although the participants may not be able to complete some steps of the skin test reading process, it is important to discuss each point. For example, the artificial arms are not ideal for reading and interpretation since they are not real arms and cannot be marked. The procedure should be done slowly so that all participants can see the process as each step occurs.

*Internet connection required.
**The artificial arms are not an ideal simulation tool for reading and interpretation as they do not feel like real arms and cannot be marked. However, they are a good substitute for real indurations, erythema, and bruising. The arms come in full length or as sections.

3. After the demonstration is complete, the instructor should invite any questions.

4. Each participant should then get a worksheet with space for recording readings for the induration on each arm. The sheets appearance will depend on how many arms are available for reading. For example, if you are using 2 arms, each with 4 indurations labeled with signs A and B, the sheet should look like the following:

> **Arm A**
> Starting from wrist to elbow (1-4) for full arms or top to bottom (1-4) for arm sections:
> 1. _____ mm (nearest to wrist)
> 2. _____ mm
> 3. _____ mm
> 4. _____ mm (nearest to elbow)
>
> **Arm B**
> Starting from wrist to elbow (1-4) for full arms or top to bottom (1-4) for arm sections:
> 1. _____ mm (nearest to wrist)
> 2. _____ mm
> 3. _____ mm
> 4. _____ mm (nearest to elbow)

5. Participants can take turns reading indurations on each arm and recording the answers. The instructor should observe the reading techniques of the participants and provide feedback as needed.

6. The instructor should have a copy of the answers (the measurements of the indurations, which accompany the arms upon purchase). Students can check their answers and should go back and recheck any answers they have written that are incorrect by 2 millimeters or more. The instructor should provide guidance in this case.

7. In evaluating participants' skills, the instructor may use the "Skills Assessment for Administering the Mantoux Tuberculin Skin Test" (Appendix 6 *Word* *PDF*)* and the "Skills Assessment for Reading the Mantoux Tuberculin Skin Test" (Appendix 7 *Word* *PDF*)* to evaluate the overall skills of participants for administration and measurement.

*Internet connection required.

Developing Test Questions

To have some idea of how much your participants actually learned during the training, you need a way to:

- ✓ Measure how much they know before the training
- ✓ Compare pre-training knowledge to how much they know after the training

The simplest way to do this is to develop a set of questions that addresses the topics you will cover. The same set of questions is administered to the participants both before and after the training. The difference between these two measures (assuming of course, more was known after training) is a gauge of how much was assimilated as a result of the training. Having a pre-and post-test is an important tool for assessing the overall effectiveness of your program.

Selecting/Constructing Questions

The questions that make up the test should reflect and correspond to the knowledge areas stated in your learning objectives. You need to ensure that the answer to every question on the test will be covered at some point in your training program. This is especially important to keep in mind if you are using a pre-designed test. You are provided with two sample tests in this section.

- ✓ The first sample test is entitled Mantoux Tuberculin Skin Test Pre- and Post-Test (Appendix 8 *Word* *PDF*).* It consists of 9 questions, all of which pertain only to skin testing.
- ✓ The second sample test is entitled Fundamentals of TB Pre- and Post-Test (Appendix 9 *Word* *PDF*).* It consists of 10 general knowledge questions about TB.

For your questions to cover both fundamentals of TB and skin testing knowledge, you will have to construct your own test by selecting questions from both sample tests. Generally speaking, your test should consist of no more than 15 to 20 questions. Multiple choice questions are the easiest to grade and the most objective to measure.

*Internet connection required.

Developing an Evaluation

A training evaluation is a summary of information that you gather from your learners about the effectiveness of your training session. The primary purpose for gathering this information is to help you evaluate whether the training has accomplished its objectives. It also helps you identify weak elements of the program and decide how to modify your approaches/materials to make them more effective for future training.

Although this is an often overlooked aspect of training programs, there are a number of benefits to be derived from incorporating an evaluation component. Based on the feedback you obtain during the evaluation of a training program, you are able to make judgments about:

- ✓ How well the training met each of the objectives
- ✓ Whether the training methods and materials helped the learners achieve the learning objectives
- ✓ How effective were the speaker(s)
- ✓ How useful the learners found the training to their job performance and responsibilities

In this section, you are provided with a general evaluation form (Appendix 10 *Word* *PDF*)* that you can photocopy and use "as is" (just write in the date of the training) or modify to suit your own needs. The first question on this form asks whether the objectives (collectively) were clearly stated and achieved. However, you might want to consider designing your own form that allows learners to evaluate each objective as you stated them. For example:

Circle how well each learning objective was met during this training using the scale below.
1 = Thoroughly 2 = Somewhat 3 = Not at all

1. Describe how TB is spread	1	2	3
2. Explain the pathogenesis of TB	1	2	3
3. Correctly administer the Mantoux tuberculin skin test	1	2	3
4. (Objective #4, and so on for each objective you identified)	1	2	3

One other modification to the sample evaluation form that you might want to consider is in the case of more than one speaker or activity facilitator. In this situation, you should provide a way for participants to evaluate each speaker/facilitator. For example:

Please rate each of the speakers/facilitators using the scale below. In determining your overall rating, consider his/her skills, knowledge, ability to answer questions and general effectiveness.

	4 = Excellent	3 = Good	2 = Fair	1 = Poor
Speaker # 1 (name)	4	3	2	1
Speaker # 2 (name)	4	3	2	1

*Internet connection required.

Techniques and Strategies for the Facilitator

In many training sessions, facilitators are asked a wide variety of questions. The questions may range from the usual content-oriented questions to questions very specific to a situation in which the participant was involved. Participants frequently ask questions during breaks, before or after the sessions, or during the session itself. Facilitators should not only expect, but also encourage questions because this is a primary method of learning.

Responding to Questions

A key to properly responding to questions is to ensure that the adult learner is free to ask them. This is usually accomplished when the learning environment is informal and relaxed, creating a climate that actively encourages questions. A fruitful learning environment is one in which consideration is given to the physical needs of the learner. These surroundings must be suited to the physical needs (e.g., the furniture is comfortable, the heating and lighting are adequate, and the training facility is inviting). This is an often ignored, but key aspect, of the training in a group setting. If your learners are jammed into a space, cannot get comfortable, or having trouble hearing, they are probably not going to be attentive, let alone ask pertinent questions. A physically comfortable environment is one that would freely encourage questioning. Provide some refreshments, if possible. (When providing training at a requesting facility, ask the contact person if this can be provided.)

Additionally, the facilitator's nonverbal messages are important when encouraging questions. Even when the physical environment is inviting and the facilitator verbally encourages questions, the way in which he/she reacts whenever a question is asked may influence the participants' willingness to ask questions. For example, if the facilitator glares or scowls whenever a question is asked, the message will be sent that questions are, in fact, not welcome. Pointing should be avoided as it tends to single out the learner and may cause embarrassment. The facilitator who stands next to seated learners may find that questions are not being asked because this position psychologically creates a situation in which the learners may feel intimidated as they "look up" to the teacher. Regardless of the intent, if a participant feels intimidated, for any reason, it is unlikely that he/she will ask questions.

To promote discussion, a facilitator may ask "Are there any questions?" Usually, he or she will wait a second or two and go on when no questions are asked. However, two strategies based on knowledge of adult development have proven successful for the facilitator who really wants to have questions asked by group members.

- ✓ First, be patient. After asking "Are there any questions?" wait a few more seconds before assuming there are no questions. Adults frequently take a bit longer to develop their thoughts and think out how they want to word them, rather than blurt out a question that may make them look foolish. Give them the additional time needed to develop their thoughts into a question.

- ✓ Second, assist the learner to develop a question by providing specific direction when asking for questions. An example might be to ask, "Are there any questions about how to use the ruler when measuring a skin test reaction?" rather than "Are there any questions about skin testing?"

There are several other strategies that can be used when responding to questions, including being honest and up front with the participants in your training. There are many times when you may be asked a question to which you may not know the answer. Be honest, and admit it. Take advantage of the experience of those in the group who can help. This will show the participants that you are human and do not pretend to know everything. Another successful technique is to focus on the sharing of ideas and information rather than on lecturing. This technique requires learners to determine for themselves how to use the ideas or information.

Giving feedback is yet another way the facilitator can provide useful responses to questions. Focus feedback on the exploration of alternatives rather than on answers and solutions. Also, focus feedback on the amount of information the person receiving it can use, rather than on the amount of information you have to give. Finally, focus feedback on the practical application it might have for the learner, not on the value it provides to you as the facilitator.

It is not always necessary to answer every question. An effective trainer will use a variety of indirect ways of responding to a question. This varies participant interaction and prevents the facilitator from becoming boring or predictable. The following are some additional ways of responding to questions:

Redirect

This means posing the question to another member in the group. Used carefully, the facilitator increases learner interaction because this technique involves more group members; however, it should not be used as a cover-up for lack of knowledge. Adult learners will soon realize that you do not know the subject and are using the technique to gloss over your lack of knowledge. When redirecting, the facilitator runs the risk of embarrassing a group member if the person to whom the question is redirected does not know the answer. Careful consideration of the group members can avoid this.

Probe

This means answering the question with a question. The purpose is to probe for a deeper meaning than is apparent in the question.

Repeat the Question

When working with older adults or a large group, it is a good idea for you to repeat any question. This can become irritating, however, if done habitually, because it assumes that everyone has not heard the question and that it needs to be repeated. This may not be so. It might also discourage learners from listening if they know the question will always be repeated. A variation of this technique is for a participant to repeat it.

Paraphrase

This is a variation of repeating the question. The facilitator rephrases the question to help clarify a point being made by the learner. Through clarifying, a more precise response can be provided.

Postpone a Response

> Not every question needs to be answered at the time it is asked. To do so may unnecessarily break the flow of a presentation. The question should be acknowledged and the questioner told that the inquiry will be addressed later. If this is said, the facilitator needs to write down the point or otherwise remember to come back to it.

Facilitators should react to questions in a positive manner. This may include praising the questioner for a particularly good or thoughtful question or referring to the question again later in the presentation. These techniques demonstrate that questions are valued and that the questioner will not be embarrassed.

By using these techniques and strategies, you will not only be able to field a variety of questions, but will also be able to tap into the experience of the participants, thereby adding to the richness of responses.

Adapted from Rossman, Mark H., et al. *Teaching and Learning Basic Skills: A Guide for Adult Basic Education and Development Education Programs*. New York: Teachers College Press, Columbia University, 1984. p. 69-74.

Conducting One-on-One Training

One of the most effective methods of conducting training about skin testing is to do a one-on-one demonstration, followed by the trainee being observed in his/her own demonstration. This process provides individualized attention for completing the proper techniques of skin testing and enables the health care worker who is being trained to have any questions answered personally.

Setting Up the Training Session

Various types of health care workers may be referred to you for skin test training. They may come from nursing homes, correctional facilities, schools, health departments, or may be people with whom you work. If a health care worker is referred to you for skin test training, follow the steps below to ensure the best learning experience:

1. Record the person's contact information (name, phone number, and address).

2. Set up an appointment with the health care worker to come to your TB clinic or employee health setting for skin test training. It would be wise to choose a day in which there are one or more patients scheduled for skin test administration, and reading and interpretation. This will allow the trainee to get some first-hand practice in all aspects of the skin testing process.

3. Mail the health care worker a photocopy of the handout called "Fundamentals of Tuberculosis" (Appendix 11 *Word* *PDF*),* which gives basic information on TB and Mantoux tuberculin skin testing. Also, send a copy of the "Guidelines for Administering the Mantoux Tuberculin Skin Test" (Appendix 3 *Word* *PDF*)* and "Guidelines for Reading the Mantoux Tuberculin Skin Test" (Appendix 4 *Word* *PDF*).* Instruct the trainee to become familiar with these materials ahead of time, so he/she can be prepared for the skin testing instruction. Also, send clear directions to your clinic site and where to find you.

4. On the day the individual arrives at your clinic, show him/her the video tape from the *Mantoux Tuberculin Skin Test Training Materials Kit*. This tape has a concise explanation and demonstration of the steps for skin testing and measurement. If you do not have a VCR available at your site, you may offer to send the health care worker the tape so that he/she can view it ahead of time and return it on the day he/she arrives at your clinic. If this is not at all possible, you will have to merely demonstrate the technique without the benefit of viewing the tape.

5. You will require supplies (listed under Practicum Supplies on page 13) prior to the demonstration.

*Internet connection required.

Demonstration of Skin Test Administration

1. You should find a co-worker who is willing to have the skin test administered on him/her using sterile saline. This will give the health care worker a good vantage point for the demonstration. If no one is available, the test can be administered on the health care worker who is being trained. Demonstration on actual patients is also acceptable (provided you have obtained their consent), in which case you can use the purified protein derivative (PPD) solution as you normally would.

2. You should follow the steps of the "Guidelines for Administering the Mantoux Tuberculin Skin Test" (Appendix 3 *Word* *PDF*)* exactly, and talk through each point while completing the skin test. The procedure should be done slowly so that the trainee can see the process as each step occurs. Before and after skin testing is complete, you should provide patient education on the purpose of the skin test, instructions on how to care for the injection site and when to come back for reading. If the skin test is not being administered on an actual patient, the patient education exercise can be simulated with a co-worker. It is also important for the person administering the skin test to encourage the patient to talk about any anxieties he/she may have about the test to ease these fears.

3. After the demonstration is complete, you should follow proper hand washing and recording procedures. It is important to note that recording (e.g., writing down the name of the person administering the skin test, the date, time, arm of placement, etc.) is just as important as administering the skin test, as the whole process is incomplete without this information.

4. The health care worker should repeat the demonstration on you or a third party, if available.

5. As the health care worker completes the skin test, you should observe the process by using the "Skills Assessment for Administering the Mantoux Tuberculin Skin Test" (Appendix 6 *Word* *PDF*).* Feedback should be provided both during and after the process.

Demonstration of Skin Test Reading

1. If time allows, you should read the arm(s) of available patients and interpret the skin test results. This will allow you to demonstrate proper measurement and interpretation technique to the health care worker. Other alternatives would be to measure an induration on an artificial arm (see page 15 for order information) and interpret the reading or watch part two of the Mantoux Tuberculin Skin Test video tape: Reading the Mantoux Tuberculin Skin Test. The benefit of the video tape alternative is that you can stop the video at intervals and answer questions or explain the process in more detail to the health care worker.

2. You should follow the steps of the "Guidelines for Reading the Mantoux Tuberculin Skin Test" (Appendix 4 *Word* *PDF*)* exactly, and talk through each point while completing

*Internet connection required.

the skin test measurement on the co-worker or artificial arm. The procedure should be done slowly so that the trainee can see the process as each step occurs. Before and after the skin test measurement is complete, patients should be provided with education on the result of the skin test and its meaning (e.g., what their reaction to the skin test means and reinforcement of information that was previously explained). If you are not demonstrating the reading on an actual patient, you can practice providing patient education with the health care worker. Explain to the health care worker that, in reality, you may need to provide additional information to the patient on follow-up evaluations and/or testing.

3. After the demonstration is complete, you should invite any questions.

4. Immediately after the induration is measured, the exact measurement in millimeters of induration should be recorded on the results section of the "Mantoux Tuberculin Skin Test Record Form" (Appendix 5 *Word* *PDF*).* The corresponding interpretation of "positive" or "negative" should also be recorded along with any adverse reactions (e.g., blistering, redness, swelling) to the skin test. Explain how the reaction is classified and factors that can affect how the reaction is interpreted.

5. The health care worker should repeat the measurement demonstration on another patient or artificial arm if available. NOTE: If no other patient is available, the same patient can be used. In this case, you should not share the skin test measurement that is received through the demonstration with the trainee until the return demonstration is complete.

6. As the health care worker completes the measurement, you should observe the process by using the "Skills Assessment for Reading the Mantoux Tuberculin Skin Test" (Appendix 7 *Word* *PDF*)* to evaluate administration and measurement skills. Feedback should be provided both during and after the process.

*Internet connection required.

Resources

Mantoux Tuberculin Skin Testing Rulers, Wall Chart, Video
Centers for Disease Control and Prevention
Office of Communications, NCHSTP
Toll Free: (888) 232-3228
Fax: (404) 639-2857
http://www.cdc.gov/tb/pubs/TBfactsheets/orderform.pdf
http://www2.cdc.gov/nchstp_od/piweb/tborderform.asp

"See-and-Touch" Arms**
Available in full length (Asian/Pacific Islander, Black, Hispanic, White)
American Respiratory Alliance of Western Pennsylvania
Telephone: (724) 772-1750
Toll Free: (800) 220-1990
Fax: (724) 772-1180
http://www.healthylungs.org/programs_services/infectious/TBArms.htm*

"Biolike TB Testing Arm Set"**
Health Edco
Telephone: (254) 776-6461 ext. 295
Toll Free: (800) 299-3366 ext. 295
Fax: (888) 977-7653 or (254) 776-1428
https://www.healthedco.com/servlet/ProductList?sq=seqHealth%2FWellness%26teqModels-Training*

Life/form®Intradermal Injection Simulator**
NASCO
Telephone: (800) 558-9595
Fax: (920) 863-8296
http://www.enasco.com/top/272/Intradermal/

Francis J. Curry National Tuberculosis Center
Tuberculin Skin Testing: Tools for Trainers
http://www.nationaltbcenter.edu*

*Internet connection required.

**The NJMS Global Tuberculosis Institute does not endorse these products but lists them for information purposes only.

Appendix 1 – Needs Assessment Form

The following survey will help develop and focus the content of the training entitled _____ in a way that best meets the learning needs of the participants. Please complete this form and return to _____ by ___/___/___. **The date, time, and location of the training will be announced at a later time**.

Please rate your level of expertise in the areas listed below.

Topic	Expertise No Expertise 1 2 3 4 5 High Expertise
Epidemiology/Etiology of TB	1 2 3 4 5
Transmission of TB	1 2 3 4 5
Pathogenesis of TB	1 2 3 4 5
Targeted Skin Testing	1 2 3 4 5
Treating Latent TB Infection	1 2 3 4 5
Diagnosis of TB	1 2 3 4 5
Treatment of TB Disease	1 2 3 4 5
BCG Vaccine	1 2 3 4 5
Mantoux TST Administration	1 2 3 4 5
Mantoux TST Reading and Interpretation	1 2 3 4 5

TB = Tuberculosis
BCG = bacille Calmette-Guérin
TST = Tuberculin Skin Test

Please feel free to make any additional comments in the space below.

Appendix 2 – Agenda

Date: _____

8:00 am – 9:00 am	Registration and Breakfast
9:00 am – 9:15 am	Welcome, Introduction, and Learning Objectives
9:15 am – 9:45 am	Mantoux Tuberculin Skin Test Pre-Test
9:45 am – 10:00 am	Fundamentals of TB Pre-Test
10:00 am – 11:00 am	Overview of TB
11:00 am – 11:30 am	Mantoux Tuberculin Skin Test Video
11:30 am – 12:00 pm	Questions
12:00 pm – 1:00 pm	Lunch
1:00 pm – 1:15 pm	Demonstration of Skin Test Administration
1:15 pm – 2:00 pm	Skin Test Administration Exercise
2:00 pm – 2:15 pm	Demonstration of Skin Test Reading
2:15 pm – 3:00 pm	Skin Test Reading Exercise
3:00 pm – 3:15 pm	Questions
3:15 pm – 3:30 pm	Post-Test and Review of Answers
3:30 pm – 3:45 pm	Evaluation
3:45 pm – 4:00 pm	Closing Remarks/Adjourn

Appendix 3 – Guidelines for Administering the Mantoux Tuberculin Skin Test

Supplies
- Vial of tuberculin – 5 tuberculin units (TU) purified protein derivative (PPD) solution
- Single-dose disposable tuberculin syringe
- 2x2 gauze pads or cotton balls
- Alcohol swabs
- Puncture-resistant sharps disposal container
- Mantoux Tuberculin Skin Test Record Form
- Appointment cards
- Gloves

Preparation
- Purified protein derivative (PPD) solution must be kept refrigerated at 36-46˚ F
- To avoid fluctuations in temperature, do not store on the refrigerator door
- Read the vial label to ensure that the correct solution and tuberculin unit (TU) strength have been selected
- Check the expiration date and the date that the vial was opened. The vial should be discarded if it has been open for more than 30 days or the expiration date has passed. Date and initial the label when a new vial is opened
- Select a well-lighted area for administering the test. Have all the equipment and supplies on hand
- Introduce yourself to the patient
- Verify that the correct patient receives the test
- Ask the patient if he/she has any allergies
- Review the patient's tuberculin skin test history. Inquire about documentation of previous tuberculin skin test results
- Provide patient education to answer questions, address fears, and ease anxieties. Discuss the purpose of the test, testing procedure, and the time frame for returning to have the test read. If the patient cannot return 48-72 hours after the test to have the induration measured and evaluated, do not administer the test. Instead, schedule another time that is more convenient for the patient

Administration of Skin Test (Syringes must be filled immediately prior to administration)
- Wash your hands
- On a firm, well-lighted surface, expose the patient's arm and slightly flex at the elbow. The injection should be replaced on the palm-side-up surface of the forearm, about 2 to 4 inches below the elbow. Avoid areas of skin with veins, sores, rashes, scars, or excess hair
- Put on gloves
- Clean the injection site with an alcohol swab, using circular motion beginning in the center and working your way outward. Allow the site to dry completely before injection
- Wipe the top of the vial with a new alcohol swab and allow it to dry thoroughly
- Fasten the needle tightly on the syringe by holding the cap and twisting it onto the tip of the syringe. Remove the needle cap and make sure that the needle bevel is facing up
- Hold vial between your thumb and fingers and insert the needle through the stopper. Inject air into the empty space, not the solution, in the vial
- Invert the vial. With the tip of the needle below the fluid level in the vial, draw out slightly more than 0.1 mL of solution

- Remove the needle from the vial. Hold the syringe in an upright position and gently tap the syringe to break up any air bubbles
- Expel all air from the syringe and excess solution from the needle, leaving exactly 0.1 mL of tuberculin solution in the syringe
- Stretch the skin taut over the injection site to provide a surface that is easy for the needle to penetrate. This can be accomplished by stretching the skin between the thumb and index finger or grasping the patient's forearm and gently pulling the skin from under the arm
- Hold the syringe between your thumb and index finger with the needle bevel facing up and the syringe parallel to the forearm
- With the needle against the patient's skin, insert the needle slowly at a 5- to 15-degree angle, just below the surface of the skin (you should be able to see the bevel of the needle just below the skin surface)
- Release the stretched skin and hold the syringe in place. Slowly inject the tuberculin solution, forming a 6 to 10 mm wheal (pale, raised area with distinct edges; has orange peel appearance and does not disappear immediately)
- If no wheal forms or if it is less than 6 mm in diameter, repeat the test approximately 2 inches from the original site or on the opposite arm
- Remove the needle without massaging or pressing the area and immediately discard the used syringe in the sharps container
- If minor bleeding occurs, use a 2x2 gauze pad or cotton ball to dab the injection site
- Do not cover the site with an adhesive bandage as it could cause irritation
- Wash your hands
- Record the following information on the record-keeping form: the date, time, location of injection site, name of manufacturer, lot number, and expiration date of PPD solution, name of person administering the skin test
- Inform the patient that mild itching, swelling, or irritation is normal and usually goes away within 1 week
- Explain how to care for the injection site: avoid scratching the site, keep the site clean and dry, and avoid creams, lotions, or adhesive bandages
- Inform the patient that it is important to return within 48 to 72 hours to have the test result read
- Give the patient a written appointment to return for the skin test reading

Appendix 4 – Guidelines for Reading the Mantoux Tuberculin Skin Test

NOTE: The results of the skin test must be read by a trained health care worker 48 to 72 hours from the time the test was administered. (Results reported as "positive" or "negative" are **not** acceptable.)

Supplies
- Small, plastic, flexible ruler marked in millimeters
- Ball point pen to mark edges of the induration
- Alcohol pad to clean off pen marks
- Mantoux Tuberculin Skin Test Record Form
- Patient education materials

Preparation
- Verify that the correct patient has returned for TST reading
- Explain the procedure to the patient to put him/her at ease
- Wash your hands
- Make the patient feel at ease with his/her arm in a relaxed position

Inspect for site
- Inspect the arm in good light and on a firm surface
- Locate the site of injection on the palm-side-up surface of the forearm with the patient's arm supported and slightly flexed at the elbow

Palpate
- Keep your fingernails short enough so they do not extend beyond the fingertip
- Since the induration is not always visible, you must rely on palpation with your fingertips to determine induration at the injection site
- Touch the area lightly with the pads of your fingertips
- Lightly sweep your fingertips in 2-inch diameters from the injection site in all four directions to locate the edges of the induration
- Use a zig-zag, feather-like touch to palpate the area for margins of induration. Be careful not to confuse a margin of induration with a margin of muscle on the forearm. To check this, repeat the palpation with the patient's arm raised to a 45-degree angle.

Mark
- Hold your palm over the injection site with your fingertips at the outer edge of the patient's forearm
- Without lifting, move your fingertips from the outer edge towards the induration
- Rest one fingertip firmly against the induration margin on one side before marking the margin. The fingertip should remain in contact with the skin at all times
- Use a ball point pen to mark lightly with a fine dot at the widest edge of the induration
- Repeat the procedure from the other side of the patient's forearm and place the second mark on the margin of induration
- Palpate again, repeating finger movements toward the injection site, to ensure that the induration was marked correctly and adjust the dots if necessary
- If the margins are not equally clear all the way around the induration, it is still necessary to mark the margins on each side of the induration. For irregular margins of induration, mark and measure the longest diameter across the forearm

Measure

- Measure only the area of induration, a hard, dense, raised formation
- Do not measure erythema, reddening of the skin that can also have swelling
- Use the millimeter ruler to measure the diameter of the induration perpendicular to the long axis of the forearm
- Place the zero ruler line inside the left dot edge and read the ruler line inside the right dot edge
- If the measurement falls between the two divisions on the millimeter scale, record the lower mark. If unsure, ask a co-worker
  Note: Reactions to the tuberculin skin test at the injection site will vary. If there is blistering, palpate the induration gently as it may be painful. Measure only the induration. Only the margins of the induration are significant, redness and swelling should not be measured

Record

- Record the exact measurement in millimeters of induration on the Mantoux Tuberculin Skin Test Record Form. Do not record the interpretation of the results as "positive" or "negative."
- Record the date and time the test was read, the name and signature of the person who read the skin test, and the presence or absence of adverse effects (i.e., blistering, redness, and swelling)
- If there is no induration, this measurement should be recorded as 0 mm of induration
- Become familiar with the interpretation guidelines for your facility

Educate

- Explain the significance of a positive skin test. For example, a positive skin test result means latent infection with the TB germ. A negative skin test result means there is no TB infection
- Direct the patient for follow-up (chest x-ray if skin test result is positive), if necessary
- Answer the patient's questions
- Provide culturally and linguistically appropriate educational materials and documentation to the patient

Note: If doing two-step testing, explain to patient the reason for doing so prior to administering the skin test. Additionally, if the first skin test result is negative, explain the significance of this result and the need for administering a second test.

Appendix 5 – Mantoux Tuberculin Skin Test Record Form

Patient Information

Name: _____

Address: _____

City/Town: _____ State: _____ Zip: _____

Telephone: _____ _____
Home Work

Skin Test Information

Administrator Name: _____

Date/time Administered: _____

Arm on which Administered: _____

Manufacturer of PPD Solution: _____

Expiration Date of PPD Solution: _____

Lot #: _____

Results

Induration: _____mm Date/time of Reading: _____

Comments and Adverse Reaction(s), if any*: _____

_____

Name of Reader: _____

Signature: _____

* It is very unlikely that a side effect to the test will occur. If such an event does happen, the most common reaction is pain or redness at the test site. In very rare cases, a person who is hypersensitive to the solution could have a severe allergic reaction near the injection site. Such rare reactions may include blistering or a skin wound.

Appendix 6 – Skills Assessment for Administering the Mantoux Tuberculin Skin Test

Scoring System

4 = Observed successful in completing **without preceptor coaching**

3 = Observed with **minimal guidance** from preceptor

2 = Observed completion with assistance from preceptor, **improvement needed**

1 = Observed **unable to complete** independently

0 = Not observed

_____
Score

_____
Trainee Date

_____
Instructor Date

Comments:

Name of Trainee: _____ Date: _____
Name of Instructor: _____

The trainee will demonstrate the following skills involved in correctly administering a Mantoux tuberculin skin test:

	Checklist
1. Selects a well-lighted area for testing	_____
2. Prepares the necessary equipment and supplies	_____
3. Reads vial label (check solution and TU strength) as it is removed from the refrigerator	_____
4. Inspects vial for expiration date and date the vial was opened. If new vial is opened, writes date and initials on label	_____
5. Correctly identifies the patient/introduces him/herself	_____
6. Determines the patient's tuberculin skin test history	_____
7. Asks the patient about allergies	_____
8. Provides patient education	_____
9. Washes his/her hands	_____
10. Positions the patient's arm correctly	_____
11. Chooses the correct injection site	_____
12. Puts on gloves	_____
13. Cleanses the injection site using circular motion and allows it dry thoroughly before inserting needle	_____
14. Cleans the top of the vial and allows it to completely	_____
15. Fastens the needle tightly on the syringe	
16. Injects air into the empty space (not solution) in vial	_____
17. Withdraws the correct amount of tuberculin solution (slightly more than 0.1 mL)	_____
18. Gently taps the syringe to remove any air bubbles	_____

Checklist

19. Expels all air from the syringe and excess solution from needle, leaving exactly 0.1mL solution in the syringe _____

20. Stretches the skin taut over the injection site _____

21. Inserts the needle at a proper angle for the intradermal injection (bevel of needle is up) _____

22. Slowly injects the tuberculin solution forming a wheal of 6 to 10 mm _____

23. Removes needle without massaging or pressing the area _____

24. If minor bleeding occurs, dabs injection site gently with cotton ball, swab, or dry gauze pad (does not cover site with adhesive bandage) _____

25. Discards used syringe in sharps container _____

26. Washes his/her hands _____

27. Records on the appropriate form the date, time, location of injection site, name of manufacturer, lot number, and expiration date of PPD solution and name of person administering the test _____

28. Instructs patient on how to care for injection site and explains normal reactions to skin test _____

29. Informs patient about importance of returning within 48-72 hours to have test result read _____

30. Gives patient written appointment to return for skin test reading _____

Comments: _____
_____
_____
_____
_____
_____

Appendix 7 – Skills Assessment for Reading the Mantoux Tuberculin Skin Test

Scoring System

4 = Observed successful in completing **without preceptor coaching**

3 = Observed with **minimal guidance** from preceptor

2 = Observed completion with assistance from preceptor, **improvement needed**

1 = Observed **unable to complete** independently

0 = Not observed

_____
Score

_____
Trainee Date

_____
Instructor Date

Comments:

Name of Trainee: _____ Date: _____
Name of Instructor: _____

The trainee will demonstrate the following skills involved in correctly reading and measuring a Mantoux tuberculin skin test:

Checklist

1. Has the necessary supplies on hand _____

2. Correctly identifies the patient and introduces him/herself _____

3. Explains the procedure to the patient _____

4. Washes his/her hands _____

5. Inspects the patient's arm in good light and on a firm surface _____

6. Locates the site of injection with the patient's forearm supported and slightly flexed at the elbow _____

7. Has fingernails shorter than fingertips _____

8. Touches the area lightly with pads of fingertips _____

9. Lightly sweeps fingertips in 2-in diameters from injection site in all 4 directions to locate edges of induration _____

10. Uses a zig-zag, feather-like touch to palpate for induration margins _____

11. Repeats the palpation with the patient's arm raised at a 45-degree angle _____

12. Holds his/her palm over the injection site with fingertips at the outer edge of the patient's forearm _____

13. Moves fingertips towards the injection site without lifting _____

14. Locates the induration with fingertip resting firmly against the induration margin _____

15. Uses a ball point pen to lightly mark the widest edge of the induration with a fine dot _____

16. Locates the induration margin on the other side of the patient's forearm and places the second mark on the margin of induration _____

17. Palpates again, repeating finger movements toward the injection site, and adjusts the dots if necessary _____

Checklist

18. Uses a millimeter ruler to measure the diameter of induration perpendicular to the long axis of the forearm _____

19. Measures only the induration, not erythema _____

20. Places the zero ruler line inside the left dot edge _____

21. Reads the ruler line inside the right dot edge _____

22. Correctly records the exact measurement in millimeters of induration on the Mantoux Tuberculin Skin Test Record Form _____

23. Records the date and time the test was read, the name and signature of person who read the test, and the presence or absence of adverse reactions (i.e., blistering, redness, swelling) _____

24. Explains the significance of a positive or negative skin test result to the patient _____

25. Answers the patient's questions _____

26. Directs the patient for follow-up, if necessary _____

27. Provides documentation, copy of Mantoux Tuberculin Skin Test Record Form, to patient and explains importance of retaining this information _____

28. Provides culturally and linguistically appropriate educational materials to patient _____

Comments: _____
_____
_____
_____
_____
_____
_____

Appendix 8 - Mantoux Tuberculin Skin Test Pre- and Post-Test

Circle the correct letter for each answer. Each question has only one answer (unless otherwise indicated).

Please check to indicate whether this is a:

_____Pre-Test **_____Post-Test**

1. The correct amount of PPD antigen to use in a tuberculin skin test is:
a. .05 mL of 5 tuberculin units
b. 0.1 mL of 5 tuberculin units
c. 0.5 mL of 5 tuberculin units
d. 1 mL of 5 tuberculin units

2. A Mantoux tuberculin skin test is administered:
a. intermuscularly
b. intradermally
c. subcutaneously
d. by scratching the skin

3. A positive skin test means a patient:
a. probably has TB disease
b. probably has TB infection
c. has TB and is infectious
d. is allergic to PPD solution

4. A skin test should be read at:
a. 24 to 48 hours (1 to 2 days)
b. 48 hours (2 days)
c. 48 to 72 hours (2 to 3 days)
d. any time up to a week

5. If a patient fails to show up for the scheduled reading, a positive reaction may still be measurable for how long after testing?
a. 7 days
b. 10 days
c. 14 days
d. none of the above

6. When placing the skin test, it is important to record the:
a. date
b. administrator
c. arm of placement
d. lot # and expiration date of PPD solution
e. all of the above

7. A tuberculin reaction of 5 mm is positive in:
a. Persons known to have or suspected of having HIV infection
b. Close contacts of a person with infectious TB
c. Persons who have a chest X-Ray suggestive of previous TB
d. All of the above

8. Which patients described below have a positive tuberculin skin test reaction? *Check all correct* ***answers***.

_____ Mr. West, 36 years old, with HIV infection, 8 mm induration

_____ Ms. Hernandez, 26 years old, native of Mexico, 7 mm induration

_____ Ms. Jones, 56 years old, has diabetes, 12 mm induration

_____ Mr. Sung, 79 years old, resident of a nursing home, 11 mm induration

_____ Mr. Williams, 21 years old, no risk factors, 13 mm induration

_____ Ms. Marcos, 42 years old, chest x-ray findings suggestive of previous TB, 6 mm induration

_____ Ms. Rayle, 50 years old, husband has pulmonary TB, 9 mm induration

Please Turn Over →

9. ***The following circles represent indurations from a Mantoux tuberculin skin test. Measure and interpret the circles for the following individuals. Indicate your response by filling in the millimeters of induration and indicate whether this is a positive or negative skin test result.***

A 30-year-old man with HIV infection _____mm induration

Negative Positive

A 25-year-old woman, IV drug user, documented HIV negative _____mm induration

Negative Positive

A 20-year-old close contact of an infectious TB case _____mm induration

Negative Positive

A 34-year-old health care worker in a long term care facility _____mm induration

Negative Positive

A 32-year-old person with no known exposures or risk factors _____mm induration

Negative Positive

Mantoux Tuberculin Skin Test Pre- and Post-Test Answer Key

Correct answer(s) are in bold.

1. The correct amount of PPD antigen to use in a tuberculin skin test is:
a. .05 ml of 5 tuberculin units
b. 0.1 ml of 5 tuberculin units
c. 0.5 ml of 5 tuberculin units
d. 1 ml of 5 tuberculin units

2. A Mantoux tuberculin skin test is administered:
a. intermuscularly
b. intradermally
c. subcutaneously
d. by scratching the skin

3. A positive skin test means a patient:
a. probably has TB disease
b. probably has TB infection
c. has TB and is infectious
d. is allergic to PPD solution

4. A skin test should be read at:
a. 24 to 48 hours (1 to 2 days)
b. 48 hours (2 days)
c. 48 to 72 hours (2 to 3 days)
d. any time up to a week

5. If a patient fails to show up for the scheduled reading, a positive reaction may still be measurable for how long after testing?
a. 7 days
b. 10 days
c. 14 days
d. none of the above

6. When placing the skin test, it is important to record the:
a. date
b. administrator
c. arm of placement
d. lot # and expiration date of PPD solution
e. all of the above

7. A tuberculin reaction of 5 mm is positive in:
a. Persons known to have or suspected of having HIV infection
b. Close contacts of a person with infectious TB
c. Persons who have a chest X-Ray suggestive of previous TB
d. All of the above

8. Which patients described below have a positive tuberculin skin test reaction?
Check all correct ***answers***

__✓__ Mr. West, 36 years old with HIV infection, 8 mm induration

_____ Ms. Hernandez, 26 years old, native of Mexico, 7 mm induration

__✓__ Ms. Jones, 56 years old, has diabetes, 12 mm induration

__✓__ Mr. Sung, 79 years old, resident of a nursing home, 11 mm induration

_____ Mr. Williams, 21 years old, no risk factors, 13 mm of induration

__✓__ Ms. Marcos, 42 years old, chest x-ray findings suggestive of previous TB, 6 mm induration

__✓__ Ms. Rayle, 50 years old, husband has pulmonary TB, 9 mm induration

Please Turn Over →

9. ***The following circles represent indurations from a Mantoux Tuberculin Skin Test. Measure & interpret the circles for the following individuals. Indicate your response by filling in the millimeters of induration and indicate whether this is positive or negative.***

A 30-year-old man with HIV infection ____**11**____mm induration

Negative **Positive**

A 25-year-old woman, IV drug user, documented HIV negative _____**8**___mm induration

Negative Positive

A 20-year-old close contact of an infectious TB case _____**5**_____mm induration

Negative **Positive**

A 34-year-old health care worker in a long term care facility _____**6**_____mm induration

Negative Positive

A 32-year-old person with no known exposures or risk factors _____**13**_____mm induration

Negative Positive

Appendix 9 – Fundamentals of TB Pre- and Post-Test

This test is used to assess course effectiveness. Please circle the letter for the best answer to each question.

Please check to indicate whether this is a:

_____ **Pre-Test** _____ **Post-Test**

1. Tuberculosis is caused by a:
   a. virus
   b. bacterium
   c. pox
   d. parasite
   e. fungus

2. TB infection is spread by:
   a. contact with blood contaminated with TB bacteria
   b. contact with clothing contaminated with TB bacteria
   c. breathing in TB bacteria expelled by a person with infectious TB
   d. eating with utensils used by a person with infectious TB
   e. all of the above

3. What is the most common site for TB disease?
   a. larynx
   b. pleura
   c. lungs
   d. lymph nodes
   e. brain

4. A definitive diagnosis of TB is made with a:
   a. Mantoux tuberculin skin test
   b. chest x-ray
   c. smear
   d. culture
   e. thorough medical history

5. Which of the following medical conditions places a person at highest risk of developing TB disease after becoming infected:
   a. fatigue
   b. less than ideal body weight
   c. pneumonia
   d. HIV infection
   e. diabetes

6. The difference between latent TB infection and TB disease is that:
   a. people with latent TB infection are not infectious, whereas people with TB disease can be infectious
   b. only TB disease can be detected by a tuberculin skin test; latent TB infection cannot
   c. people with latent TB infection are infectious, whereas people with TB disease are not
   d. latent TB infection is curable but TB disease is not

7. Which of the following is NOT a symptom of active pulmonary TB disease?
   a. productive, prolonged cough
   b. fever
   c. diarrhea
   d. night sweats
   e. weight loss

8. Miliary TB occurs when tubercle bacilli:
   a. enter the blood stream and are carried to all parts of the body
   b. convert from an active state to an inactive, dormant state
   c. become visible on chest x-rays
   d. are encapsulated by the body's immune system
   e. none of above

9. The standard treatment for latent TB infection is to:
   a. give isoniazid daily for 9 months
   b. give rifampin and isoniazid daily for 18 months
   c. closely monitor the patient's health status and then give isoniazid only if TB disease develops
   d. treat with a regimen of 4 drugs for 6 months
   e. treat with a regimen of 3 drugs for 12 months

10. The bacilli Calmette-Guérin (BCG) vaccine:
   a. is not used in the United States
   b. is very effective in preventing TB
   c. contraindicates the use of the Mantoux tuberculin skin test
   d. is contraindicated in children under the age of 12
   e. all of the above

Fundamentals of TB Pre- and Post-Test Answer Key

Correct answers are in bold.

1. Tuberculosis is caused by a:
   a. virus
   b. bacterium
   c. pox
   d. parasite
   e. fungus

2. TB infection is spread by:
   a. contact with blood contaminated with TB bacteria
   b. contact with clothing contaminated with TB bacteria
   c. breathing in TB bacteria expelled by a person with infectious TB
   d. eating with utensils used by a person with infectious TB
   e. all of the above

3. What is the most common site for TB disease?
   a. larynx
   b. pleura
   c. lungs
   d. lymph nodes
   e. brain

4. A definitive diagnosis of TB is made with a:
   a. Mantoux tuberculin skin test
   b. chest x-ray
   c. smear
   d. culture
   e. thorough medical history

5. Which of the following medical conditions places a person at the highest risk of developing TB disease after becoming infected:
   a. fatigue
   b. less than ideal body weight
   c. pneumonia
   d. HIV infection
   e. diabetes

6. The difference between latent TB infection and TB disease is that:
   a. people with latent TB infection are not infectious, whereas people with TB disease are sometimes infectious
   b. only TB disease can be detected by a tuberculin skin test; latent TB infection cannot
   c. people with latent TB infection are infectious, whereas people with TB disease are not
   d. latent TB infection is curable but TB disease is not

7. Which of the following is NOT a symptom of active pulmonary TB disease?
   a. productive, prolonged cough
   b. fever
   c. diarrhea
   d. night sweats
   e. weight loss

8. Miliary TB occurs when tubercle bacilli:
   a. enter the blood stream and are carried to all parts of the body
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   d. are encapsulated by the body's immune system
   e. none of above

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   c. contraindicates the use of the Mantoux tuberculin skin test
   d. is contraindicated in children under the age of 12
   e. all of the above

Appendix 10 – Program Evaluation

For each item, please circle the number that indicates the degree to which the following attributes were met using the scale below.

5=Almost Always 4=Frequently 3=Occasionally 2=Seldom 1=Almost Never

1. Handouts/teaching aids were helpful and well organized.	**5**	**4**	**3**	**2**	**1**
2. There was enough time to cover all material.	**5**	**4**	**3**	**2**	**1**
3. Ideas were communicated clearly.	**5**	**4**	**3**	**2**	**1**
4. Presenter(s) gave personal attention to participants when necessary.	**5**	**4**	**3**	**2**	**1**
5. Questions were answered to my satisfaction.	**5**	**4**	**3**	**2**	**1**
6. Presenter(s) exhibited enthusiasm and competence in the subject.	**5**	**4**	**3**	**2**	**1**
7. I would recommend this program to other co-workers/ colleagues who also need TB education and skin test training.	**5**	**4**	**3**	**2**	**1**

8. Please provide any additional comments you have regarding the strengths/weaknesses of the program.

_____
_____
_____

9. What changes would you make to the program?

_____
_____
_____

10. How will this course assist you in your job?

_____
_____
_____

11. What further TB training do you need (if any)?

_____
_____
_____

Appendix 11 – Fundamentals of Tuberculosis Handout

Introduction

This resource is intended for the health care worker with little or no background in tuberculosis (TB). It provides basic information about TB, including its etiology, mode of transmission, diagnosis and treatment.

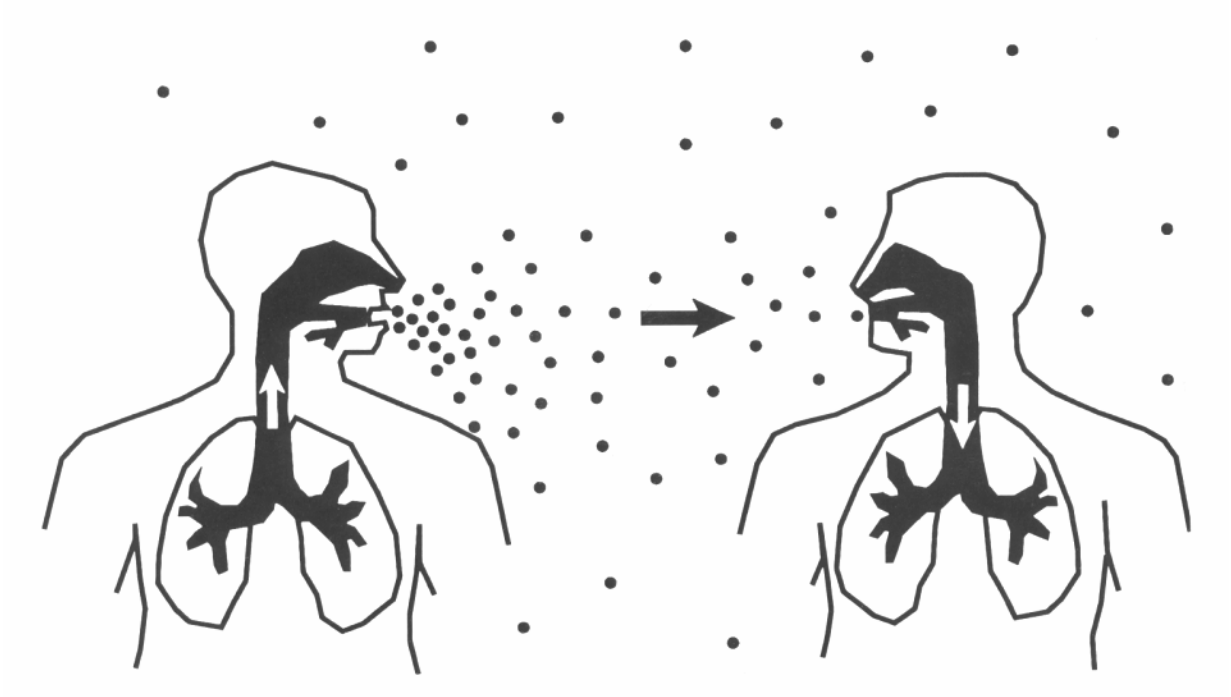
Overview of Contents

Etiology
TB is caused by a bacterium called *Mycobacterium tuberculosis* (often abbreviated *M. tuberculosis*). *M. tuberculosis* organisms are sometimes called tubercle bacilli.

Transmission
TB is spread from person to person through the air. When a person with infectious TB disease (TB that can be spread) coughs or sneezes, tiny particles containing *M. tuberculosis* may be expelled into the air. These particles, called droplet nuclei, are about 1 to 5 microns in diameter (less than 1/5000 of an inch). Droplet nuclei can remain suspended in the air for several hours, depending on the environment.

If another person inhales air than contains these droplet nuclei, transmission may occur. Transmission is the spread of an organism, such as *M. tuberculosis*, from one person to another (**Figure 1**).

Figure 1. *Transmission of TB. TB is spread from person to person through the air. The dots in the air represent droplet nuclei containing tubercle bacilli.*



Not everyone who is exposed to TB becomes infected. The probability that TB will be transmitted depends on three factors:

- The infectiousness of the TB patient
- The type of environment in which the exposure occurred
- The length of the exposure

The infectiousness of a TB patient is directly related to the number of tubercle bacilli that is expelled into the air. Patients who expel many tubercle bacilli are more infectious than patients who expel few or no bacilli. Patients are more likely to be infectious if they:

- Have TB of the lungs or larynx
- Have a cavity in the lung
- Are coughing or undergoing cough-inducing procedures
- Have acid-fast bacilli (AFB) on the sputum smear
- Are not receiving adequate treatment

Usually, only people with pulmonary or laryngeal TB are infectious. This is because these people may be coughing and expelling tubercle bacilli into the air. People with extrapulmonary TB, that is, TB in parts of the body other than the lungs, are generally not infectious. Patients who have a cavity in the lung may be expelling tubercle bacilli if they are coughing, especially if they do not cover their mouth when they cough, or if they have a cough that produces a lot of sputum. The presence of tubercle bacilli on a sputum smear also indicates that the patient may be expelling tubercle bacilli. Patients who have had no treatment, have recently started treatment, or have not been receiving adequate treatment are much more likely to be infectious. Infectiousness appears to decline very rapidly after adequate treatment is started, but how quickly it declines varies from patient to patient.

TB can be spread in many places, including homes or work sites. Groups who are at high risk for TB exposure include:

- Close contacts of a person with infectious TB
- Foreign-born persons from areas where TB is common
- Persons who work or reside in high-risk congregate settings
- Persons who inject drugs
- Locally identified high-burden groups, such as farm workers or homeless persons

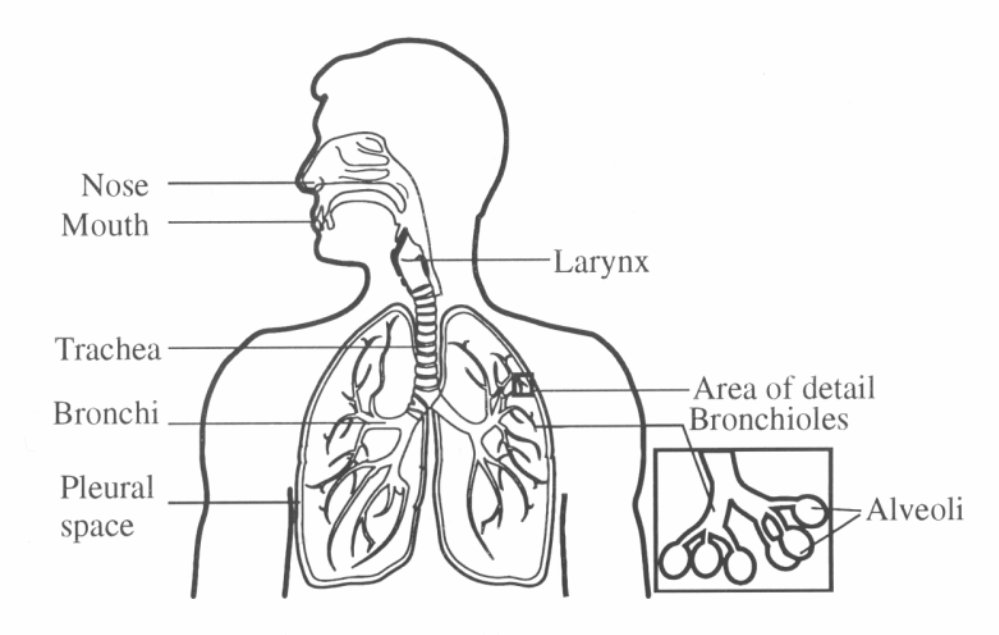
TB can also be transmitted in other facilities or institutions with people who are at high risk for TB such as, such as hospitals, homeless shelters, correctional facilities, nursing homes, and residential homes for those with HIV. TB is most likely transmitted when health care workers, co-workers (i.e., administrative personnel), and patients come in contact with individuals who have unsuspected TB disease, who are not receiving adequate treatment, and who have not been isolated from others. People with TB disease are most likely to transmit TB before the disease has been diagnosed and treatment has started. TB patients who are receiving treatment are less likely to be infectious.

TB is not spread by casual contact but by close, repeated contact or prolonged contact with an infectious individual. People with TB disease are most likely to spread it to the people they spend time with every day, including family members, friends, and co-workers.

Pathogenesis

When a person inhales air that contains droplet nuclei, most of the larger droplets become lodged in the upper respiratory tract (the nose and throat), where infection is unlikely to develop. However, the droplet nuclei may reach the small air sacs of the lung (the alveoli), where infection begins (**Figure 2**). The following section describes the pathogenesis of TB (the way TB infection and disease develop in the body).

Figure 2. *The lungs and alveoli.*



At first, the tubercle bacilli multiply in the alveoli and a small number enter the bloodstream and spread throughout the body. Bacilli may reach any part of the body, including areas where TB disease is more likely to develop. These areas include the upper portions of the lungs, as well as the kidneys, the brain, and bone.

Within 2 to 10 weeks, however, the body's immune system usually intervenes, halting multiplication and preventing further spread. The immune system is the system of cells and tissues that protect the body from foreign substances.

Latent TB Infection vs. TB Disease

Latent TB Infection

To be infected with TB means that tubercle bacilli are in the body but are being kept in a dormant or latent state by the body's immune system. The immune system does this by producing special immune cells that surround the tubercle bacilli. The cells form a hard shell that keeps the bacilli contained and under control. Because of the potential for the bacilli to become active, multiply, and lead to TB disease, individuals infected with *M. tuberculosis* are said to have latent TB infection (LTBI).

TB infection is detected by the tuberculin skin test. Most people with LTBI have a positive reaction to the tuberculin skin test. (The tuberculin skin test is discussed in more detail later.)
People who have LTBI, but not TB disease are NOT infectious – in other words, they cannot spread the infection to others. These people usually have a normal chest x-ray. It is important to remember that LTBI is not considered a case of TB. Major similarities and differences between LTBI and TB disease are shown in **Table 1**.

Table 1: LTBI vs. TB Disease

LTBI	TB Disease (in the lungs)
Tubercle bacilli	
Tuberculin skin test or QuantiFERON®-TB Gold test result usually positive	
Chest x-ray usually normal	Chest x-ray usually abnormal
Sputum smears and cultures negative	Sputum smears and cultures 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

TB Disease

Some people with LTBI develop TB disease. TB disease develops when the immune system cannot keep the tubercle bacilli under control and the bacilli begin to multiply rapidly. The risk that TB disease will develop is higher for some people than for others. The pathogenesis of LTBI and disease is shown in **Figure 3**.

TB disease can develop very soon or many years after infection. In the United States, about 5% of all people who have recently been infected with *M. tuberculosis* will develop TB disease 1 to 2 years after infection. Another 5% will develop disease later in their lives. In other words, about 10% of all people who have LTBI will develop disease at some point. The remaining 90% will stay infected, but free of disease, for the rest of their lives.

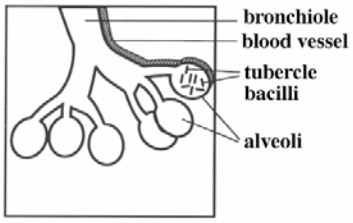
Because about half the risk of developing TB disease is concentrated in the first 2 years after infection, it is important to detect new infection early. People with LTBI can be given treatment to prevent them from getting TB disease. Thus, detecting new infection early helps prevent new cases of TB disease.

Figure 3. *[Pathogenesis of LTBI and TB disease.*

1

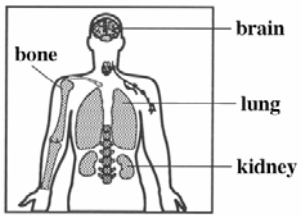
Droplet nuclei containing tubercle bacilli are inhaled, enter the lungs, and travel to the alveoli.

2



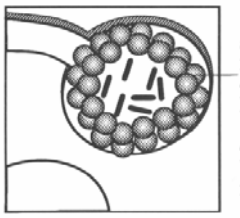
Tubercle bacilli multiply in the alveoli.

3



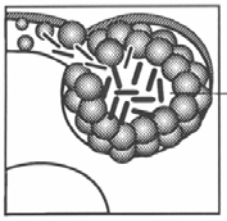
A small number of tubercle bacilli enter the bloodstream and spread throughout the body. The bacilli may reach any part of the body, including areas where TB disease is more likely to develop (such as the lungs, kidneys, brain, or bone).

4



Within 2 to 10 weeks, the immune system produces special immune cells that surround the tubercle bacilli. The cells form a hard shell that keeps the bacilli contained and under control (LTBI).

5



If the immune system cannot keep the bacilli under control, the bacilli begin to multiply rapidly (TB disease). This process can occur in different places in the body such as the lungs, kidneys, brain, or bone (see diagram in box 3).

Risk Factors for the Developing TB Disease
Certain medical conditions increase the risk that LTBI will progress to TB disease. The risk may be about 3 times higher (as with diabetes) to more than 100 times higher (as with HIV infection) for people who have these conditions than for those who do not. Some of these conditions are:

- HIV infection,
- Chest x-ray findings consistent with prior TB (in a person inadequately treated)
- Low body weight (10% or more below ideal)
- Recent infection (within the past 2 years)
- Silicosis
- Diabetes mellitus
- Chronic renal failure/hemodialysis
- Prolonged therapy with corticosteroids and other immunosuppressive agents
- Certain types of cancer (e.g., leukemia, Hodgkin's disease, or cancer of the head and neck)
- Certain intestinal conditions (e.g., gastrectomy, jejunoileal bypass)
- Solid organ transplant

HIV infection is the greatest risk factor of progression from TB infection to TB disease. When the immune system is weakened, the body may not be able to control the multiplication and spread of tubercle bacilli. For this reason, people who are infected with both *M. tuberculosis* and HIV, as with other infections, are much more likely to develop TB disease than people who are infected only with *M. tuberculosis*. Studies suggest that the risk of developing TB disease is 7% to 10% each year for people who are infected with both *M. tuberculosis* and HIV, whereas it is 10% over a lifetime for people infected only with *M. tuberculosis*.

Figure 4*. Risk of Developing TB Disease.*

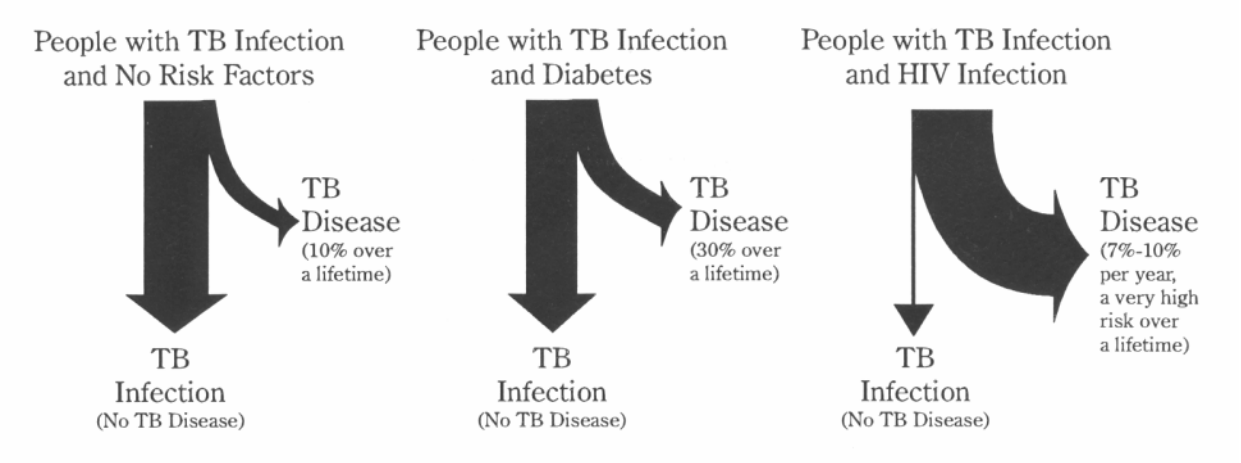


Figure 4 shows the risk of developing TB disease for three different groups of people. For people with LTBI and no risk factors, the risk is about 10% over a lifetime. For people with LTBI and diabetes, the risk is 3 times as high, or about 30% over a lifetime. For people with LTBI and HIV infection, the risk is about 7% to 10% PER YEAR, a very high risk over a lifetime.

In an HIV-infected person, TB disease can develop in either of two ways. First, a person who has LTBI can become infected with HIV and then develop TB disease as the immune system is weakened. Second, a person who has HIV infection can become infected with *M. tuberculosis* and then rapidly develop TB disease.

Sites of TB Disease

TB disease can occur in different places in the body. Pulmonary TB is TB that occurs in the lungs. About 85% of TB cases are pulmonary. Most patients with pulmonary TB have a cough and an abnormal chest x-ray, and they should be considered infectious until they meet all of the following criteria:

- Adequate treatment for 2 to 3 weeks
- Symptoms improvement
- Three consecutive negative sputum smears from sputum collected on different days

Extrapulmonary TB occurs in places other than the lungs, such as the larynx, the lymph nodes, the brain, the kidneys, or the bones and joints. Extrapulmonary TB occurs more often in people who are infected with HIV than in people who are not infected with HIV. In HIV-infected people, extrapulmonary TB is often accompanied by pulmonary TB. Most types of extrapulmonary TB are not considered infectious.

Miliary TB occurs when tubercle bacilli enter the bloodstream and are carried to all parts of the body, where they grow and cause disease in multiple sites. This condition, which is rare but serious, is called miliary TB because the chest x-ray has the appearance of millet seeds scattered throughout the lung.

Classification System for TB

Many systems have been used to classify people who have TB. The current classification system (**Table 2**) is based on the pathogenesis of TB. Many health departments and private health care providers use this system when describing patients. Thus, it is important to be familiar with this system. In particular, you should be aware that any patient with a classification of 3 or 5 should be receiving treatment for TB, and the suspected case or verified case should be reported to the health department.

Table 2: Classification System for TB

Class	Type	Description
0	No exposure to TB Not infected	No history of exposure, negative reaction to the tuberculin skin test
1	Exposure to TB No evidence of infection	History of exposure, negative reaction to a tuberculin skin test given at least 10 weeks after exposure
2	Latent TB Infection No TB disease	Positive reaction to the tuberculin skin test, negative sputum smears and cultures (if done), no clinical or x-ray evidence of TB disease
3	Current TB disease	Positive sputum culture for *M. tuberculosis* (if done), or a positive reaction to the tuberculin skin test and clinical or x-ray evidence of current TB disease
4	Previous TB disease (not current)	Medical history of TB disease, or abnormal but stable x-ray findings for a person who has a positive reaction to the tuberculin skin test, negative sputum smears and cultures (if done), and no clinical x-ray evidence of current TB disease
5	TB suspected	Signs and symptoms of TB disease, but evaluation not complete

Diagnosis of Latent TB Infection

The Tuberculin Skin Test

The tuberculin skin test is used to determine whether a person has LTBI. In this test, a substance called tuberculin is injected into the skin. Tuberculin is protein derived from tubercle bacilli that have been killed by heating. In most people who have LTBI, the immune system will recognize the tuberculin because it is similar to the tubercle bacilli that caused the infection. This recognition generally will cause a reaction to the tuberculin skin test. Tuberculin is used for diagnosing LTBI; it is not a vaccine. Tuberculin testing is useful for:

- Examining a person who is not sick but who may have LTBI, for example, a person who has been exposed to someone with TB. In fact, the tuberculin skin test is the only way to diagnose LTBI before the infection progresses to TB disease
- Screening at-risk groups of people for LTBI
- Examining a person who has symptoms of TB disease

Different types of tuberculin tests are available, such as the Mantoux tuberculin skin test and the multiple-puncture test. The Mantoux tuberculin skin test is the preferred test because it is the most accurate. Multiple puncture tests are <u>not</u> recommended.

Mantoux Tuberculin Skin Test

The Mantoux skin test is given using a needle and syringe to inject 0.1 mL of 5 tuberculin units (TU) of liquid tuberculin between the layers of the skin (intradermally), usually on the forearm. A tuberculin unit is a standard strength of tuberculin. The tuberculin used in the Mantoux skin test is also known as purified protein derivative or PPD. For this reason, the tuberculin skin test is sometimes called a PPD skin test.

With the Mantoux tuberculin skin test, the patient's arm is examined 48 to 72 hours after the tuberculin is injected. Most people with LTBI have a positive reaction to the tuberculin. The result is an area of induration (swelling that can be felt) around the site of injection. The transverse diameter of the induration is measured across the forearm; erythema (redness) or bruising around the indurated area is not measured.

QuantiFERON®-TB Gold Test (QFT-G)

The QuantiFERON®-TB gold test (QFT-G) is a whole-blood test for detecting LTBI. The test measures the patient's immune reactivity to *M. tuberculosis*. Blood samples are mixed with antigens. If the patient is infected with *M. tuberculosis*, the blood cells will recognize the tuberculin and release interferon-gamma (IFN-γ) in response. As with the tuberculin skin test, follow-up medical evaluation should be conducted on persons with positive test results to rule out TB disease.

QFT-G results are interpreted in a manner similar to that used for interpreting positive cut-off values for the tuberculin skin test. However, QFT-G results are usually available within 24 hours. Therefore, test results can be obtained with a single patient visit, and there is no need for the patient to return for test interpretation. Interpretation of QFT-G results is influenced by the patient's estimated risk for TB infection.

Classification of TST Reactions
Whether a reaction to the Mantoux tuberculin skin test is classified as positive depends on the size of induration and the person's risk factors for TB.

≥5 mm of induration is considered a positive reaction in:

- HIV-infected persons
- Close contacts of a person with infectious TB
- Persons who have chest x-ray findings consistent with prior TB
- Organ transplant recipients
- Persons who are immunosuppressed for other reasons (e.g., taking the equivalent of ≥15 mg/day of prednisone for 1 month or more

≥10 mm of induration is considered a positive reaction in:

- Recent immigrants (within last 5 years) from a high-prevalence country
- Injection drug users (with unknown or HIV negative status)
- Residents or employees of high-risk congregate settings (for example, nursing homes or correctional facilities)
- Mycobacteriology laboratory personnel
- Children <4 years of age, or children or adolescents exposed to adults at high risk
- People with other high-risk conditions such as diabetes

≥15 mm of induration is considered a positive reaction:

- Persons with no known risk factors for TB

In most cases, people who have a very small reaction or no reaction to the tuberculin skin test probably do not have LTBI.

For people who may be exposed to TB on the job (such as health care workers and staff of nursing homes or correctional facilities), the classification of the skin test reaction as positive or negative depends on the:

- Size of the induration
- Employee's individual risk factors for TB
- Risk of exposure to TB in the person's job

Therefore, in facilities where the risk of exposure to TB is very low, 15 or more millimeters of induration may be considered a positive reaction for employees with no other risk factors for TB. In patient care facilities, 10 or more millimeters of induration may be considered a positive reaction for employees with no other risk factors for TB.

Most people who have a positive skin test reaction will have a positive reaction if they are tested later in their lives, regardless of whether they receive treatment. This is because *the tuberculin skin test detects the immune response to tuberculin, not the presence of tubercle bacilli in the body*. Additionally, it is important to note that a false-positive or a false-negative reaction may occur when the tuberculin skin test is given incorrectly or the results are not measure properly. The following is a description of false-positive and false-negative reactions.

False-Positive Reaction

The skin test is a valuable tool, but it is not perfect. Several factors can affect the skin test reaction. Two of these factors are infection with nontuberculous mycobacteria (mycobacteria other than *M. tuberculosis*) and bacille Calmette-Guérin (BCG) vaccination. BCG is a vaccine for TB disease that is used in many countries. However, it is rarely used in the United States because studies have shown that it is not completely effective and does not confer life-long immunity. People who are infected with nontuberculous mycobacteria or who have been vaccinated with BCG may have a positive reaction to the tuberculin skin test even if they do not have LTBI. This is called a false-positive reaction.

With the tuberculin skin test, there is NO RELIABLE WAY to distinguish a positive tuberculin reaction caused by vaccine with BCG from a reaction caused by a true TB infection.[1] However, the reaction is more likely to be due to LTBI if any of the following are true:

- The reaction is large
- The person was vaccinated a long time ago
- The person comes from an area of the world where TB is common
- The person has been exposed to someone with infectious TB disease

People who have positive reaction should be further evaluated for TB disease, regardless of whether they were vaccinated with BCG.

False-Negative Reactions

Some people have a negative reaction to the tuberculin skin test even though they have LTBI. These are called false-negative reactions. A false-negative reaction may be due to:

- Anergy (inability to mount an immune response)
- Recent TB infection (within the past 10 weeks)
- Very young age (younger than 6 months old)

The most common cause of false-negative reaction is anergy, the inability to react to the skin test because of a weakened immune system. While HIV infection is a main cause of anergy, many conditions, such as immunosuppressive therapy, or severe TB disease itself, can weaken the immune system and cause anergy.

Another cause of false-negative reaction is recent TB infection (infection within the past 10 weeks). It takes 2 to 10 weeks after TB infection for the body's immune system to be able to react to tuberculin. Therefore, after TB has been transmitted, it takes 2 to 10 weeks before TB infection can be detected by the tuberculin skin test. For this reason, close contacts of someone with infectious TB disease with a negative reaction to the tuberculin skin test should be retested 8-10 weeks after the last time they were in contact with the person who has TB disease.

[1] The QuantiFERON®-TB Gold test is able to distinguish *M. tuberculosis* from other mycobacteria and BCG vaccination

A third cause of false-negative reaction is a very young age. Children younger than 6 months old may have a false-negative reaction to the tuberculin skin test because their immune systems are not yet fully developed. A false-positive or a false-negative reaction may also occur when the tuberculin skin test is given incorrectly or the results are not measured properly.

Any patient with symptoms of TB should be evaluated for TB disease, regardless of his/her skin test reaction. In fact, people with symptoms of TB should be evaluated for TB disease right away, at the same time that the tuberculin skin test is given. The symptoms of pulmonary TB disease include coughing up sputum (phlegm from deep in the lungs) or blood. The general symptoms of TB disease (pulmonary or extrapulmonary) include weight loss, fatigue, malaise, fever, and night sweats. The diagnosis of TB disease is discussed in more detail later.

Targeted Skin Testing Programs

Targeted tuberculin skin testing identifies persons at high risk for the development of TB disease who would benefit from treatment of LTBI, if detected. Therefore, all testing activities should be accompanied by a plan for the necessary follow-up medical evaluation and treatment. Persons at high risk for TB (i.e., risk substantially greater than that of the general U.S. population) have either been infected recently with *M. tuberculosis* or have clinical conditions that are associated with an increased risk of progression from LTBI to TB disease. Therefore, targeted tuberculin testing programs should be conducted only among groups at high risk and discouraged in those at low risk. Many residential facilities, health care facilities, and other high-risk congregate settings have targeted skin testing programs. This means that employees and residents are periodically given tuberculin skin test in order to:

- Identify people who have LTBI and possibly TB disease, so that they can be given treatment as needed
- Determine whether TB is transmitted in the facility

Two-Step Testing

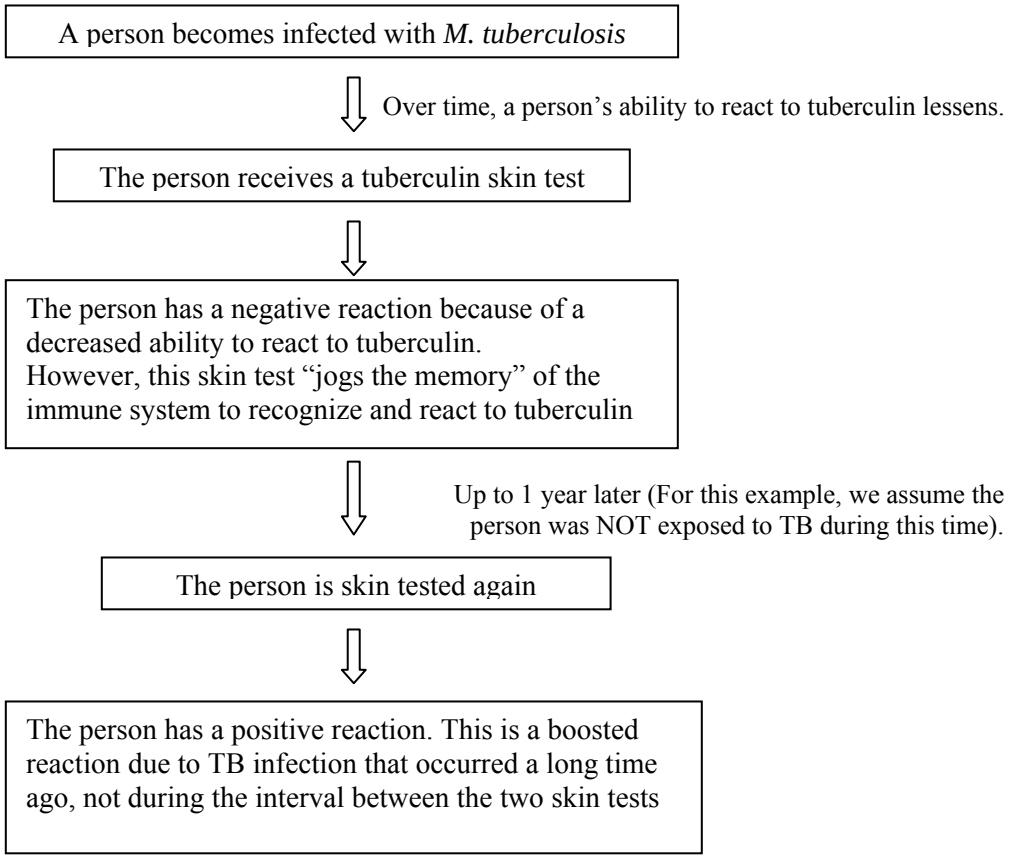
In a targeted skin testing program, employees or residents are skin tested when they start their job or enter the facility. This is called the baseline skin test. If they have a negative skin test reaction, they may be retested at regular intervals thereafter, depending on the risk classification of the setting.

Employees or residents of health care or correctional facilities whose skin test reaction converts from negative to positive between testing intervals have probably become recently infected with *M. tuberculosis*. These skin test conversions may indicate that TB is being transmitted in the facility. People with skin test conversions are at high risk of developing TB disease because they were infected with *M. tuberculosis* relatively recently (within the past 2 years). In order to detect TB transmission and identify people who have skin test conversions, accurate information must be obtained from every employee's baseline skin test, as well as from additional skin tests.

One factor that can affect the accuracy of the baseline skin test is the booster phenomenon. The booster phenomenon happens because, in some people who have LTBI, the ability to react to tuberculin lessens over time. When these people are skin tested many years after they become infected with *M. tuberculosis*, they may have a negative reaction. However, if they are tested again within 1 year, they may have a positive reaction. This reaction occurs because the first skin test has "jogged the memory" of the immune system, boosting its ability to react to tuberculin. It may appear that these people were infected between the first and second skin tests (recent TB infection).

However, the second, positive skin test reaction is actually a boosted reaction, due to TB infection that occurred a long time ago. The booster phenomenon occurs mainly among older adults and is illustrated in **Figure 5**.

Figure 5. *The booster phenomenon.*

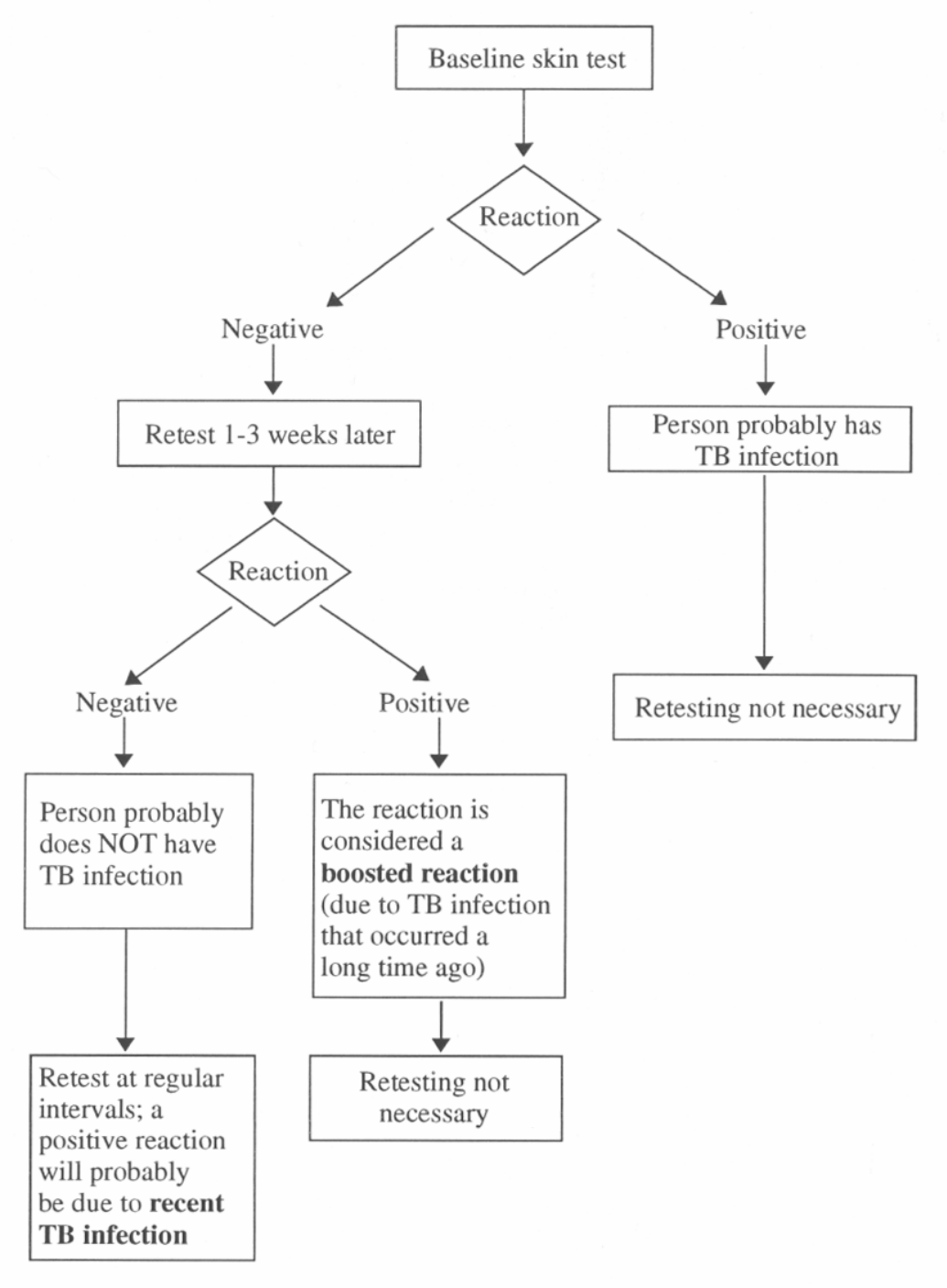


The booster phenomenon can present a problem in a skin testing program. To avoid misinterpretation, a strategy has been developed for telling the difference between boosted reactions and reactions caused by recent infection. This strategy, called two-step testing, means that if a person has a negative reaction to an initial skin test, he/she is given a second test 1 to 3 weeks later:

- If the reaction to the second test is positive, it probably is a boosted reaction (due to TB infection that occurred a long time ago)
- If the reaction to the second test is negative, the person is considered uninfected. In this person, a positive reaction to a skin test given later will probably be due to recent infection

Two-step testing is often used for employees who will be required to have TB skin testing at frequent intervals. In particular, two-step testing is often used in health care facilities or in other facilities where personnel may be at high risk for TB exposure. The procedure for two-step testing is shown in **Figure 6**.

***Figure 6**. Two-step testing.*



Treatment for Latent TB Infection

Treatment for latent TB infection (formerly known as preventive therapy or chemoprophylaxis) is recommended to prevent progression from LTBI to TB disease. High-risk persons should be evaluated for LTBI if they have a positive skin test reaction, regardless of their age.

Sometimes treatment is given to people who have a negative skin test reaction, such as high-risk contacts and children who have been exposed to TB. All patients being considered for treatment of LTBI should receive a medical evaluation to:

- Exclude the possibility of TB disease
- Determine whether they have ever been treated for infectious TB
- Identify any medical problems that may complicate therapy or require careful monitoring

The usual treatment of LTBI infection is isoniazid (INH) given daily for 9 months for all persons. Patients should be evaluated every month for signs of hepatitis and other adverse reactions to INH. They should also be educated about the symptoms caused by adverse reactions to INH and instructed to seek medical attention immediately if symptoms occur. In addition, people at greatest risk for hepatitis should have liver function tests before starting INH therapy. An alternate regimen is rifampin (RIF) for 4 months.

Diagnosis of TB Disease
Before clinicians can diagnose TB disease in a patient, they must think of the possibility of this disease when they see a patient with symptoms of TB or abnormal chest x-ray findings. Because TB is not as common as it was many years ago, many clinicians do not consider the possibility of TB when making diagnoses for patients who have symptoms of TB. When this happens, the diagnosis of TB may be delayed or even overlooked, and the patient will remain ill and possibly infectious. Anyone with symptoms of TB should be evaluated for TB disease. In addition, anyone found to have a positive tuberculin skin test reaction should be evaluated for TB disease.

Overview
There are four steps in diagnosing TB disease; the medical history, the tuberculin skin test, the chest x-ray and the bacteriologic examination. A discussion of what is involved in each step follows.

1. **The Medical History**
   a. Exposure to TB: One important part of the medical history is asking a patient about his/her exposure to TB. Patients should be asked whether they have spent time with someone who has infectious TB or someone with TB-like symptoms. Some people may have been exposed to TB in the distant past, when they were children. Others may have been exposed more recently.

      Anyone who has been exposed to TB may have LTBI. Many people become infected with *M. tuberculosis* without knowing that they were exposed. The risk of being exposed to TB is higher for some occupations (for example, certain health care workers) and in some residential facilities (for example, nursing homes or correctional facilities).

   b. Symptoms of TB disease: Another important part of the medical history is checking for symptoms of TB disease. Although, people with TB disease may or may not have symptoms, most patients with TB disease have one or more symptoms that led them to seek medical care. Occasionally, TB is discovered during a medical examination for an unrelated condition (for example, when a patient is given a chest x-ray before undergoing surgery).

      Pulmonary TB disease usually causes one or more of the following symptoms:

      - Cough
      - Pain in the chest while breathing or coughing
      - Cough with sputum (phlegm from deep in the lungs) or blood

      The general symptoms of TB disease (pulmonary or extrapulmonary) include:

      - Weight loss
      - Fatigue
      - Malaise
      - Fever
      - Night sweats

The symptoms of extrapulmonary TB depend on the part of the body that is affected by the disease. For example, TB of the spine may cause pain in the back; TB of the kidney may cause blood in the urine. All of these symptoms may be the result of other diseases, but they should prompt the clinician to suspect TB disease.

c. Previous TB infection or TB disease: During the medical history, the clinician should ask the patient whether he/she has ever been diagnosed with or treated for TB infection or disease.

- Patients known to have a positive skin test reaction probably have LTBI. If they were infected within the past 2 years, they are at high risk for TB disease.
- Patients who have had TB disease before should be asked when they had the disease and how it was treated. If the regimen prescribed was inadequate or if the patient did not follow the recommended treatment, TB may re-occur, and it may be resistant to one or more of the drugs used in the previous treatment regimen.

d. Risk factors for developing TB disease: A fourth part of the medical history is checking for risk factors for developing TB disease. The following conditions, also listed on page 54, appear to increase the risk that LTBI will progress to TB disease:

- HIV infection
- Chest x-ray findings consistent with prior TB (in a person inadequately treated)
- Low body weight (10% or more below ideal)
- Recent infection (within the past 2 years)
- Silicosis
- Diabetes mellitus
- Chronic renal failure/hemodialysis
- Prolonged therapy with corticosteroids and other immunosuppressive agents
- Certain types of cancer (e.g., leukemia, Hodgkin's disease, or cancer of the head and neck)
- Certain intestinal conditions (e.g., gastrectomy, jejunoileal bypass)
- Solid organ transplant

Clinicians should determine whether patients have any of these conditions. In particular, HIV infection greatly increases the risk that LTBI will progress to TB disease.

A physical examination is an essential part of the evaluation of any patient. It cannot confirm or rule out TB disease, but it can provide valuable information about the patient's overall condition and other factors that may affect how TB disease is treated if it is diagnosed.

2. **The Tuberculin Skin Test**
   Patients with symptoms of TB disease are often given a tuberculin skin test to detect exposure to and infection with TB. However, as many as 20% of the patients found to have TB disease have a negative tuberculin skin test reaction. For this reason, patients with symptoms of TB disease should always be evaluated for TB disease, regardless of their skin test results.

   Furthermore, for patients with symptoms of TB disease, clinicians should not wait for tuberculin skin test results (48 to 72 hours) before starting other diagnostic tests. A tuberculin skin test is not necessary for patients known to have had a previous positive skin test reaction.

3. **The Chest X-ray**
   The chest x-ray is useful for diagnosing TB disease. About 85% of TB patients have pulmonary TB. Usually, when a person has TB disease in the lungs, the chest x-ray appears abnormal. It may show infiltrates (collections of fluid and cells in the tissues of the lung) or cavities (hollow spaces within the lung that may contain many tubercle bacilli).

   However, the results of a chest x-ray cannot confirm that a person has TB disease. A variety of illnesses may produce abnormalities whose appearance on a chest x-ray resembles TB. Although an abnormality on a chest x-ray may lead a clinician to suspect TB, only a bacteriologic culture that is positive for ***M. tuberculosis*** proves that a patient has TB disease. Moreover, a chest x-ray cannot detect LTBI.

4. **The Bacteriologic Examination**
   The next step in diagnosing TB disease is the bacteriologic examination. This is done in a laboratory that specifically deals with ***M. tuberculosis*** and other mycobacteria (a mycobacteriology laboratory). There are four parts to a bacteriologic examination.

   a. Obtaining a specimen
   b. Examining the specimen under a microscope
   c. Culturing the specimen
   d. Conducting drug susceptibility testing

a. Obtaining a specimen: Specimens that will be sent to the laboratory can be obtained in several ways. Usually, patients who are suspected of having pulmonary TB disease simply cough up sputum (phlegm from deep in the lungs) into a sterile container for processing and examination. This is the easiest and most cost-effective procedure.

   If a patient cannot cough up sputum on his/her own, other techniques can be used to obtain a specimen. An induced sputum sample can be obtained easily by having the patient inhale a saline (salt water) mist, which causes the patient to cough deeply. Induced specimens are often clear and watery, so they should be labeled “induced specimen” so that they will not be confused with saliva. (Laboratories will not accept saliva as a specimen.)

   Another procedure, bronchoscopy, can be used to obtain pulmonary secretions or lung tissue. In this procedure, an instrument called a bronchoscope is passed through the mouth directly into the diseased portion of the lung, and some sputum or lung tissue is removed.

b. Examining the specimen under a microscope: Before the specimen is examined under a microscope, it is smeared onto a glass slide and stained with a dye. This is called a smear. Then laboratory personnel use the microscope to look for acid-fast bacilli (AFB) on the smear. AFB are mycobacteria that stay stained after they have been washed in an acid solution. Tubercle bacilli are one kind of AFB.

When AFB are seen in a smear, they are counted. There is a system for reporting the number of AFB that are seen at a certain magnification. According to the number of AFB seen, the smears are classified as 4+, 3+, 2+, or 1+. Smears that are classified as 4+ and 3+ are considered strongly positive; 2+ and 1+ smears are considered moderately positive. If very few AFB are seen, the smear is classified by the actual number of AFB seen (no plus sign). For example, if only 4 AFB were seen in the entire smear, the smear is classified as "4 AFB seen." Smears classified in this way are considered weakly positive. Finally, if no AFB are seen, the smear is called negative. But a negative smear does not rule out the possibility of TB because there can be AFB that were not seen in the smear.

It takes only a few hours to prepare and examine a smear. Therefore, the results of the smear examination should be available to the clinician within 1 day.

The results of the smear examination can be used to help determine the infectiousness (contagiousness) of the patient. Patients who have many tubercle bacilli in their sputum have a positive smear. Patients who have positive smears are considered infectious because they can cough many tubercle bacilli into the air. However, because AFB are not always tubercle bacilli, patients who have positive smears do not necessarily have TB. Furthermore, as mentioned previously, patients who have negative smears may have TB.

c. Culturing the specimen: Culturing the specimen means growing mycobacteria on media (substances that contain nutrients) in the laboratory. When mycobacteria have formed colonies (groups), they can be identified. All specimens should be cultured, regardless of whether the smear is positive or negative.

Culturing the specimen is necessary to determine whether it contains *M. tuberculosis* and to confirm a diagnosis of TB disease. (However, in some cases, patients are diagnosed with TB disease on the basis of their signs and symptoms, even if their specimen does not contain *M. tuberculosis*.)

The first procedure in culturing the specimen is to detect the growth of the mycobacteria, which grow very slowly. This can take from 4 days to 8 weeks, depending on the type of medium used.

The second procedure is to identify which type of mycobacteria is growing. When *M. tuberculosis* is identified, the patient is said to have a positive culture for *M. tuberculosis*. A positive culture for *M. tuberculosis*, also called *M. tuberculosis* isolate, confirms the diagnosis of TB disease.

When *M. tuberculosis* is NOT identified, the patient is said to have a negative culture for *M. tuberculosis*. A negative culture does not necessarily rule out diagnosis of TB disease; as mentioned earlier, some patients with negative cultures are diagnosed with TB disease on the basis of their signs and symptoms.

d. Conducting drug susceptibility testing: Drug susceptibility tests, the final part of the bacteriologic examination, are done to determine which drugs will kill the tubercle bacilli that are causing TB disease in a particular patient. Tubercle bacilli that are killed by a particular drug are said to be susceptible to that drug, whereas those that can grow even in the presence of a particular drug are said to be resistant to that drug. The drug susceptibility pattern of a strain of tubercle bacilli is the list of drugs to which the strain is susceptible and to which it is resistant.

   The results of drug susceptibility tests can help clinicians choose the appropriate drugs for each patient. This is very important. Patients with TB disease who are treated with drugs to which their strain of TB is resistant may not be cured. In fact, their strain of TB may become resistant to additional drugs.

   Drug susceptibility tests should be done when a patient is first found to have a positive culture for *M. tuberculosis* (that is, the first isolate of *M. tuberculosis*). In addition, drug susceptibility tests should be repeated if a patient has positive culture for *M. tuberculosis* after 2 months of treatment or if a patient does not seem to be getting better. That way, the clinician can find out whether the patient's strain of TB has become resistant to certain drugs. If necessary, the clinician may change the drugs used for treating the patient.

Treatment of TB Disease
TB disease must be treated for at least 6 months and in some cases, treatment lasts even longer if sputum smears and cultures do not convert to negative. The initial phase for treating TB disease should include four first-line drugs: isoniazid, rifampin, pyrazinamide, and ethambutol, unless otherwise indicated. When the drug susceptibility results are available, usually in about 8 weeks, clinicians may change the regimen. Treatment is continued with at least two drugs to which the bacilli are susceptible for the duration of the regimen.

Using only one drug to treat TB disease can create a population of tubercle bacilli that is resistant to that drug. Drug resistance can also develop when patients do not take treatments as prescribed. Thus, to prevent relapse and drug resistance, clinicians must prescribe an adequate regimen and make sure that patients adhere to treatment. The best way to ensure that patients adhere to treatment is to use directly observed therapy (DOT), which is health care worker or trained outreach worker observation of the ingestion of prescribed medication.

Monitoring
All patients being treated for TB disease should be educated about the signs of adverse reactions to the drugs they are taking and instructed to seek medical attention immediately if they have any of these symptoms. Patients should be seen by a clinician at least monthly during treatment, and evaluated for possible adverse reactions. In addition, before starting treatment, patients should have baseline tests to help clinicians detect any abnormalities that may complicate treatment. Patients who are not receiving DOT should be carefully monitored for adherence to treatment. The only way to ensure adherence to treatment is to use DOT. If DOT cannot be provided for the entire treatment period, a clinician should work closely with the patient to establish a routine for regular medication taking. It is also crucial for the clinician to work with patients in identifying barriers to adherence and brainstorm ways to overcome these obstacles. Clinical and bacteriologic evaluations should be performed during treatment to determine whether a patient is responding to the treatment regimen. Patients should be carefully reevaluated if their:

- Symptoms do not improve during the first 2 months of treatment
- Symptoms worsen after improving initially
- Culture results have not become negative after 2 months of treatment
- Culture results become positive after being negative

In certain situations, clinicians may also use chest x-rays to monitor a patient's response to treatment. The treatment of TB can be complicated, especially in patients who fail to respond to treatment, relapse, have drug-resistant TB, or have adverse reactions to medications. Clinicians who do not have experience with these situations should consult a TB expert.

Infectiousness

The infectiousness of a TB patient is directly related to the number of tubercle bacilli that he/she expels into the air. Patients who expel many tubercle bacilli are more infectious than patients who expel few or no bacilli. Patients are more likely to be infectious if they:

- Have TB of the lungs or larynx
- Have a cavity in the lung
- Are coughing or undergoing cough-inducing procedures
- Have AFB on the sputum smear
- Are not receiving adequate treatment

Infectiousness appears to decline very rapidly after adequate treatment is started, but how quickly it declines varies from patient to patient. Patients who have been receiving adequate treatment for 2 to 3 weeks, whose symptoms have improved, and who have 3 consecutive negative sputum smears from sputum collected on different days can be considered noninfectious.

TB can be spread in many places, such as homes, schools, or health care facilities. In a health care facility, TB is most likely to be transmitted when health care workers and patients come in contact with patients who have suspected TB disease, who are not receiving adequate treatment, and who have not been isolated from others. All health care facilities should take measures to prevent the spread of TB.

People with TB disease are most likely to transmit TB before the disease has been diagnosed and treatment has started. TB patients who are receiving treatment are less likely to be infectious. TB patients who may be infectious should be instructed to cover their mouths and noses with tissues when coughing and sneezing.

If a patient is suspected to have TB, he/she should be immediately placed in an environment in which transmission to others is unlikely. In many cases, hospitalization of a patient until non-infectious can be warranted. A patient should be kept from work or school at least until he/she is non-infectious and well enough to resume normal activities. All of these measures should be taken without compromising the dignity and comfort of the patient.

Glossary

acid-fast bacilli (AFB) – mycobacteria that stay stained even after they have been washed in an acid solution; may be detected under a microscope in a stained smear; number in smear determines classification as positive or negative

alveoli – the small air sacs of the lung that are at the end of the airway; when droplet nuclei reach these air sacs, TB infection begins

anergy – the inability to react to a skin test because of a weakened immune system, often caused by HIV infection or severe illness

bacille Calmette-Guérin (BCG) – a vaccine for TB disease that is used in many countries but rarely used in the United States; may cause a false-positive reaction to the tuberculin skin test

baseline skin test – the tuberculin skin test given to employees or residents in certain facilities when they start their job or enter the facility

booster phenomenon – a phenomenon in which people (especially older adults) who are skin tested many years after becoming infected with *M. tuberculosis* may have negative reaction to an initial skin test, followed by a positive reaction to a skin test given up to 1 year later; this happens because the first skin test boosts the immune response. Two-step testing is used in programs in which routine skin testing is done to determine the difference between boosted reactions and reactions caused by recent infection.

bronchoscopy – a procedure used to obtain pulmonary secretions or lung tissue with an instrument called a bronchoscope; used only when patients cannot cough up sputum on their own and an induced specimen cannot be obtained

close contacts – people who spend frequent and prolonged time with someone who has infectious TB disease

colonies – groups of mycobacteria that have grown in a culture

culture – organisms grown on media (substances containing nutrients) so that they can be identified; a positive culture for *M. tuberculosis* contains tubercle bacilli, whereas a negative culture contains no detectable tubercle bacilli

droplet nuclei – very small droplets (1 to 5 microns in diameter) that may be expelled when a person who has infectious TB coughs or sneezes; these droplets can remain suspended in the air for several hours, depending on the environment

drug-resistant – able to grow in the presence of a particular drug

drug-susceptible – able to be killed by a particular drug

erythema – redness around the site of the injection when a Mantoux tuberculin skin test is done; erythema is not considered when the reaction size is measured because redness does not indicate that a person has TB infection

extrapulmonary TB – TB disease that occurs in places other than the lungs, such as lymph nodes, pleura, brain, kidneys, or bones; most types of extrapulmonary TB are not infectious

false-negative reaction – a negative reaction to the tuberculin skin test in a person who has TB infection; may be caused by anergy, recent infection (within the past 10 weeks), or very young age (younger than 6 months old)

false-positive reaction – a positive reaction to the tuberculin skin test in a person who does not have TB infection; may be caused by infection with nontuberculous mycobacteria or by vaccination with BCG

immunosuppressive therapy – therapy that suppresses, or weakens, the immune system

induced sputum – sputum that is obtained by having the patient inhale a saline (salt water) mist, causing the patient to cough deeply; this procedure is used to help patients cough up sputum if they cannot do so on their own

induration – swelling that can be felt around the site of injection after a Mantoux tuberculin skin test is done; the reaction size is the diameter of the indurated area (excluding any redness or brusing); measured across the forearm

infectious – capable of spreading infection; a person who has infectious TB disease expels droplets containing *M. tuberculosis* into the air when he/she coughs or sneezes

infiltrate – a collection of fluid and cells in the tissues of the lung; visible on a chest x-ray in people with pulmonary TB disease

malaise – a feeling of general discomfort or illness

Mantoux tuberculin skin test – the preferred method of testing for TB infection; done by using a needle and syringe to inject 0.1 mL of 5 tuberculin units of liquid tuberculin between the layers of the skin (intradermally), usually on the forearm; the reaction to this test, a small swollen area (induration), is measured 48 to 72 hours after the injection and is classified as positive or negative depending on the size of the reaction and the patient's risk factors for TB

media – substances containing special nutrients for growing cultures of bacteria found in specimens

miliary TB – TB disease that occurs when tubercle bacilli enter the bloodstream and are carried to all parts of the body, where they grow and cause disease in multiple sites; the chest x-ray of patients with miliary TB often looks like millet seeds scattered throughout the lung

multiple puncture test – tuberculin skin test done by puncturing the skin of the forearm with a set of short prongs or tines to inject tuberculin (for example, Tine test); although easy to give and

convenient, these tests are not accurate and should not be used to determine whether a person has TB infection

nontuberculous mycobacteria – mycobacteria that do not cause TB disease and are not usually spread from person to person; one example is *M. avium* complex

pathogenesis – how an infection or disease develops in the body

pulmonary TB – TB disease that occurs in the lungs (about 85% of all U.S. cases), typically causing a cough and an abnormal chest x-ray; pulmonary TB is usually infectious if untreated

purified protein derivative (PPD) – the type of tuberculin used in the Mantoux tuberculin skin test

QuantiFERON®-TB gold test (QFT-G) – a blood test used as an aid in diagnosing latent TB infection and TB disease; this test requires only a single patient encounter, and the result can be ready within 1 day; QFT-G appears to be capable of distinguishing between the sensitization caused by *M. tuberculosis* infection and that caused by BCG vaccination

silicosis – a lung disease caused by inhaling silica dust, which is used in the production of glass and ceramics; occurs most often in mining and foundry workers

skin test conversion – a change in a skin test reaction from negative to positive between screening intervals

smear – a specimen that has been spread onto a glass slide, stained, washed in an acid solution, and then placed under the microscope for examination; used to detect AFB in a specimen

sputum – phlegm from deep in the lungs, collected in a sterile container for processing and examination

transmission – the spread of an organism, such as *M. tuberculosis*, from one person to another; depends on the contagiousness of the patient, the type of environment, and the length of exposure

tubercle bacilli – another name for *Mycobacterium tuberculosis* organisms, which cause TB disease

tuberculin – protein derived from tubercle bacilli that have been killed by heating; used to determine whether a person has TB infection. Tuberculin is not a vaccine and cannot cause TB

tuberculin skin test – a test used to detect TB infection

two-step testing – a strategy used in TB screening programs to distinguish a boosted reaction (caused by TB infection that occurred many years before the skin test) from a reaction caused by recent infection. If a person has a negative reaction to an initial skin test, a second test is give 1 to 3 weeks later; a positive reaction to the second test probably represents a boosted reaction, not recent infection. Two-step testing is used in many TB screening programs for skin testing employees when they start their job.

Fundamentals of Tuberculosis (TB)

1

TB in the United States

- From 1953 to 1984, reported cases decreased by approximately 5.6% each year
- From 1985 to 1992, reported cases increased by 20%
- 25,313 cases reported in 1993
- Since 1993, cases are steadily declining

2

Factors Contributing to the Increase in TB Cases

- HIV epidemic
- Increased immigration from high-prevalence countries
- Transmission of TB in congregate settings (e.g., correctional facilities, long term care)
- Deterioration of the public health care infrastructure

3

Transmission and Pathogenesis of TB

- Caused by *Mycobacterium tuberculosis (M. tuberculosis)*
- Spread person to person through airborne particles that contain *M. tuberculosis*, called droplet nuclei
- Transmission occurs when an infectious person coughs, sneezes, laughs, or sings
- Prolonged contact needed for transmission
- 10% of infected persons will develop TB disease at some point in their lives

4

Sites of TB Disease

- Pulmonary TB occurs in the lungs
  - 85% of all TB cases are pulmonary
- Extrapulmonary TB occurs in places other than the lungs, including the:
  - Larynx
  - Lymph nodes
  - Brain and spine
  - Kidneys
  - Bones and joints
- Miliary TB occurs when tubercle bacilli enter the bloodstream and are carried to all parts of the body

5

Not Everyone Exposed Becomes Infected

- Probability of transmission depends on:
  - Infectiousness
  - Type of environment
  - Length of exposure
- 10% of infected persons will develop TB disease at some point in their lives
  - 5% within 1-2 years
  - 5% at some point in their lives

6

Persons at Risk for Developing TB Disease

- Persons at high risk for developing TB disease fall into 2 categories
  - Those who have been recently infected
  - Those with clinical conditions that increase their risk of progressing from LTBI to TB disease

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Recent Infection as a Risk Factor

Persons more likely to have been recently infected include

- Close contacts to persons with infectious TB
- Skin test converters (within past 2 years)
- Recent immigrants from TB-endemic areas (within 5 years of arrival to the U.S.)
- Children ≤ 5 years with a positive TST
- Residents and employees of high-risk congregate settings (e.g. correctional facilities, homeless shelters, healthcare facilities)

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Increased Risk for Progression to TB Disease

Persons more likely to progress from LTBI to TB disease include

- HIV infected persons
- Those with history of prior, untreated TB
- Underweight or malnourished persons
- Injection drug use
- Those receiving TNF-α antagonists for treatment of rheumatoid arthritis or Crohn's disease
- Certain medical conditions

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Latent TB Infection (LTBI)

- Occurs when person breathes in bacteria and it reaches the air sacs (alveoli) of lung
- Immune system keeps bacilli contained and under control
- Person is not infectious and has no symptoms

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TB Disease

- Occurs when immune system cannot keep bacilli contained
- Bacilli begin to multiply rapidly
- Person develops TB symptoms

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LTBI vs. TB Disease

LTBI	TB Disease
Tubercle bacilli in the body	
TST or QFT-Gold® result usually positive	
Chest x-ray usually normal	Chest x-ray usually abnormal
Sputum smears and cultures negative	Symptoms smears and cultures 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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Targeted Testing

- Detects persons with LTBI who would benefit from treatment
- De-emphasize testing of groups of people who are not at risk (mass screening)
- Consider using a risk assessment tool
- Testing should be done only if there is an intent to treat
- Can help reduce the waste of resources and prevent unnecessary treatment

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Groups to Target with the Tuberculin Skin Test

- Persons with or at risk for HIV infection
- Close contacts of persons with infectious TB
- Persons with certain medical conditions
- Injection drug users
- Foreign-born persons from areas where TB is common
- Medically underserved, low-income populations
- Residents of high-risk congregate settings
- Locally identified high-prevalence groups

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Administering the TST

- Use Mantoux tuberculin skin test
- 0.1 mL of 5-TU of purified protein derivative (PPD) solution injected intradermally
- Use a 27 gauge needle
- Produce a wheal that is 6-10mm in diameter

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Reading the TST

- Read within 48-72 hours
- Measure induration, not erythema
- Positive reactions can be measured accurately for up to 7 days
- Negative reactions can be read accurately for only 72 hours

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TST Interpretation - 1

5 mm of induration is positive in:

- HIV-infected persons
- Close contacts to an infectious TB case
- Persons who have chest x-ray findings consistent with prior untreated TB
- Organ transplant recipients
- Persons who are immunosuppressed (e.g., those taking the equivalent of >15 mg/d of prednisone for 1 month or those taking TNF-α antagonists)

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TST Interpretation - 2

10 mm induration is positive in:

- Recent immigrants (within last 5 years) from a high-prevalence country
- Injection drug users
- Persons with other high-risk medical conditions
- Residents or employees of high-risk congregate settings
- Mycobacteriology laboratory personnel
- Children < 4 years of age; infants, children, and adolescents exposed to adults at high risk

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TST Interpretation - 3

15 mm induration is positive in:

- Persons with no known risk factors for TB

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Recording TST Results

- Record results in millimeters of induration, not “negative” or “positive”
- Only trained healthcare professionals should read and interpret TST results

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False Positive TST Reactions

- Nontuberculous mycobacteria
  - Reactions are usually ≤10mm of induration
- BCG vaccination
  - Reactivity in BCG vaccine recipients generally wanes over time
  - Positive TST results is likely due to TB infection if risk factors are present
  - BCG-vaccinated persons with positive TST result should be evaluated for treatment of LTBI
  - QFT is able to distinguish *M.tb* from other mycobacteria and BCG vaccine

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False Negative TST Reactions

- Anergy, or inability to react to TST because of weakened immune system
- Recent TB infection (2-10 weeks after exposure)
- Very young age (newborns)
- Recent live-virus vaccination can temporarily suppress TST reactivity
- Poor TST administration technique (too shallow or too deep, or wheal is too small)

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Boosting

- Some people with history of LTBI lose their ability to react to tuberculin (immune system "forgets" how to react to TB-like substance, i.e., PPD)
- Initial TST may stimulate (boost) the ability to react to tuberculin
- Positive reactions to subsequent tests may be misinterpreted as new infections rather than "boosted" reactions

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Two-Step Testing - 1

- A strategy for differentiating between boosted reactions and reactions caused by recent TB infection
- Use two-step testing for initial (baseline) skin testing of adults who will be re-tested periodically
- 2nd skin test given 1-3 weeks after baseline

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Two-Step Testing - 2

- If the 1st TST is positive, consider the person infected
- If the 1st TST is negative, administer 2nd TST in 1-3 weeks
- If the 2nd TST is positive, consider the person infected
- If the 2nd TST is negative, consider the person uninfected at baseline

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Infectiousness - 1

- Patients should be considered infectious if they:
  - Are undergoing cough-inducing procedures
  - Have sputum smears positive for acid-fast bacilli (AFB) and:
    - Are not receiving treatment
    - Have just started treatment, or
    - Have a poor clinical or bacterial response to treatment
  - Have cavitary disease
- Extrapulmonary TB patients are not infectious

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Infectiousness - 2

- Patients are not considered infectious if they meet all these criteria:
  - Received adequate treatment for 2-3 weeks
  - Favorable clinical response to treatment
  - 3 consecutive negative sputum smears results from sputum collected on different days

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Techniques to Decrease TB Transmission

- Instruct patient to:
  - Cover mouth when coughing or sneezing
  - Wear mask as instructed
  - Open windows to assure proper ventilation
  - Do not go to work or school until instructed by physician
  - Avoid public places
  - Limit visitors
  - Maintain home or hospital isolation as ordered

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Evaluation for TB

- Medical history
- Physical examination
- Mantoux tuberculin skin test
- Chest x-ray
- Bacteriologic exam (smear and culture)

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Symptoms of TB

- Productive prolonged cough*
- Chest pain*
- Hemoptysis*
- Fever and chills
- Night sweats
- Fatigue
- Loss of appetite
- Weight loss

*Commonly seen in cases of pulmonary TB

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Chest x-Ray

- Obtain chest x-ray for patients with positive TST results or with symptoms suggestive of TB
- Abnormal chest x-ray, by itself, cannot confirm the diagnosis of TB but can be used in conjunction with other diagnostic indicators

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Sputum Collection

- Sputum specimens are essential to confirm TB
  - Specimens should be from lung secretions, not saliva
- Collect 3 specimens on 3 different days
- Spontaneous morning sputum more desirable than induced specimens
- Collect sputum before treatment is initiated

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Smear Examination

- Strongly consider TB in patients with smears containing acid-fast bacilli (AFB)
- Use subsequent smear examinations to assess patient's infectiousness and response to treatment

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Culture

- Used to confirm diagnosis of TB
- Culture all specimens, even if smear is negative
- Initial drug isolate should be used to determine drug susceptibility

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Treatment of Latent TB Infection

- Daily Isoniazid therapy for 9 months
  - Monitor patients for signs and symptoms of hepatitis and peripheral neuropathy
- Alternate regimen – Rifampin for 4 months

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Treatment of TB Disease

- Include four 1st-line drugs in initial regimen
  - Isoniazid (INH)
  - Rifampin (RIF)
  - Pyrazinamide (PZA)
  - Ethambutol (EMB)
- Adjust regimen when drug susceptibility results become available or if patient has difficulty with any of the medications
- Never add a single drug to a failing regimen
- Promote adherence and ensure treatment completion

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Directly Observed Therapy (DOT)

- Health care worker watches patient swallow each dose of medication
- DOT is the best way to ensure adherence
- Should be used with all intermittent regimens
- Reduces relapse of TB disease and acquired drug resistance

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Clinical Monitoring

Instruct patients taking TB medications to immediately report the following:

- Rash
- Nausea, loss of appetite, vomiting, abdominal pain
- Persistently dark urine
- Fatigue or weakness
- Persistent numbness in hands or feet

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Drug Resistance

- Primary - infection with a strain of *M. tuberculosis* that is already resistant to one or more drugs
- Acquired - infection with a strain of *M. tuberculosis* that becomes drug resistant due to inappropriate or inadequate treatment

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Barriers to Adherence

- Stigma
- Extensive duration of treatment
- Adverse reactions to medications
- Concerns of toxicity
- Lack of knowledge about TB and its treatment

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Improving Adherence

- Adherence is the responsibility of the provider, not the patient and can be ensured by:
  - Patient education
  - Directly observed therapy (DOT)
  - Case management
  - Incentives/enablers

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Measures to Promote Adherence

- Develop an individualized treatment plan for each patient
- Provide culturally and linguistically appropriate care to patient
- Educate patient about TB, medication dosage, and possible adverse reactions
- Use incentives and enablers to address barriers
- Facilitate access to health and social services

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Completion of Therapy

- Based on total number of doses administered, not duration of treatment
- Extend or re-start if there were frequent or prolonged interruptions

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Meeting the Challenge

- Prevent TB by assessing risk factors
- If risk is present, perform TST
- If TST is positive, rule out active disease
- If active disease is ruled out, initiate treatment for LTBI
- If treatment is initiated, ensure completion

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Remember

"A decision to test is a decision to treat."

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