



# TB Infection Control

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Has the following disclosures to make:

- No conflict of interests
- No relevant financial relationships with any commercial companies pertaining to this activity



# TB Infection Control

*Heartland National TB Center  
TB Nurse Case Management*



Public Health

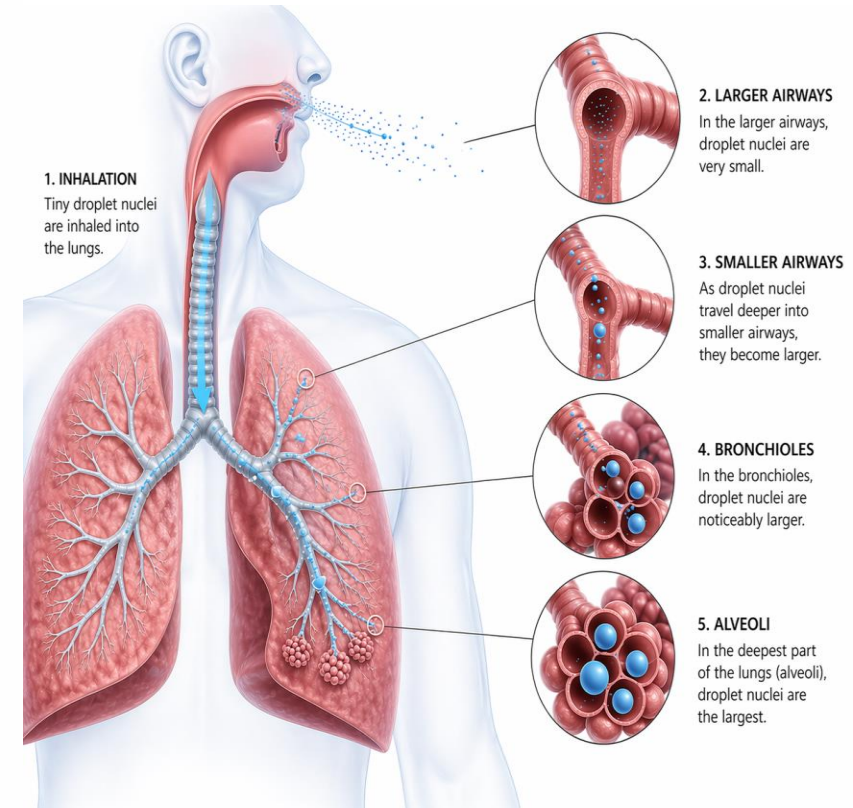
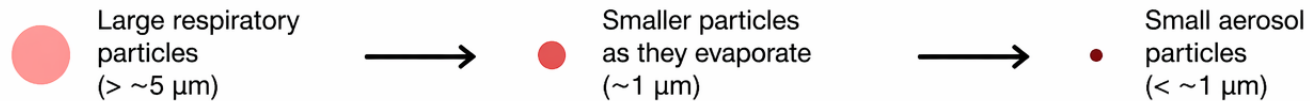
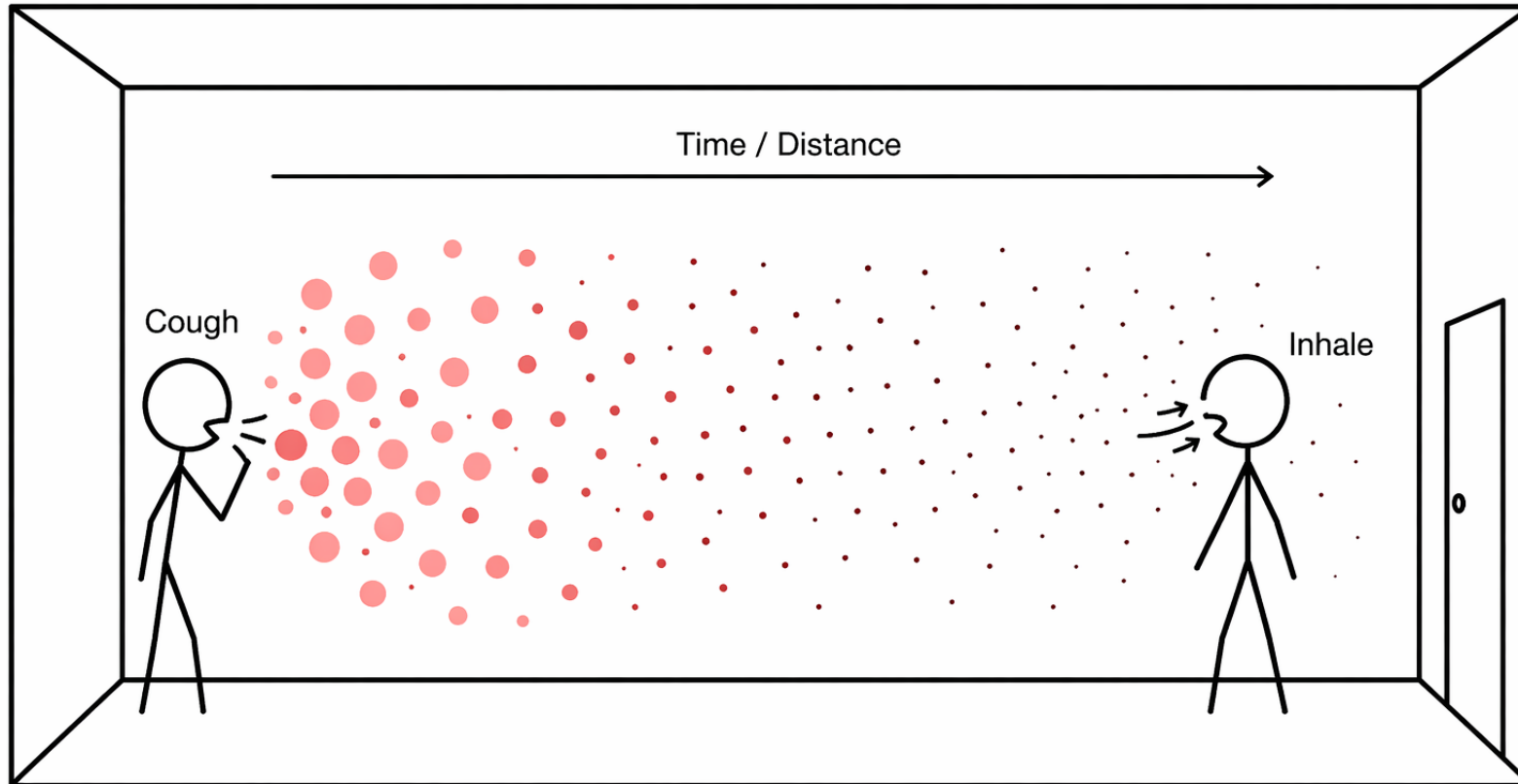
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# Objectives

- Infection Control Measures in a clinic or hospital setting:
  - Identify the hierarchy in a TB infection control program.
  - Choose the best respiratory protection for the patient and health care worker.
  - Reduce transmission by manipulating space, ventilation, and air cleaning methods.
- Identify if a TB patient is infectious, and if so, when a TB patient is considered non-infectious:
  - Determine risk of infectiousness.
  - Know when to place your patient on isolation precautions.
  - Know when it is safe to allow your patient to return to work/ school/community activities.

# TB Infection Control



# Hierarchy of Controls

## Administrative

- Reduces the risk of exposure to potential TB cases by managing *people* and *policies*.

## Environmental

- Reduce concentration of droplet nuclei by managing and treating *the air*.

## Respiratory protection

- Proper use of *personal protective equipment (PPE)* in certain scenarios

# Administrative Controls

Recommendations to reduce M.TB transmission **through policy and practice:**

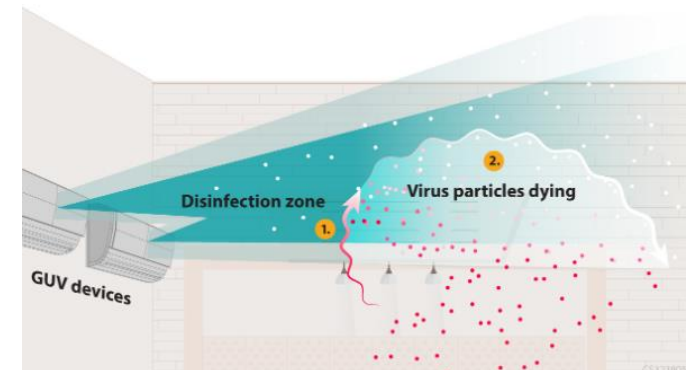
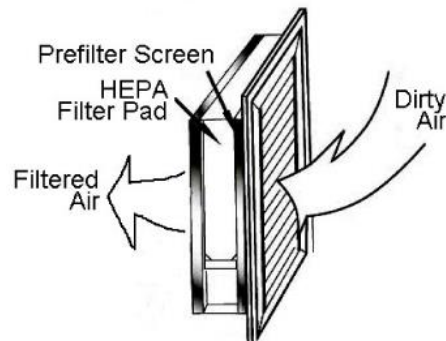
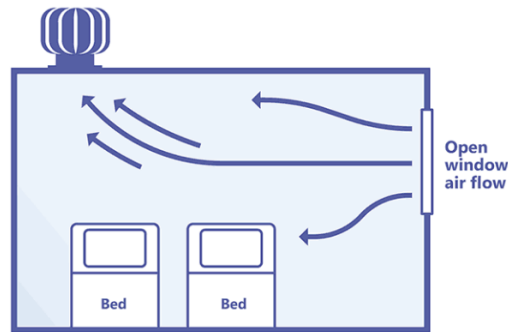
Policies, procedures and guidelines on controls used to prevent TB transmission including triage, environmental measures and maintenance, respiratory protection control, and worker training.

- Triage people with TB s/s or w/ TB disease.
- Physical “isolation” by of people w/ presumed or demonstrated infectious TB.
- Pharmacologic “isolation” by prompt initiation of effective TB treatment /Anti-TB Treatment (ATT) of people w/ TB disease.
- Respiratory hygiene (including cough etiquette) in people w/ presumed or confirmed TB.

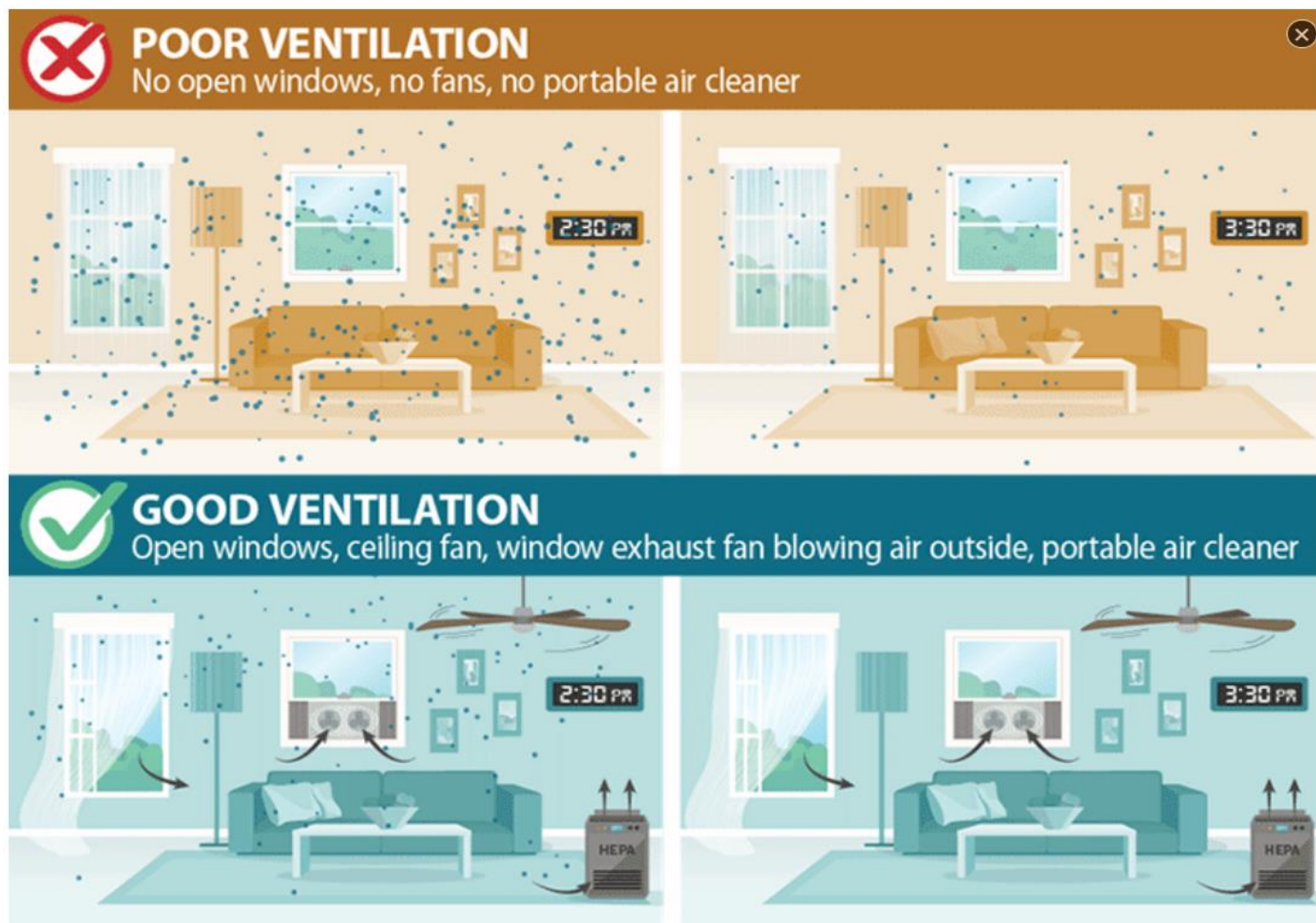
# Environmental (engineering) Controls

**Reduce concentration of infectious bacilli in air in areas where contamination is likely:**

- Upper-room germicidal ultraviolet (GUV) systems – uses UV light to kill microorganisms
- Ventilation systems (including natural, mixed-mode, mechanical ventilation and recirculated air through high-efficiency particulate air (HEPA) filters
- All (airborne infection isolation room)(negative pressure room)
- Airflow



# Examples of Ventilation in Home Settings

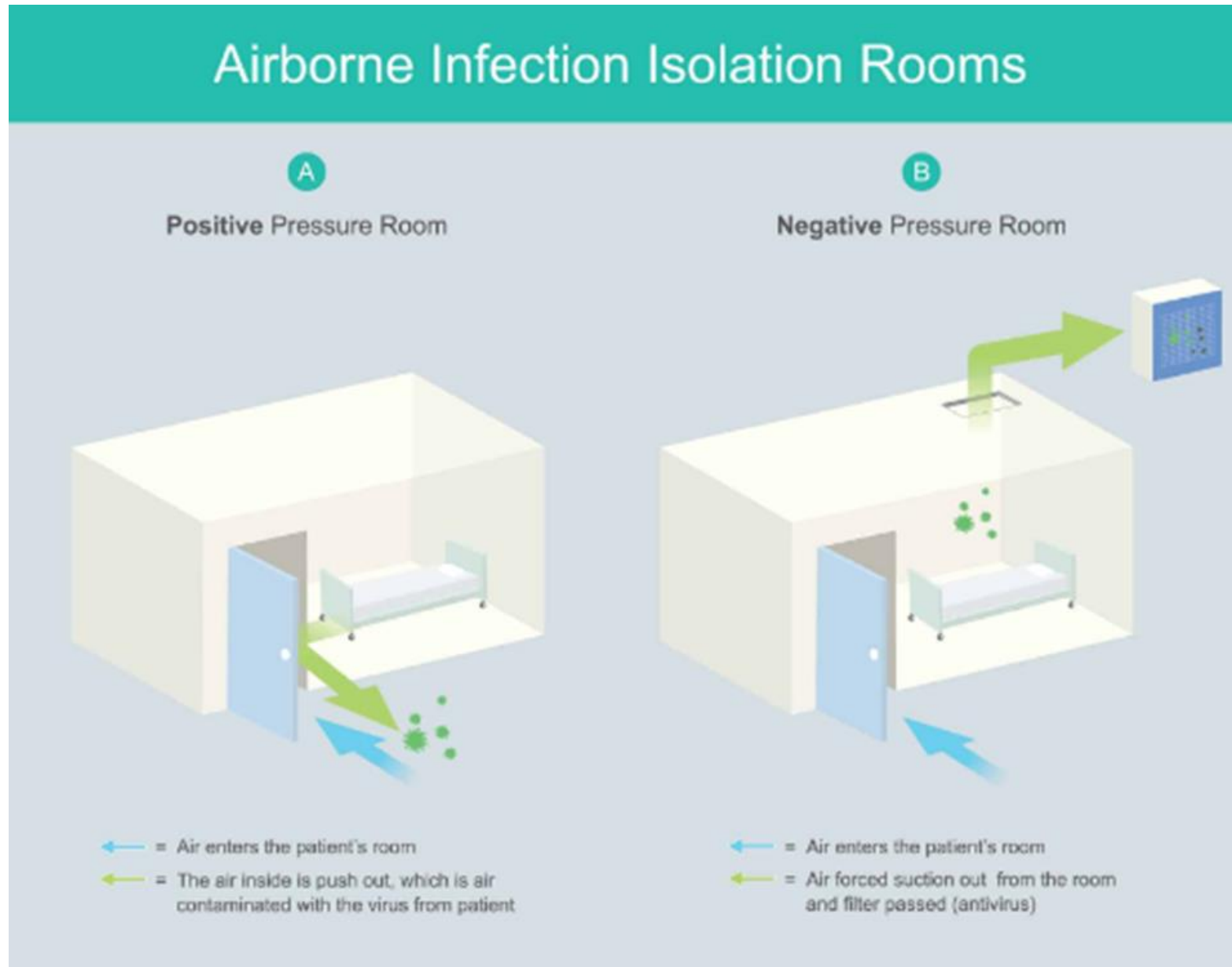


# Relative Pressure - Positive, Negative, or Neutral

**Positive:** More air delivered to room than is exhausted. Pushes out of the room relative an adjacent area . You don't want you're TB exam room positive relative to the hall.

**Negative** moves air into the room. More air is exhausted than delivered. This is required for your airborne isolation rooms.

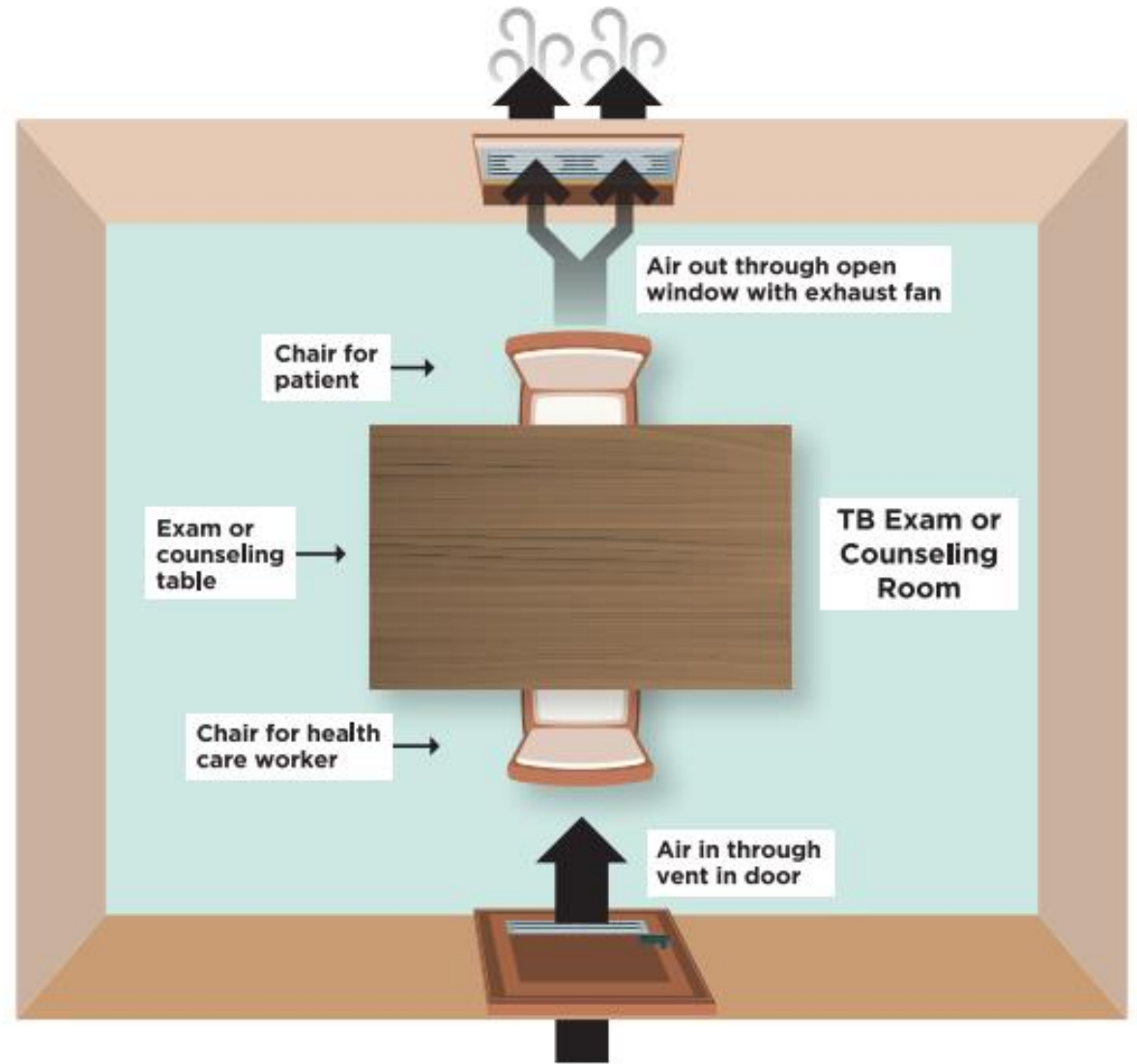
**Neutral** or light positive is the normal for most clinic type settings.



# Ventilation for Clinic Exam Rooms

Open doors, louvers, and windows to bring in fresh air from outside and allow for the escape of contaminated room air.

Fan-assisted Natural Ventilation in TB Exam or Counseling Room



# Airborne Containment Removal

Air change per hour (ACH) is the number of times that the total air volume in a room or space is completely removed and replaced in an hour.

The effective number of ACH can be increased by using cleaners (i.e. , HEPA filtering devices)

**Air changes per hour (ACH) and time required for removal efficiencies of 99% and 99.9% of airborne contaminants\***

| ACH | 99%                                      | 99.9% |
|-----|--|-------|
|     | Minutes Required for Removal Efficiency† |       |
| 2   | 138                                      | 207   |
| 4   | 69                                       | 104   |
| 6   | 46                                       | 69    |
| 12  | 23                                       | 35    |
| 15  | 18                                       | 28    |
| 20  | 14                                       | 21    |
| 50  | 6  | 8     |
| 400 | <1                                       | 1     |

\* This table can be used to estimate the time necessary to clear the air of airborne *Mycobacterium tuberculosis* after the source patient leaves the area or when aerosol-producing procedures are complete.

† Time in minutes to reduce the airborne concentration by 99% or 99.9%.

# Respiratory Protection

**Protect personnel** who must work in environments with contaminated air:

- Personal respiratory protection within framework of respiratory protection program.
- Program should identify risks, personnel who may be exposed, other mitigations to prevent exposure, and respirator selection, program administration
- Particulate respirators (N95)

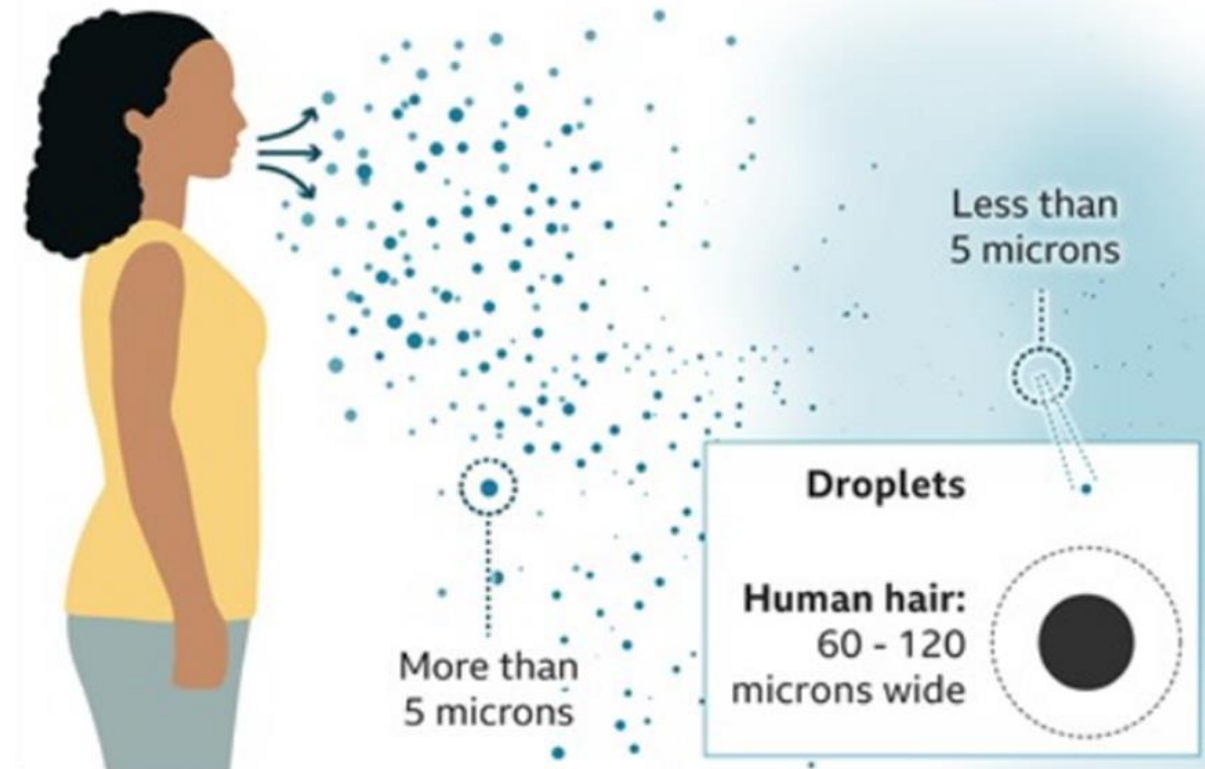
## The difference between droplet and airborne transmission

### Droplet transmission

Coughs and sneezes can spread droplets of saliva and mucus

### Airborne transmission

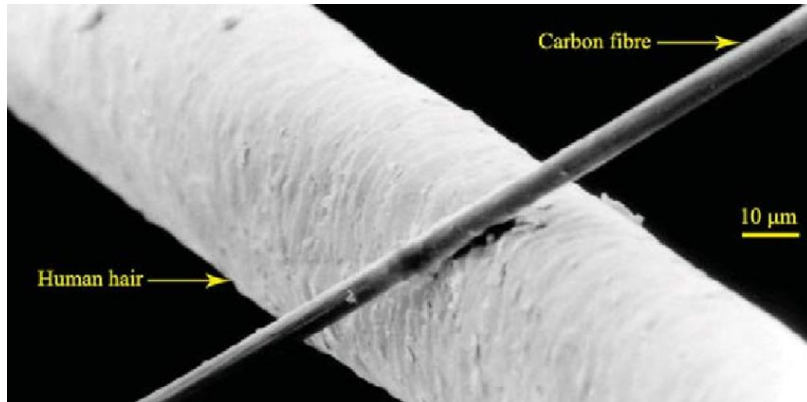
Tiny particles, possibly produced by talking, are suspended in the air for longer and travel further



Source: WHO

BBC

# How Big are droplet nuclei?



6 µm diameter carbon filament compared to 50 µm diameter human hair

< 5 µm; contains 1 – 3 MTB

1 – 10 µm – diameter of typical bacterium

3 – 8 µm – width of a strand of spider web silk

50 - 100 µm diameter of human hair

# Respiratory Protection



*The TB patient (left) is wearing a surgical mask. The health care worker (right) is wearing a filtering facepiece respirator (FFR).*

- Per CDC, the minimum respiratory protection a health care worker should wear is a **filtering facepiece respirator (FFR)** to prevent the inhalation of airborne droplet nuclei. Specifically, the N95 or better FFR.
- Patients with infectious TB should wear a **surgical mask** to reduce droplet production.
  - **Patients should not be wearing N95 respirators.**
  - N95s can increase work of breathing associated with pulmonary TB, as they have more resistance to breathing than surgical masks.
  - Use of surgical masks on persons with TB has been shown to decrease transmission to guinea pigs by over 50% (.).
  - There may be circumstances where it may be reasonable to ask a person with TB to temporarily wear a surgical mask inside an AII room. However, a worker should always wear their respirator when in an AII room.

# Understanding the Difference

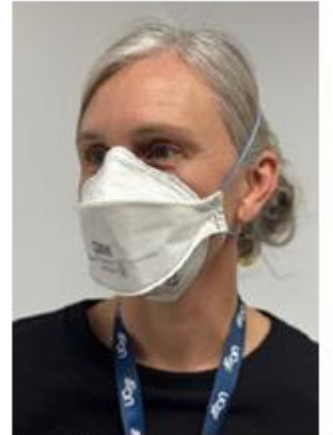
FIGURE 2:  
Surgical mask worn by person with infectious TB during transit through facility



Source: iStock.com/Sasirin Pama



FIGURE 1:  
TB healthcare provider wearing an N95 respirator



Source: CTRC

For the patient: ↗

Warning: If a TB patient is wearing an N95 they can have increased respiratory distress.

For the HCW: ↗

Fit Testing should be done to ensure fit.

# How to tell if your N95 Respirator is NIOSH Approved

## Defining "NIOSH Approved"

The National Institute for Occupational Safety and Health (NIOSH) is the federal agency responsible for testing and approving respirators used in U.S. workplace settings.



Photo courtesy of Shutterstock

A NIOSH-approved N95 is the most common type of filtering facepiece respirator (FFR), which is a type of disposable respirator meant to form a tight seal to the face, removing particles from the air as you breathe through it. This includes all types of particles, such as bacteria, viruses, and dust. When used in an occupational setting, NIOSH-approved respirators, including N95s, are meant to be used as part of a workplace's respiratory protection program. These programs are regulated by the [Occupational Safety and Health Administration \(OSHA\)](#) and must include specific elements such as medical evaluations, [fit testing](#), and training. If your respirator has been approved by NIOSH, you can be confident that it is working as expected to protect you as long as:

- It is properly maintained
- It fits properly
- It is worn and used correctly
- It is replaced as recommended by the manufacturer

NIOSH only approves respirators that pass its strict [quality assurance and performance requirements](#). As part of these tests, NIOSH uses a near worst-case penetrating aerosol size (i.e., particles that are best able to make it through a filter), and an N95 respirator must not allow more than 5% of these particles to penetrate through. This ensures that every respirator that passes these tests will filter potentially hazardous particles as expected when used in real-world situations.

## How to tell if an N95 is NIOSH Approved

The easiest way to tell if your N95 is NIOSH approved is to search for it on the NIOSH [Certified Equipment List \(CEL\)](#). All NIOSH-approved respirators have a testing and certification (TC) approval number (e.g., TC 84A-XXXX), which must be printed on the respirator. The CEL has an option to search by the TC approval number, which will also help identify any private labels (alternate brand names) associated with that approval number. If you search a NIOSH TC approval number and no results are found within the CEL, that means it is not a valid NIOSH approval number and the product is not NIOSH approved. NIOSH also [provides frequently updated lists of all approved FFRs](#) by type (including N95s) and model/part numbers, which include the manufacturer's instructions describing how to put the respirator on correctly.



Example of using the TC approval number search option on the Certified Equipment List

<https://wwwn.cdc.gov/niosh-cel/>



## The National Personal Protective Technology Laboratory (NPPTL)

|                                    |
|------------------------------------|
| Certified Equipment List           |
| Search                             |
| General Cautions and Limitations + |
| Definitions of Terms               |
| Prior Manufacturers Names          |

[Certified Equipment List](#) > [Search](#)

Promoting productive workplaces through safety and health research

### TC (Approval) Number

[Quick Searches](#) [Advanced Search](#) [Instructions and Tips](#)

Maximum number of records returned in a set:

For a specific respirator or respirators, enter the NIOSH TC approval number(s) separated with semi-colon. Each class of respirator must be entered separately. Format with approval code (13F, 13G, 14G, 19C, 21C, 23C or 84A), followed by a dash and the 4 digits following.

### Order the results by:

- Approval Number
- Manufacturer Name

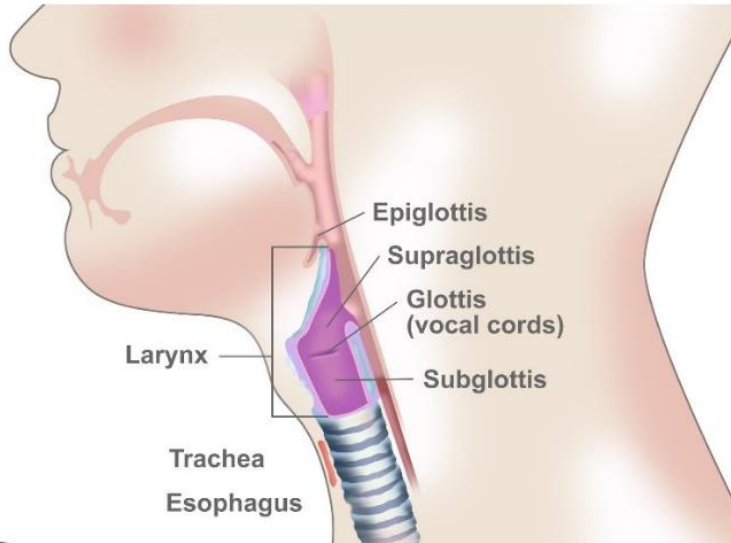
 

### NPPTL Homepage

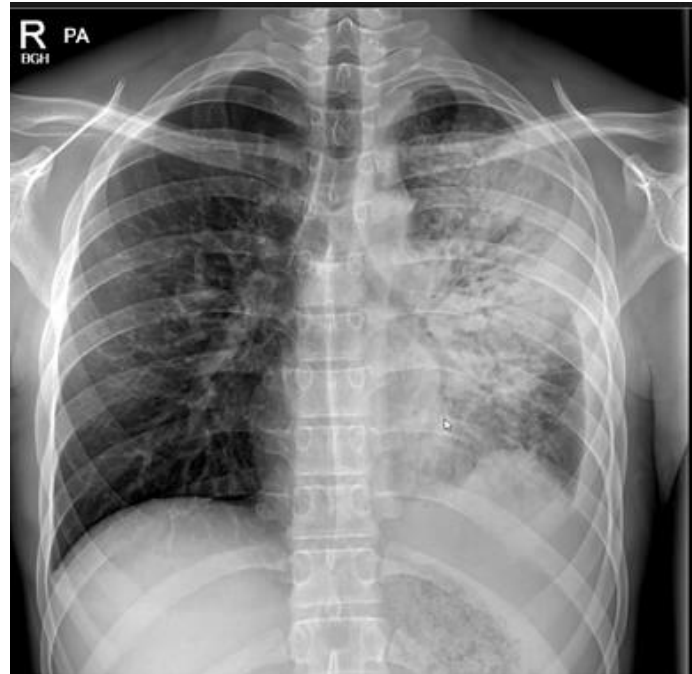
- [A to Z Index](#)
- [For Respirator Users](#)
- [For Respirator Manufacturers](#)
- [Protective Clothing and Ensembles](#)
- [Protective Technology Program at NIOSH](#)
- [Respirator Trusted-Source Information](#)
- [Approved Particulate Filtering Facepiece](#)

# Which sites of disease can be potentially infectious?

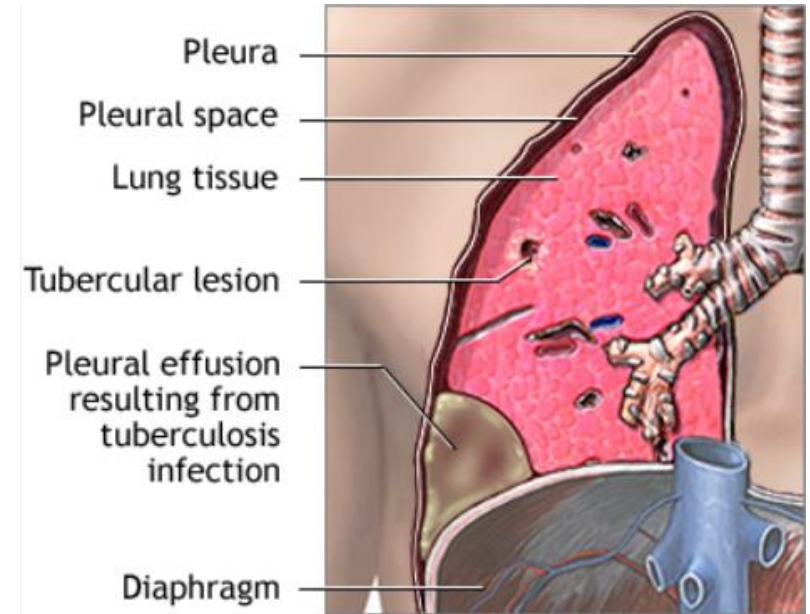
Air access is key!



Laryngeal TB

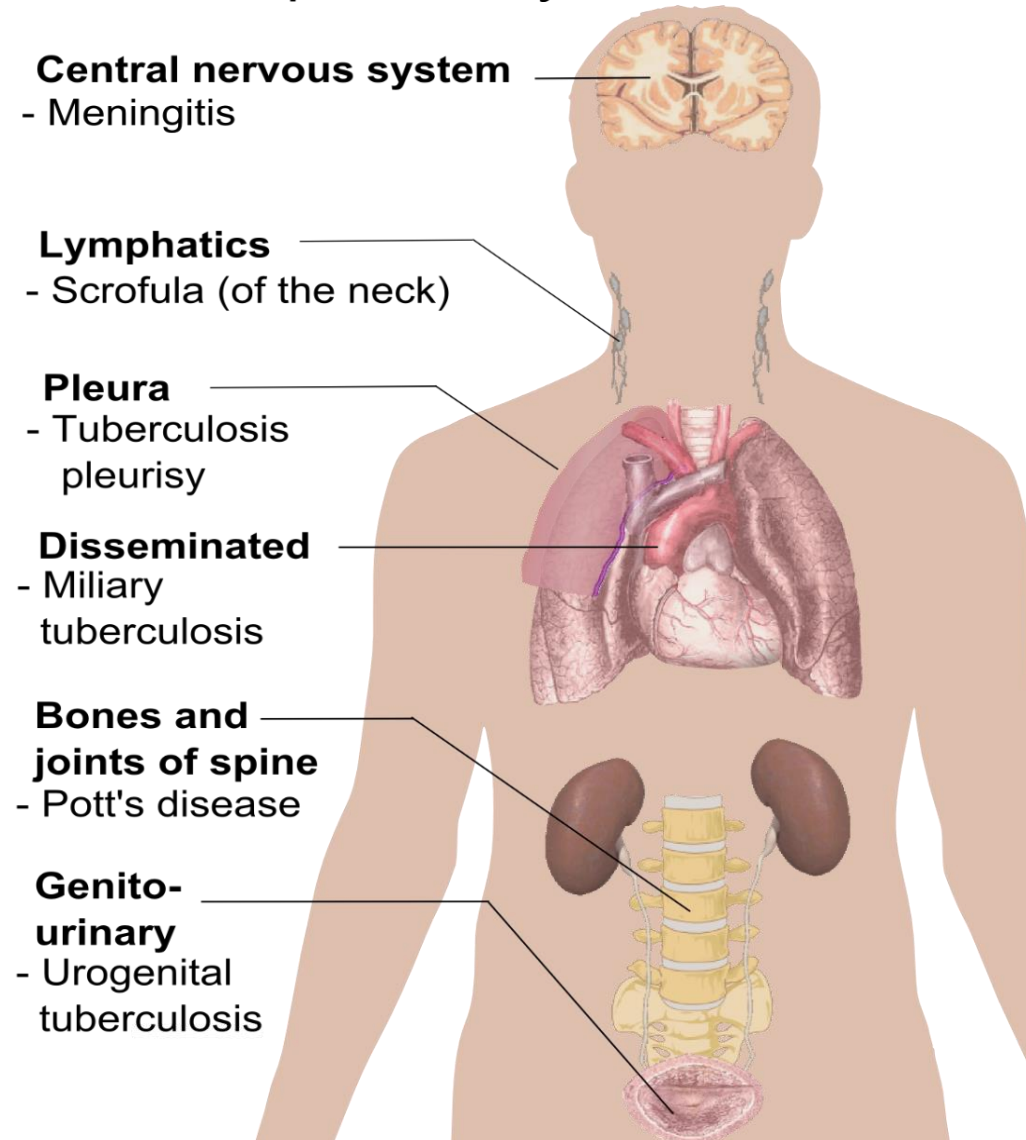


Pulmonary TB with or without cavitation



Isolated pleural TB - not considered infectious. Pulmonary or laryngeal involvement then patient is infectious.

## Main sites of Extrapulmonary tuberculosis



# Which Risk Factors Increase the Risk of Infectiousness?

| Increased Risk   | Decreased Risk   |
|--|--|
| <ul style="list-style-type: none"><li>• Cavity</li><li>• Sputum smear positive</li><li>• Laryngeal TB</li><li>• Coughing (3+ weeks)</li><li>• Cough inducing procedures</li><li>• Aerosolizing procedures</li><li>• Small enclosed space</li><li>• Poor ventilation</li><li>• <i>Increased airspace sharing time (duration/frequency during infectious period)</i></li></ul> | <ul style="list-style-type: none"><li>• Good cough hygiene (cover your cough!)</li><li>• Sputum smear negative</li><li>• Appropriate and adequate treatment (what does that mean?)</li></ul> |

# Higher Smear = Higher Risk

Table 3.8 – Smear classifications and results.

| Classification of Smear                     | Smear Result        | Infectiousness of Patient           |
|---|---------------------|-------------------------------------|
| 4+  | Strongly positive   | Probably very infectious            |
| 3+  | Strongly positive   | Probably very infectious            |
| 2+  | Moderately positive | Probably infectious                 |
| 1+  | Moderately positive | Probably infectious                 |
| Actual number of AFB seen<br>(no plus sign) | Weakly positive     | Probably infectious                 |
| No AFB seen                                 | Negative            | <b>May or may not be infectious</b> |

\*The criteria for determining whether a patient may be considered noninfectious are discussed in *Module 5, Infectiousness and Infection Control*.

# TB Infectiousness In Children

- Typically, Paucibacillary TB. Children don't typically have a productive cough or are unable to provide a sample.
- Even if they do, their samples are less likely to contain visible TB bacteria – even when the bacteria are present in their bodies – pulmonary TB with negative smears but positive cultures.
- Unless Adult Type presentation (cavity, smear positive), usually not considered to be infectious.
- While small children aren't usually considered infectious, perform a source case investigation, if unknown:
  - How did they get exposed to TB?
  - Is there an accompanying adult with them that has infectious, untreated TB?

# Criteria to Determine if TB Isolation is Indicated

## **TB Isolation *IS NOT* Indicated**

- 1.1 – Children <10 years, *unless* they have adult type TB\* (if so, they fall into 2.1)
- 1.2 – Patients with extrapulmonary TB and no pulmonary involvement\*\*

## **TB Isolation *IS* Indicated**

- 2.1 – Patients with confirmed or suspected pulmonary or laryngeal TB
- 2.2 – Patients with extrapulmonary TB if pulmonary TB is not yet ruled out\*\*
- 2.3 – Patients who are not adherent to or tolerant of anti-TB therapy

*\*Adult type TB: cavitation on chest imaging; and/or if sputum is collected, have smear positivity; and/or have suspected laryngeal TB.*

*\*\*Ruling out pulmonary TB includes obtaining three negative AFB sputum smears, a negative nucleic acid amplification (NAA), radiology not consistent with TB, with no respiratory symptoms. Refer to DSHS TB Section's Standing Delegation Orders (SDOs) for more details.*

# Steps for TB Isolation and Restrictions

- 1) **Determine if TB isolation is necessary.**
  - Consider the age of the patient as well as disease site when determining need for TB isolation.
- 2) **Assign a restriction level.**
  - Review where the patient lives, works, and spends a significant amount of time when assigning restriction level.
  - Adjust restrictions as necessary to protect the patient and the community; re-evaluate weekly during the TB isolation period.
- 3) **Release the patient from TB isolation and restrictions.**
  - Follow evidence-based criteria to ensure patients do not remain isolated with restrictions longer than necessary.
  - Follow each step using tables and figures referenced in this guide. Use appendices to document TB isolation and restriction status and to supplement patient education.

# High-Risk Settings and their Populations

- **Correctional Facilities\***
  - Includes jails, prisons, federal detention facilities (i.e., Immigrations and Customs Enforcement [ICE]) and other detention facilities.
- **Inpatient Care Facilities\***
  - Hospitals, skilled nursing facilities, long-term care facilities, nursing homes, etc.
  - These are inpatient settings housing individuals with varying risk factors.
- **High-Risk Outpatient Settings**
  - Includes dialysis units, cancer infusion centers, HIV treatment centers, transplant clinics, and dental-care settings.
- **Homeless Shelters**
  - Includes dialysis units, cancer infusion centers, HIV treatment centers, transplant clinics, and dental-care settings.
- **Refugee Camps and Rescue Missions**
  - Includes unaccompanied children's shelters.
  - These are non-stable settings; caution should be taken to prevent exposure of transient contacts.

*\*For infection control in healthcare settings, refer to **Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005**. For infection control in correctional facilities, refer to **Prevention and Control of Tuberculosis in Correctional Facilities, 1996**.*

# Restriction Levels - Extensive

## EXTENSIVE LEVEL RESTRICTIONS

Extensive restrictions apply to:

- Patients with confirmed or suspected TB who are not yet on ATT; or
- Patients on ATT who live in High-Risk Transmission Settings. These include correctional facilities, inpatient care facilities, homeless shelters, and refugee camps or rescue missions (Table 3); or
- Patients with possible drug-resistant TB (DR-TB) pending laboratory confirmation (if the patient is not on ATT for DR-TB); or
- Patients who are not - adherent to or tolerant of ATT.

This level of restriction limits movement to an established location(s) and requires proper masking for the patient and healthcare personnel (Appendix 8). Extensive restrictions may include the use of airborne infection isolation rooms (AIIR), separation, or placing a patient on home-based isolation until ATT

# Restriction Levels - Moderate

Moderate restrictions apply to:

- Patients who have started ATT, but have not met the release criteria; *and*
- Patients who are adherent to and tolerant of ATT who do not live in High-Risk Transmission Settings (**Table 3**).

This level of restriction allows for some patient movement in the community while reducing the risk of transmission to contacts. They may limit employment, housing, or social or community activities occurring in crowded or poorly ventilated indoor spaces, as well as new exposures to vulnerable populations; however most outdoor activities are permitted (Shah et al., 2024). Masking is required indoors for environments outside the home.

# Restriction Levels – Low

Low level restrictions only apply to:

- Patients who are adherent to and tolerant of at least 5 ATT doses who do not live in High-Risk Transmission Settings (**Table 3**); *and*
- patients who are not likely to transmit TB to the general community but have not met the release criteria because of the following:
  - They remain AFB sputum smear positive; *and*
  - they are likely to expose vulnerable people.

This level of restriction allows for routine activities in and around the home and community but would explicitly restrict working in or visiting High-Risk Transmission Settings (**Table 3**) and Other Congregate Settings with Risk of TB Transmission (**Table 4**) as determined by the PHR or LHD. If the patient must enter the setting temporarily for medical care, ensure airborne infection control practices (e.g., AIIR, separation, masking) occur. Masking is also required when patient is around vulnerable contacts (i.e., immunocompromised, young children, etc.).

# Release the Patient from TB Isolation and Restrictions

Patients are more likely to transmit TB before they begin ATT. The bacterial load decreases quickly after effective therapy begins, and, despite AFB smear positivity, the risk of transmission declines rapidly. *“Most patients are unlikely to transmit (TB) to others after the first few days (24–72h) of ATT initiation” (Shah et al., 2024).* Some instances, however, require longer durations of TB isolation to protect vulnerable contacts.

...

PHRs and LHDs will release most patients based on the number of ATT doses and not bacteriological results. However, sputum smear negativity is required for other patients where the risk of a TB exposure would impact vulnerable or susceptible contacts.



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