- After 2 or more years of annual screening, if the annual risk of infection (based on TST conversion rate in those screened) is shown to be less than 0.5%, consultation should be made with the OCPHO to consider the possibility of reducing the frequency of screening and/or restricting annual screening to fewer workers who are at higher risk, and not testing the remaining workers except after exposure.

Post-Exposure:

- Single TST 8 weeks after exposure for TST-negative HCPs exposed without adequate protection to people with respiratory TB disease.
    - For previously TST-positive HCPs exposed to people with respiratory TB disease without adequate protection refer for medical evaluation and educate on signs and symptoms of active TB disease.

Employers have reported greater success in encouraging HCPs to participate in screening programs when they are performed in conjunction with some other required activity (e.g. orientation, Workplace Hazardous Materials Information System (WHMIS) training, employee updates, vaccination days).

The Tuberculin Skin Test (TST)

The TST is the standard method of determining whether a person is infected with MTB and is the test of choice for serial screening purposes. It consists of an intradermal injection of a small amount of purified protein derivative (PPD), derived from *Mycobacterium tuberculosis* bacteria. These extracts are also referred to as tuberculins. Its components have antigenic properties triggering a cell-mediated delayed hypersensitivity response that the immune system recognizes due to its similarities with the tubercle bacilli causing infection. This reaction is limited to the site of injection.

Epinephrine hydrochloride solution (1:1000) and other appropriate agents should be routinely available for immediate use in case an anaphylactic or other acute hypersensitivity reaction occurs. Health care providers should be familiar with the current recommendations of the National Advisory Committee on Immunization (NACI) on monitoring the patient for immediate reactions over a period of at least 15 minutes after inoculation and for the initial management of anaphylaxis in non-hospital settings.

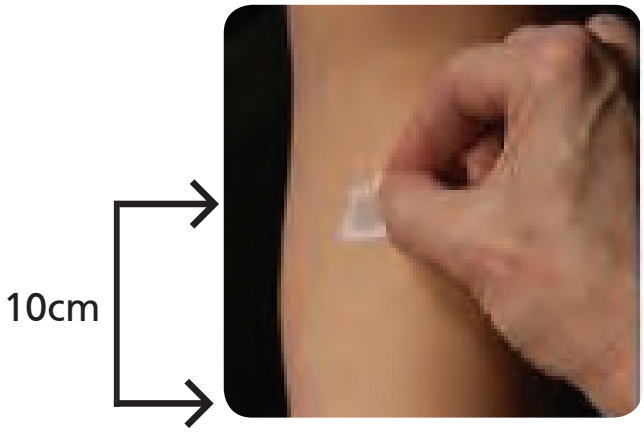
TST Technique

The TST is an intradermal test conducted in three stages: 1) Administration 2) Reading 3) Interpretation. All tests should be performed, measured and interpreted by a **trained** health care professional. A positive test should be confirmed by two people with experience in interpreting the TST.

Administration of the TST

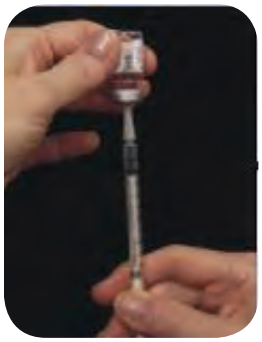
- Tubersol® 5 tuberculin units (5-TU) of purified protein derivative – standard (PPD-S) is recommended in Canada. Store at 2° to 8° C, but do not freeze. Discard the solution if frozen.
- Remove the tuberculin solution from the vial under aseptic conditions. A little more than 0.1ml of PPD solution should be drawn into the TB syringe. Hold the syringe upright and lightly tap out the air, then expel one drop. Check that a full 0.1ml remains in the syringe.
- Do not transfer the solution from one container to another (the potency of the PPD may be diminished).
- Draw up the solution just before injecting it. Do not preload syringes for later use as the potency of the PPD may be diminished.
- The solution can be adversely affected by exposure to light. PPD should be stored in the dark except when doses are actually being withdrawn from the vial.
- Discard the solution if the vial has been in use for longer than 1 month or for an undetermined amount of time (the potency of the solution may be diminished).
- Use the solution within 1 month after opening. Label each bottle with the discard date when it is opened.
- If the TST is accidentally given as a subcutaneous or an intramuscular injection, this should not pose a serious problem. It is possible that tuberculin-sensitive people would have localized inflammation, which should be self-limited. It would not be possible to take a measurement of or clinically interpret any such reaction, so the TST should be administered again *but using proper intradermal technique* on the volar surface of the forearm. This should be done immediately (as soon as it is realized that the injection was too deep).

1. Locate and clean injection site

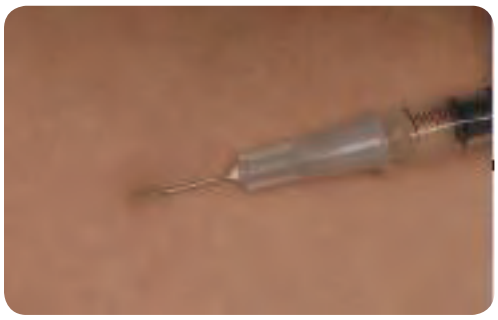


- Avoid any areas with abrasions, swelling, visible veins or lesions
- Use inner aspect of forearm about 10cm below elbow
- Cleanse the area with an alcohol swab and let it dry

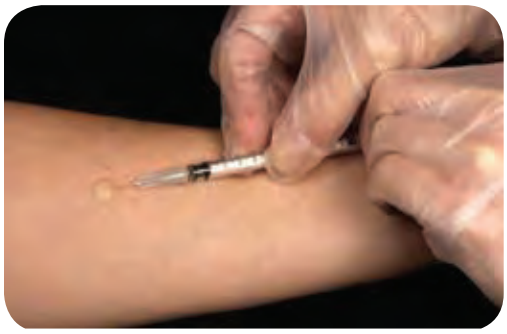
2. Prepare Syringe



3. Inject Tuberculin



Insert slow intradermal injection, bevel up at 5–15° degrees



After injection, look for a tense, pale wheal at needle point

4. Record Information

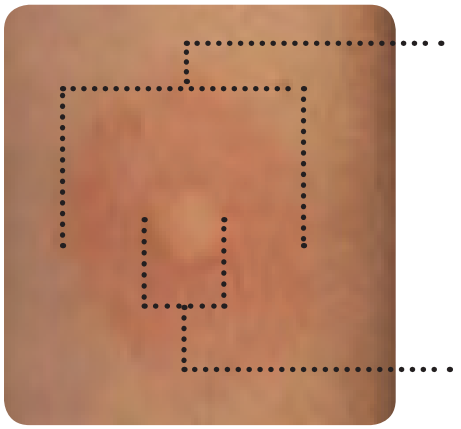
- Record all the information required for documentation:
  - Date of injection
  - Dose
  - Lot #
  - Manufacturer
  - Expiration date
  - Site of injection
  - Person administering the TST

Reading of the TST

The TST should be read 48–72 hours after administration as the reaction to tuberculin causes maximal induration at 48–72 hours and subsides over a period of days. After 72 hours it is difficult to interpret a reaction.

Reactions may persist for up to 1 week, but for as many as 21% of individuals with a positive reaction at 48 to 72 hours the reaction will be negative after 1 week. If the TST cannot be read within 72 hours because of unforeseen circumstances, it should be repeated at a location far enough from the previous test that the reactions do not overlap. **No minimum wait is required before the repeat test.**

1. Inspect Site



Erythema (redness)
Do Not Measure

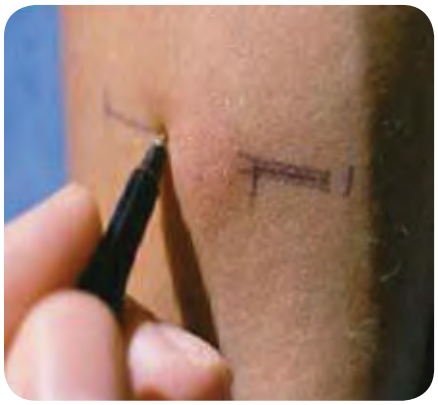
Visually inspect under appropriate lighting

Measure Induration
(hard, dense, raised formation)

2. Palpate Induration

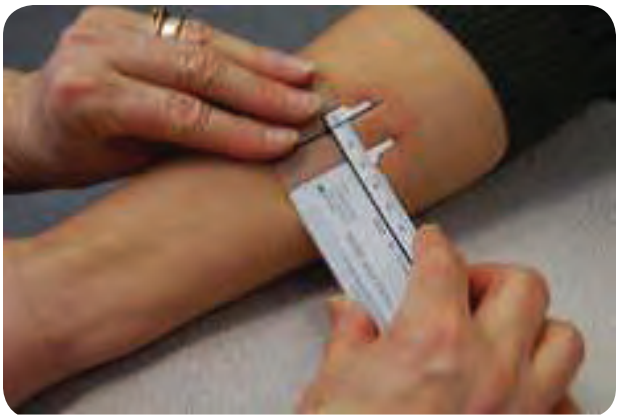
Use fingertips to find margins of induration

3. Mark Induration



- Mark the border of induration by moving the tip of a pen at a 45° angle laterally toward the site of the injection
- The tip will stop at the edge of induration if present.

4. Measure induration (not redness)



- Use a caliper ruler to measure the distance between the pen marks, reflecting the **transverse** diameter of the induration
- Disregard the redness
- Record no induration as "0mm".
- Do not round off the diameter of the induration to the nearest 5mm as this can interfere with determining whether TST conversion has occurred in the event of a future TST. If the measurement falls between demarcations on the rules, the smaller of the two numbers should be recorded.

5. Record measurement of transverse induration in mm.

- Record all the information required for documentation:
  - Date the induration was read
  - Transverse measurement of induration in mm (this is recorded as one number i.e. 18mm not 18mm x15mm). All TST readings, whether negative or positive should be recorded numerically and NEVER recorded as "negative" or "positive"
  - Any adverse reactions
  - Name of individual reading the test
  - Provide a record of the TST result to the individual tested

*All test results should be recorded on the **NWT Tuberculosis Surveillance form** and reported to the OCPHO (as per Public Health Act (2009)

Interpretation of the TST

When a TST is performed, the final result reflects a biological response that is presented as a TST reaction at the site of TST testing. This reaction will help determine if an individual is possibly infected with TB.

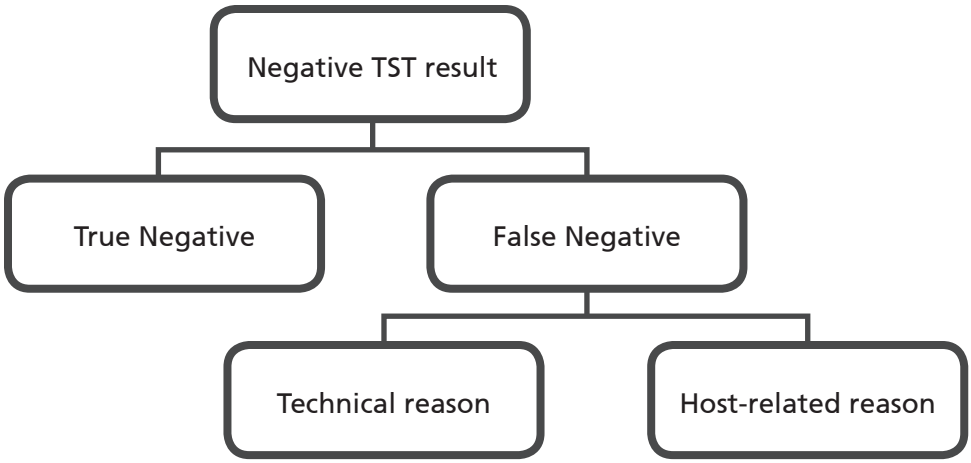
Many factors can influence how a TST is interpreted. This is discussed in the following sections.

A negative test results occurs if:

- No reaction at TST testing site
- Induration is less than 5mm

There are some circumstances that cause a result to be a false negative. There are technical and host-related factors that can influence this to happen.

Figure 4.1: TST Interpretation



Technical-related factors that cause *false negative* TSTs include the following:

- Tuberculin used
  - Improper storage
  - Improper dilution
  - Chemical denaturation
  - Contamination
  - Adsorption
- Poor technique
  - Injection of too little antigen
  - Subcutaneous injection
  - Delayed administration after drawing into syringe
  - Injection too close to other skin tests
- Reader variability
  - Inexperienced reader
  - Error in recording
  - Conscious or unconscious bias

Host-related factors that have been shown to cause a *false negative* TST are mostly for biological reasons, and include the following:

- Immunosuppression due to
  - Advanced age
  - Treatment with corticosteroids (≥15mg/day of prednisone or equivalent)
  - Cancer treatment agents
  - HIV infection (especially CD4 count <500 x 10^6/L)
  - Tumor necrosis factor (TNF)- alpha inhibitors
- Malnutrition (particularly if recent weight loss)
- Severe illness (including active TB)
- Major viral illness (including mononucleosis, mumps or measles)
- Immunization with live vaccines within 4 weeks such as Measles, Mumps, Rubella, Varicella (chicken pox) or Yellow Fever
- Very young age (less than 6 months)

Individuals with an impaired immune response are unable to react to a TST test. They are referred to having an **anergic response**. As described above, a negative TST does not exclude the possibility of having TB infection or disease due to the numerous factors that can cause this to happen.

Size

The first dimension is the size of the TST reaction. Three cut points have been established according to the sensitivity and the specificity of the TST test and the prevalence of tuberculosis in different groups.

Table 4.1: Tuberculin Skin Test Cut-points for Interpretation of the TST

TST Result	Indication*
0–4mm	In general this is considered negative and no treatment is indicated[†]
	Child less than 5 years of age and high risk of TB infection[‡]
≥5mm	HIV infection
	Contact with infectious TB within the past 2 years
	Fibronodular disease on chest x-ray (healed TB and not previously treated)
	Organ transplantation (related to immune suppressant therapy)**
	TNF alpha inhibitors
	Other immunosuppressive drugs, e.g. corticosteroids (equivalent of ≥15mg/day of prednisone for 1 month or more; risk of TB disease increases with higher dose and longer duration)
	End-stage renal disease
≥10mm	TST conversion (within 2 years)
	Diabetes, malnutrition (<90% ideal body weight), cigarette smoking, daily alcohol consumption (>3 drinks/day)
	Silicosis
	End-stage renal disease
	Hematologic malignancies (leukemia, lymphoma) and certain carcinomas (e.g. head and neck)

*Age >35 years is not a contraindication to treatment of LTBI if the risk of progression to active TB disease is greater than the risk of serious adverse reactions to treatment.

[†]Treatment with INH of people with HIV infection who were TST negative (0–4mm) and/or anergic was of no benefit in several randomized trials. Other authorities suggest this treatment may be considered in the presence of HIV infection of other cause of severe immunosuppression AND high risk of TB infection (contact with infectious TB, from high TB incidence country or abnormal chest x-ray consistent with prior TB infection). Hence any decision to give treatment should be individualized in consultation with a TB expert.

[‡]If first TST test is negative, begin treatment immediately. Repeat TST 8 weeks after exposure to infectious TB case ended. Treatment can be stopped in a healthy child if repeat TST is negative. In children <6 months of age the immune system may not be mature enough to produce a positive TST, even if the child is infected.
See **Section 9, Pediatric Tuberculosis**.

**LTBI therapy is often given to people in whom transplantation is planned but before the actual transplantation.

Positive Predictive Value of TST

Another consideration of the interpretation of the TST is the positive predictive value (PPV) of the TST. PPV is the likelihood a positive test, represents a true TB infection. The higher the PPV, the more confident you are in the positive test result of the TST. You can estimate what the PPV is by considering the following factors: the prevalence of TB where the patient is from and if the patient is exposed to anything that causes the TST result to be falsely positive.

The PPV is influenced by the prevalence of TB in the population. Therefore the higher the prevalence of TB, the more confident you are in the positive result of the TST.

There are two main reasons that would cause a false positive reaction decreasing the specificity of the TST and in turn decreasing the PPV. The first are non-tuberculosis mycobacteria or NTM, which do not cause tuberculosis. However, the similarities of NTM with *M. tuberculosis* cause a cross-reaction in people with past exposure to NTM leading to a small positive tuberculin reaction (5–9mm). NTM are not very common in Canada but prior NTM exposure should be considered in patients from tropical, subtropical, or warm temperate climates.

Size	Positive Predictive Value of TST	Risk of developing active disease
• Is the patient immunocompromised? • Has there been a recent exposure to an active case? • Do they have an abnormal CXR?	• Past exposure to NTM? • Previous vaccination with BCG? • Are they from a community with high/ low prevalence of TB?	• Are they among the high, increased or low risk categories?

The second reason is due to prior BCG vaccination. If vaccinated with BCG in the past, it can influence the result of the TST. People vaccinated **after** 12 months of age have a greater chance of causing this false TST reaction. Populations who may have received BCG include:

- Persons born in developed countries or where TB is endemic
- Aboriginal persons from communities with high rates of TB (in the NWT most infants vaccinated with BCG are vaccinated in infancy <12 months of age)
- Older Canadian-born persons, particularly health care practitioners

BCG vaccination can be ignored as a cause of a positive TST under the following circumstances:

- BCG vaccination was given in infancy, and the person tested is now aged 10 years or older
- There is a high probability of TB infection: such as those persons who are close contacts of an infectious TB case, Aboriginal Canadians from a high-risk community or immigrants/visitors from a country with high TB incidence
- There is high risk of progression from TB infection to disease

BCG should be considered the likely cause of a positive TST under the following circumstances:

- BCG vaccine was given after 12 months of age AND
  - There has been no known exposure to active TB disease or other risk factors AND
  - The person is either Canadian-born non-Aboriginal OR
  - An immigrant/visitor from a country with low TB incidence.

Figure 4.2: The BCG World Atlas

http://www.bcgatlas.org/