

#### **TB Infection Control**

Lori Eitelbach, BSN, RN May 7, 2025

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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 May 7, 2025



#### **Objectives**

- □ Infection Control Measures in a clinic or hospital setting:
- Identify three levels of an effective TB infection control program.
- Choose the best respiratory protection for the patient and health care worker.
- Prevent transmission with considerations of 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 Programs – 3 Levels of Hierarchy of Control Measures

Administrative control

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

Environmental control

• Prevents the spread of the disease and reduces the concentration of droplet nuclei by managing the air.

Respiratory protection control

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

#### **Administrative Controls**

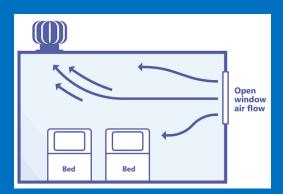
### Recommended to reduce M.TB transmission through policy and practice:

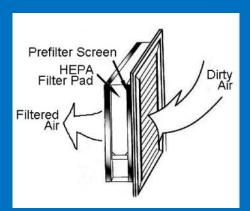
- •Triage people with TB s/s or w/ TB disease.
- Respiratory separation / isolation of people w/ presumed or demonstrated infectious TB.
- Prompt initiation of effective TB treatment of people w/ TB disease.
- Respiratory hygiene (including cough etiquette) in people w/ presumed or confirmed TB.
- •Policies, procedures and guidelines on respiratory protection control, and healthcare worker (HCW) training.

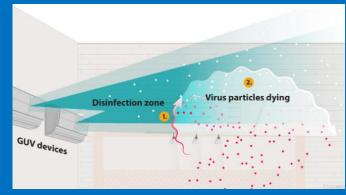
#### **Environmental (engineering) Controls**

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

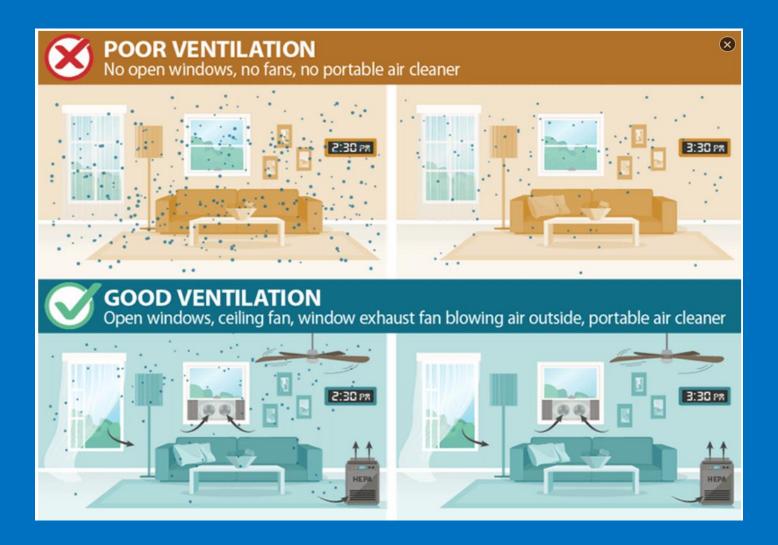






https://tbksp.who.int/en/node/2587

#### **Examples of Ventilation in Home Settings**



#### Airborne Infection Isolation Rooms



# Ventilation Flow - Positive, Negative, or Neutral

**Positive** pushes out of the room. You don't necessarily want this in a clinic setting for TB.

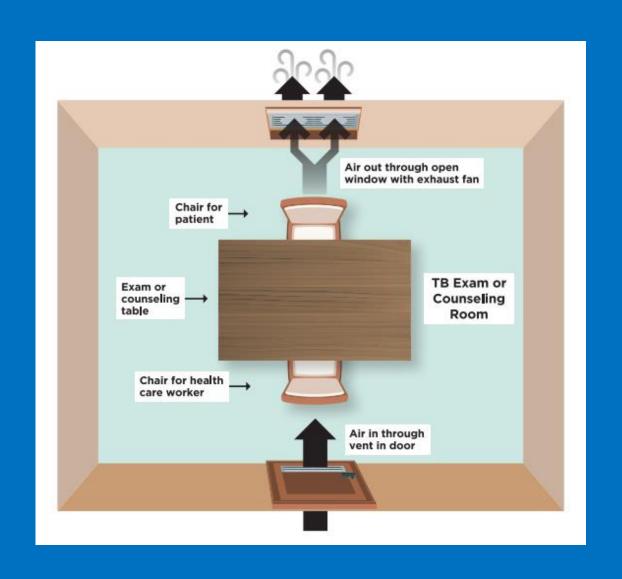
**Negative** sucks into the ventilation system. This is great for your airborne isolation rooms.

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

#### **Natural 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



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

ACH	99%	99.9%		
ACH	Minutes Required for Removal Efficiency <sup>†</sup>			
2	138	207		
4	69	104 69		
6	<b>46</b>			
12	23	36		
15	18	28		
20	14	21		
50	6	8		
400	ব	1		

<sup>\*</sup> 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.

#### Airborne Containment Removal

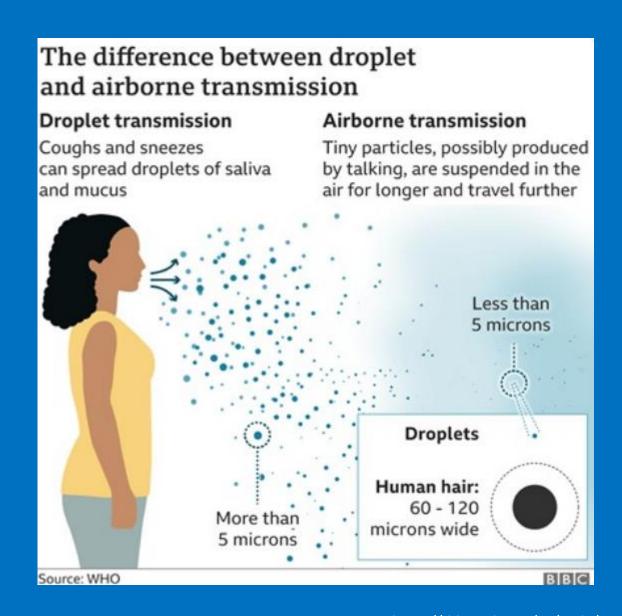
Air change per hour (ACH) is the number of times that the total air volume in a room or space is completely removed and replaced in an hour.

<sup>†</sup> Time in minutes to reduce the airborne concentration by 99% or 99.9%.

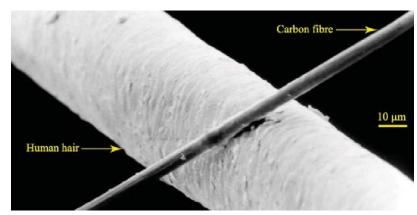
#### **Respiratory Protection**

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

- Personal respiratory protection within framework of respiratory protection program.
  - Protective masks
  - Particulate respirators



# How Big is a droplet nuclei?



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

 $< 5 \mu m$ ; 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 by Mask**

- □ 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.
  - FFR better known as N95 respirator.
  - FFRs are "single-use respirators"
- Patients with infectious TB should wear a **surgical mask** to prevent expelling droplet nuclei into the air.
  - Patients should not be wearing N95 respirators.
  - Use of surgical masks on persons with TB has been shown to decrease transmission to guinea pigs by over 50%.
  - N95s can increase work of breathing associated with pulmonary TB, as they have more resistance to breathing than surgical masks.
  - There may be circumstances where it may be reasonable to ask a person with TB to temporarily wear a surgical mask inside an All room.



The TB patient (left) is wearing a surgical mask.

The health care worker (right) is wearing a filtering facepiece respirator (FFR).

### Surgical mask worn by person with infectious TB during transit through facility



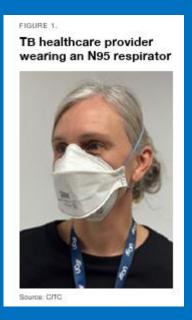
For the patient:

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.

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

NIOSH only approves respirators that pass its strict <u>quality assurance and performance requirements</u>. 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

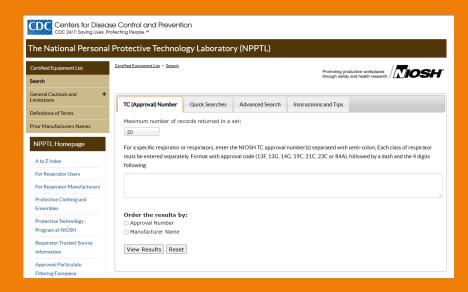


Example of using the TC approval number search option on the Certified Equipment List

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 NIOSHTC 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.



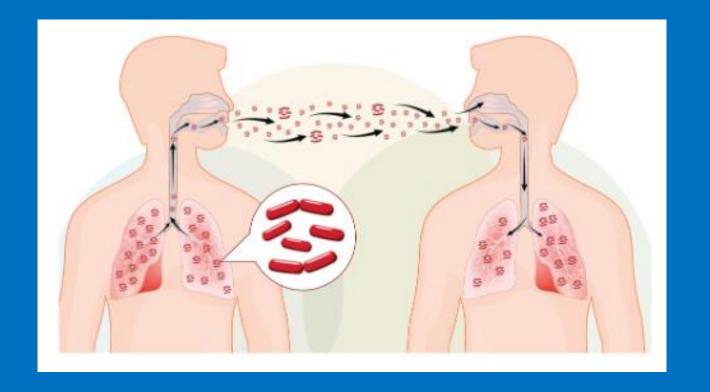
# How to Check if Respirator is CDC/NIOSH-certified?



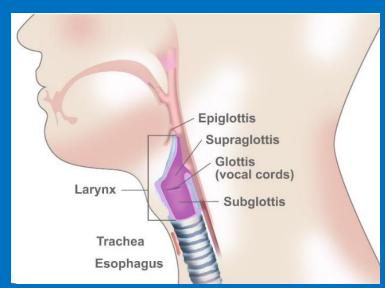
# Identifying Factors Associated with Infectiousness

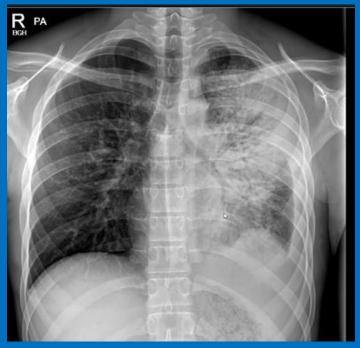
TB Spreads Person to Person via Shared Air

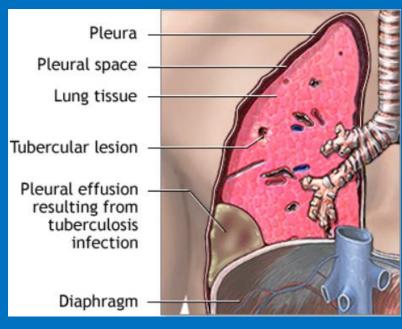
- ☐ Do they have TB disease?
- Does the site of disease provide opportunity for airborne spread?



# Which sites of disease can be potentially infectious?







Laryngeal TB

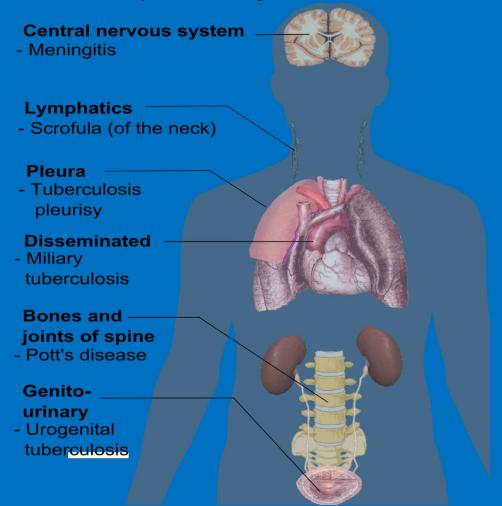
Pulmonary TB with or without cavitation

What about Pleural TB?

Pleural TB - not considered infectious unless pulmonary or laryngeal involvement

#### **Extrapulmonary TB**

Main sites of Extrapulmonary tuberculosis



# Which Risk Factors Increase the Risk of Infectiousness?

Increased Risk	Decreased Risk
<ul> <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>Increased airspace sharing time (duration/frequency during infectious period)</li> </ul>	<ul> <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 (no plus sign)	Weakly positive	Probably infectious
No AFB seen	Negative	May not be infectious*

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

#### TB Disease In Kids

- □Typically, Paucibacillary TB. Children don't typically have a productive cough, or are able 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, you want to 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?

#### **How to Determine Infectious Period**

#### **STARTS**

/

**3 months** before 1<sup>st</sup> respiratory symptom or 1<sup>st</sup> diagnostic finding

If smear negative, asymptomatic (non cavitary): **1 month** before date of suspected diagnosis

#### **ENDS**

When considered no longer infectious and can come off isolation

Table 8.1—Recommendations for Estimating the Start of the Infectious Period by Case Characteristics

Case with Respiratory TB Symptoms	Case with Positive Sputum Smear	Case with Pulmonary Cavity on Chest X-ray	Recommended Minimum Beginning of the Infectious Period
Yes	No	No	3 months before symptom onset or first finding consistent with TB disease, whichever is longer
Yes	Yes	Yes	3 months before symptom onset or first finding consistent with TB disease, whichever is longer
No	No	No	1 month (4 weeks) before date of suspected diagnosis
No	Yes	Yes	3 months before finding consistent with TB disease

#### **Texas tool: TB 425**

Table 2.	Table 2. Estimating the Beginning of the Infectious Period							
	A. Criteria		B. Estimated Start of Infectious Period	C. Infectious Period Start Date				
TB Symptoms	Acid Fast Bacilli (AFB) Sputum Smear Positive	Cavitary CXR	Select any of the following based on criteria met by client in Column A	Select <u>earliest</u> date of symptom onset listed in Table 1				
Yes	Yes	Yes	Three (3) months before symptom					
Yes	Yes	No	onset or first positive finding consistent with TB disease (e.g. abnormal chest radiograph)					
Yes	No	No	whichever is longer.					
No	Yes	Yes	Three (3) months before first positive finding consistent with TB					
No	No	No	Four (4) weeks before date of suspected diagnosis					
Source: /	Source: Adapted from MMWR. 2005; 54 (No. RR-15)							

Nucleic Acid Ampification

**Testing (NAAT)** 

Molecular test used to detect the DNA (deoxyribonucleic acid) of Mycobacterium tuberculosis complex (MTBC) in a sputum or other respiratory sample

- ☐ Polymerase Chain Reaction (PCR) is a common form of NAAT used in laboratory diagnosis.
- ☐ GeneXpert® MTB/RIF test is a PCR that simultaneously detects MTBC and the genetic mutation that confers rifampin (RIF) resistance.



#### NAAT: Xpert and Release from Isolation





Consensus statement on the use of

Cepheid Xpert MTB/RIF® assay in making
decisions to discontinue airborne infectior
isolation in healthcare settings

#### Recommendations: (see also Flow Charts, Appendix III)

- 1. Positive Xpert Result: M. tuberculosis complex detected. Diagnosis of TB is highly likely. Continue A.I.I. until deemed non-infectious during hospital stay or until discharged to home isolation.
- 2. Negative First and Second Xpert Results: If the first Xpert result is negative (M. tuberculosis complex not detected), a second specimen collected at least eight hours after the first specimen should be tested if TB still is clinically suspected. If the second Xpert result is negative, infectious TB is not likely. Consider release from A.I.I. if infectious TB is no longer a significant clinical consideration.
- 3. Negative Xpert Results with Positive or Discordant AFB Sputum Smears: Two negative Xpert results with positive AFB sputum smears likely indicate presence of nontuberculous mycobacteria (NTM); Appendix IIIb. One negative Xpert result in a patient with positive AFB sputum smears is suspicious for NTM, and collection of sputum for a second Xpert test is recommended. If the second Xpert result is still negative, infectious TB is not likely. If smears are discordant (i.e., 1 AFB positive, 1 AFB negative), decisions should be based on clinical suspicion.
- 4. Invalid Xpert Result: An Invalid result represents a failure of the assay; this is a rare event, estimated to occur with 1-2% of specimen-runs. If an invalid result is reported, the laboratory likely has repeated the test on leftover specimen 10 and the presence or absence of Mycobacterium tuberculosis complex cannot be determined. If an Invalid result is reported with the initial specimen and TB still is clinically suspected, repeat the test using a new specimen (go to

# When can Airborne (infection) Isolation (AII) be discontinued?

- What is the general rule of thumb for sputum smear positive TB?
- What about when sputums are smear negative?



#### Guidance on Release from Hospital Tuberculosis Isolation<sup>a</sup>

Diagnostics:	Clinical Impression:	Under Airborne Isolation (AII) and discharging to:	Patient must meet all criteria:
Sputum AFB Smear Positive	Active TB Disease	Home—No high risk individuals or individuals without prior exposure	Follow-up plan has been made with local TB program and DOT has been arranged <sup>b</sup> Started on standard TB treatment     All household members, who are not immunocompromised, have been previously exposed to the person with TB     Patient is willing to not travel outside the home until negative sputum smear results are received     No infants or children younger than 5 years of age or persons with immunocompromising conditions are present in the household who have not been evaluated and started on appropriate treatment
NAAT Positive		Home—WITH high risk individuals OR High-Risk/Congregate Setting	Patients with infectious TB should NOT be allowed to return to a setting with high risk individuals. The patient can be discharged and is considered non-infectious if:  Three consectutive negative sputum smears from sputum collected in 8 - 24 hour intervals (at least one early morning specimen) AND  Started on drug regimen and tolerating for AT LEAST 2 weeks or longer AND  Symptoms have improved
Sputum AFB Smear Negative (or No Sputum AFB Smear Done) <u>AND</u> NAAT Positive	High likelihood of TB	Home—with/without high risk individuals OR High-Risk/Congregate Setting	Three consecutive negative sputum smears from sputum collected in 8 to 24 hour intervals (at least one early morning specimen) Started on standard TB treatment and tolerating for AT LEAST 5 days
Sputum AFB Smear Negative <u>AND</u> NAAT Negative	High likelihood of TB	Home—with/without high risk individuals OR High-Risk/Congregate Setting	A plan has been made to follow-up on culture results     No infants or children younger than 5 years of age or persons with immunocompromising conditions are present in the household who have not been evaluated and started on appropriate treatment

AFB - Acid-fast bacilli AII - airborne infection isolation DOT - Directly Observed Therapy DST - Drug Susceptibility Testing MDDR - Molecular Detection of Drug Resistance MDR - Multi-drug resistant NAAT - Nucleic Acid Amplification Test TB - Tuberculosis XDR - Extensively-drug resistant

<sup>\*</sup>Pulmonary Tuberculosis

The hospital and/or treating clinician should contact the local health department prior to release of a patient with confirmed active TB disease.

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Sputum AFB Smear Negative <u>AND</u> NAAT Negative	High likelihood of TB	Home—with/without high risk individuals OR High-Risk/Congregate Setting	A plan has been made to follow-up on culture results     No infants or children younger than 5 years of age or persons with immunocompromising conditions are present in the household who have not been evaluated and started on appropriate treatment

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<sup>&</sup>lt;sup>b</sup>The hospital and/or treating clinician should contact the local health department prior to release of a patient with confirmed active TB disease.

#### **Texas tool: TB 425**

Table 3. Estimating the End of the Infectious Period (Release from Respiratory Isolation) for clients with drug susceptible TB

		A. Criteria	В.	Check (√) when criteria is met	C. Infectious Period End Date Type the date the selected criteria in Column A was met.
	1.	Three (3) consecutive negative AFB sputum smears, collected in 8 to 24 hour intervals (one should be an early morning specimen)			
When patient has POSITIVE AFB	2.	Symptomatic improvement			
sputum smear at diagnosis	3.	Effective multi-drug therapy for tuberculosis for at least the equivalent of two weeks given as directly observed therapy (DOT)			
	4.	Completely adherent with DOT			
	5.	Drug resistance is not suspected or confirmed			
When patient has three consecutive	1.	Three (3) consecutive negative AFB sputum smears, collected in 8 to 24 hour intervals (one should be an early morning specimen)			
NEGATIVE AFB	2.	Symptomatic improvement			
sputum smears at diagnosis <u>and</u> has never had a	3.	Multi-drug therapy for tuberculosis for <b>at least 5 days</b> given as DOT			
positive sputum	4.	Completely adherent with DOT			
specimen	5.	Drug resistance is not suspected or confirmed			

Source: Adapted from MMWR. 2005; 54 (No. RR-12)

# What are your policies regarding discharge from hospital to the home?

- Not all TB patients need to be hospitalized.
- If still on AII, what are your rules and policies for discharge home?



# Patient Centered Care: Home Based Isolation

#### Discharge Home on Isolation can be done if:

#### Follow-up plan has been made with local TB program and DOT has been arranged

- All household members, who are not immunocompromised, have been previously exposed to the person with TB
- Patient is willing to not travel outside the home until negative sputum smear results are received
- No infants or children younger than 5 years of age or persons with immunocompromising conditions are present in the household who have not been evaluated and started on appropriate treatment

#### Reasons to hold discharge:

- Going to congregate setting that doesn't have a negative pressure room: alternative arrangements may be needed.
- Cannot be discharged to safe environment: need to find safe location while on Isolation. (Safe for patient and safe for community.)
- Unable to be discharged with enough meds to continue care. May need to hold for arranging procurement of meds.

#### Scenario #1

A 45-year-old man with confirmed pulmonary tuberculosis was admitted to the hospital and started on standard 4-drug TB therapy 10 days ago. He is clinically improving and is now afebrile with no cough.

- ☐ What else do you need to know before he can be released from AII?
- Sputum smears were originally positive, but last set of 3 were smear negative.
- He needs another 4 doses of meds to have been on treatment 14 days.
- □ Can he be discharged home on isolation and take the 4 doses at home?
- ☐ Would it make a difference if you knew he has a 2-month-old child at home who the LHD hasn't yet been able to screen?
- □ What would have to occur with the patient or the 2-month-old child before he can be discharged home?
- —Patient would have to achieve smear conversion and 14 DOT doses, OR
- —Child would need to be screened for TB with an IGRA or TST and CXR and then placed on appropriate treatment (active, LTBI or window).

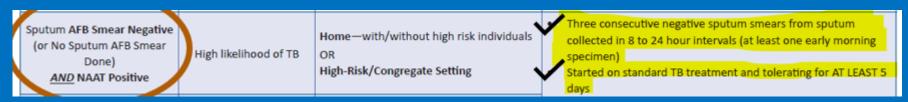
#### Scenario #2

- History of foreign travel while serving in the military, including deployments in Asia. Hospitalized with chronic cough, hemoptysis. Sputum 3+ on smear. What should the hospital do next?
- Follow Airborne Isolation (if not already implemented)
- Order NAAT to see if it's due to MTB
- Results: NAAT did NOT detect MTB

- Can they release patient from Airborne Isolation?
- Get second NAAT. If that too is negative, yes, most likely a Non-Tuberculosis Mycobacterium (NTM)

- 38-year-old US born female health care worker with a history of working in medical settings in Africa. You have just received a lab report that an intestinal biopsy sample has been identified to have MTB. Can she continue to work at the hospital?
- Pulmonary involvement needs to be ruled out.
- Chest xray shows an infiltrate in the RUL. What's our next step?
- Obtain sputums.
- ☐ Sputums are smear negative x 3, NAAT detected MTB with no RIF resistance. She has no pulmonary symptoms. What other details would you want to know before determining when she can return to work?

#### Scenario #3



Current treatment and response to treatment.

# Final Question: How do you know if your patient is infectious?

#### Answer:

Through your Nursing and Contact Investigation assessments.



#### **Overall Important Points of Note...**

- Ensure your clinic or hospital setting has appropriate infection control measures in place.
- □ It's important to determine your patient's risk of infectiousness.
- Become familiar with guidelines on when it is safe to allow your patient to return to work/school/community activities.
- Be mindful of providing patient-centered care, especially while helping them through their infectious period.

#### THANK YOU!

#### Questions?

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