TB Screening & Testing

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Comprehensive TB Nurse Case Management
June 5 – June 6, 2024
San Antonio, Texas

Ellen Elmore, MD has the following disclosures to make:

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

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TB Screening & Testing

JUNE 5, 2024

Ellen Elmore MD

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WHY

WHO

WHEN

WHAT

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THE TB SCREENING PROCESS

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WHY

WHO

WHEN

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THE TB SCREENING PROCESS
Objective #1

WHY do we screen?

WHO do we screen?

WHEN do we screen?

?

WHAT

& WHO #2
(yes, who again)
¿

THE TB SCREENING PROCESS
Objective #2

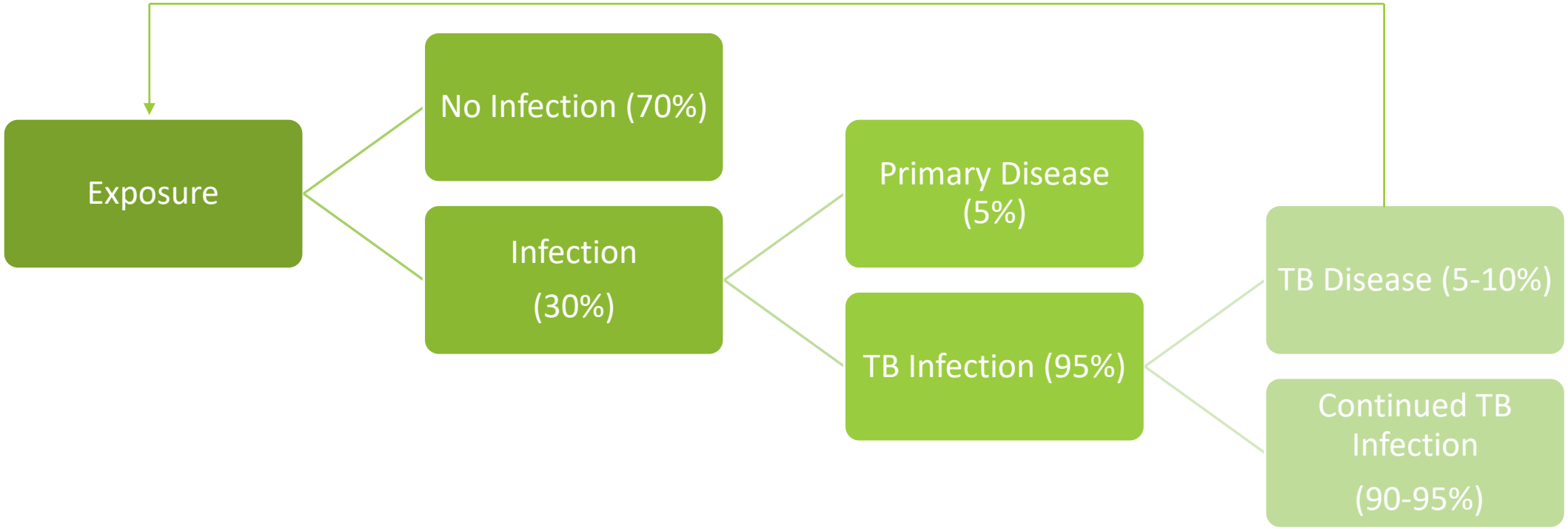
What are the TB screening methods? Describe the tests & the interpretation of those results for adults & children.

Who is at risk for developing TB disease from TB infection?

But first… what is TBI?

Tuberculosis infection is a state that is characterized by persistent immune response to stimulation by Mycobacterium tuberculosis (MTB) antigens with **no evidence of clinically manifest TB disease**.

Exposure → Infection → Disease



Reproduced from slides from Charles Daley, MD

Why do we test for TB Infection (TBI)?

To Prevent TB Disease: Find TB Infection

The CDC estimates that up to 13 million persons in the US have TBI. Approx 5%–10% of those who remain untreated will develop TB disease at some point in their lifetime.

Efforts to eliminate TB in the US include:

-finding and treating persons with TB disease

-expanding LTBI testing and treatment to prevent progression to TB disease and

-addressing disparities among groups disproportionately experiencing impacts of TB.

Goal: achieve TB elimination in the United States (<1 case per million persons annually)

The Burden of TB in the US & Globally

USA: 13m TBI	8300 to 9600 TB disease	600 deaths
Global: 2billion TBI	10 million TB disease	1.6m deaths

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Who Should be Tested for TB Infection (TBI)?

Targeted Testing for TB Infection

The simplified version:

- People who are at increased risk for *M. tuberculosis* infection
- People at increased risk for progression to active disease if infected with *M. tuberculosis* (even if not at increased exposure risk)

Others who are frequently tested:

- People tested for administrative reasons (e.g., mandatory employment testing)
- People with symptoms of active TB disease (fever, night sweats, cough, and weight loss)

RISK for INFECTION *PEOPLE*

RISK for PROGRESSION *CONDITIONS*

Persons at increased risk for infection	Conditions that increase risk for progression
Contacts to active pulmonary or laryngeal TB*	Persons living with HIV
People from or with frequent travel to countries where TB is common	Children <5 years old
Employees or residents of high risk congregate settings	Injection drug users
Health care workers with increased risk for occupational exposure*	Persons who are immunocompromised from medical conditions or medications
Infants and children exposed to adults who at high risk for TB disease	Diabetes

A closer look

Contacts of Individuals with Active TB

CONTACTS: Get CI involved asap!

Among close contacts to a TB Case:

- 30% have TB Infection
- 1-3% have TB disease

Without TB Infection treatment:

- 10% with TBI with develop TB disease
  - Approximately 5% of contacts with newly acquired TBI progress to TB disease within 2 years
  - The other 5% activate > 2 years after acquisition

Examination of contacts is **one of the most effective strategies** for TBI diagnosis and TB control!

A closer look

Risk of disease by Age, & HIV status

Age at Infections	Risk of Active TB
Birth – 1 year*	43%
1 – 5 years*	24%
6 – 10 years*	2%
11 – 15 years*	16%
Healthy Adults	5-10% lifetime risk
HIV Infected Adults+	30-50% lifetime

*Miller, Tuberculosis in Children Little Brown, Boston, 1963

+WHO, 2004

A closer look

Also:

Younger = Higher risk AND Worse Disease

Age at Infection (years)	No Disease (%)	Intrathoracic TB (%)	TB Meningitis (%)
<1	50	30-40	10-20
1-<2	75-80	10-20	2.5
2-<5	95	5	0.5
5-10	98	2	<0.5
≥10	80-90	10-20	<0.5

**Adapted from Marais et al. The natural history of childhood intra-thoracic tuberculosis: a critical review of literature from the pre-chemotherapy area. Int J Tuberc Lung Dis. 2004; 8(4):392-402*

Targeted Testing: Who else?

WE'VE COVERED

Contacts of persons with active TB

HIV positive individuals

Immigrants from high prevalence countries

Injection Drug Users

Residents and Employees of high risk congregate settings:

- Correctional facilities and Homeless Shelters
- Hospitals, Clinics, Nursing Homes, Substance Abuse Facilities

Children exposed to high-risk adults or environments

Patients considering treatment with TNF-α Antagonists

infected in last 2y

organ transplant

DM

<5yo

leukemia, lymphoma

Fibrotic lesion(s) on CXR

silicosis

CKD

Malnourishment

HEENT CA, lung CA

immunosuppressive DO or therapy

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✓WHY

✓WHO

→WHEN

WHAT

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THE TB SCREENING PROCESS

WHY?

To prevent TB disease

WHO?

People at high risk for exposure

AND/OR

at risk for progression of TBI to TB disease

When Should We Test for TB Infection (TBI)?
As soon as we can!

The simplified answer:

- As soon as you become aware of the person who is at increased risk
- Get them tested/advise them to get tested/talk to their doctor about getting them tested
- Educate the various facilities about the need to test their high-risk patients/clients tested

Think about World TB day announcements or Medical Society Letters and other opportunities to get the word out. Befriend a reporter at your local news station and let them know you are able to talk to them about TB screening. Be proactive! Get creative!

TB disease pts should be interviewed by CI asap, ideally before leaving the hospital/clinic, or wherever the dx is 1st made; for a number of reasons, including to get a contact list so they can identify high risk contacts right away to prioritize them to evaluation & testing. This is key!

Where are our pts born?

Among persons in the United States with active TB disease who were non-US born, the most common countries of birth were Mexico, the Philippines, India, Vietnam, and China. The TB incidence rates in 2020 in those countries were estimated by the World Health Organization to be:

Mexico: 24/100,000 (Medium)
The Philippines: 539/100,000 (High)
India: 188/100,000 (High)
Vietnam: 176/100,000 (High)
China: 59/100,000 (Medium)

Persons who were born in, or resided in, these countries should be tested at least once regardless of how long they have resided in the United States. When? As soon as you find out it hasn't yet been done.

That's WHY, WHO & WHEN! And now, the what!

Diagnostics:

What do we have to test for TBI?

Two types of tests currently available

– interferon-gamma release assays (IGRAs)
and

-the tuberculin skin test (TST) –

these are indirect tests and

they require a competent immune response to identify people infected with MTB.

A positive test result by either method is not, by itself, a reliable indicator of the risk of progression to active disease.

Which is better?

-both are indirect tests for immune sensitization

-both depend on the host immune response

- as for sensitivity and specificity … well….

(hint: don't look for perfection; seek acceptance of what is)

IGRA

or TST

there is no gold standard test

The TST

intradermal injection of purified protein derivative (PPD)

PPD tuberculin solution contains dozens of TB antigens

composition varies among batches

many of these antigens are present in environmental nontuberculous mycobacteria (NTM) prevalent in the US and in BCG vax

several problematic limitations of the TST

Might be easy to perform

Might not be so easy to read/interpret

Nothing beats experience!

The IGRA

detect interferon-λ (IFN-λ) release from a patient's $CD4^+$ and $CD8^+$ T- lymphocytes after stimulation by antigens found on *M tuberculosis (MTB)* complex

2 available: the **QuantiFERON-TB Gold Plus** assay (4th gen QFT; replaced the previously used & studied QuantiFERON-TB Gold In-Tube assay & other earlier QFT versions) and the **T-SPOT.TB** assay

Antigens are not in MAC/other NTMs that can rarely cause human dz, nor in M. bovis- BCG strains, but are in wild M. bovis strains

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PROS

TST	IGRA
Inexpensive	One visit
Simple to perform	Likely more accurate
	Clear, objective results
	Unaffected by BCG
	Less cross reactivity

CONS

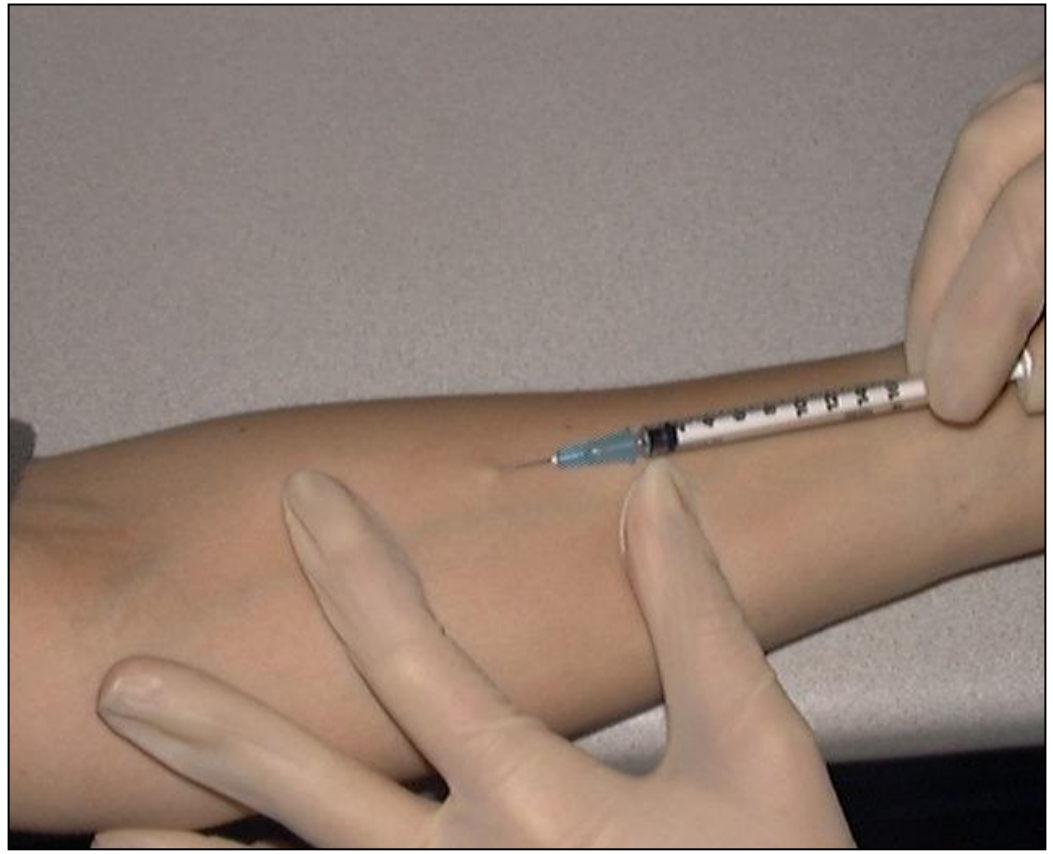
TST	IGRA
Must return in 48-72 hrs	Expensive
Interpretation is somewhat subjective	Conversion/reversion
False Negatives:	Tspot requires more blood
Elderly	Time limit for processing
Immunosuppressed	Subject to handling & processing errors
False Positives: BCG vaccination	FP: low risk populations
Low risk populations	
Non-tuberculous mycobacteria	

The Tuberculin Skin Test (TST)

0.1 ml of 5 Tuberculin units PPD injected intradermally; +wheal

Induration in millimeters read 48-72 hours after injection

Usually also see erythema



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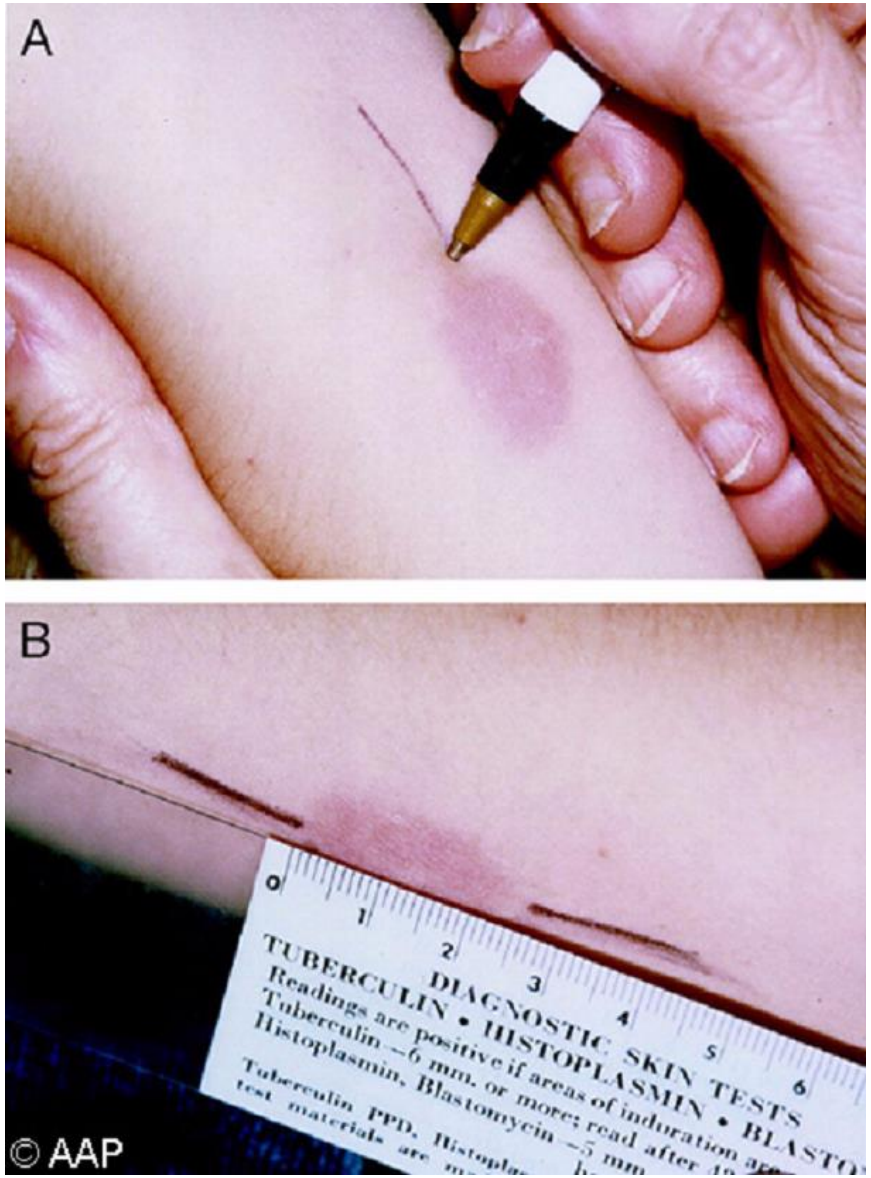
Reading the TB Skin Test

Measure **induration**,

not erythema!!!



Tuberculin Skin Test Practicum

San Antonio, Texas
Thursday, June 27, 2024

Heartland National TB Center

2303 Southeast Military Drive
Building 501, HNTC Training Room
San Antonio, Texas 78223

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AGENDA

Session 1

Thursday, June 27, 2024

8:00 – 8:15 am	**Registration, Welcome & Introductions**
8:15 – 8:50 am	Targeted Tuberculin Skin Testing
8:50 – 11:20 am	Using the Tuberculin Skin Test as a Diagnostic Tool with Mantoux Tuberculin Skin Test Video and Practicum
11:20 – 11:35 am	Myth's, Misconceptions, and FAQs of the Tuberculin Skin Test
11:35 – 11:45 am	Q&A and Evaluations
11:45 am	**Adjourn**

Session 2

Thursday, June 27, 2024

12:45 – 1:00 pm	**Registration, Welcome & Introductions**
1:00 – 1:35 pm	Targeted Tuberculin Skin Testing
1:35 – 4:05 pm	Using the Tuberculin Skin Test as a Diagnostic Tool with Mantoux Tuberculin Skin Test Video and Practicum
4:05 – 4:20 pm	Myth's, Misconceptions, and FAQs of the Tuberculin Skin Test
4:20 – 4:30 pm	Q&A and Evaluations
4:30 pm	**Adjourn**

Times/topics subject to change

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Test interpretation depends on 2 things:

the **induration** at the injection site

And

the **risk** of TBI progression to TB

Induration ≥ 5 mm considered positive in:	Induration ≥ 10 mm considered positive in:	Induration ≥ 15 mm considered postive in:
HIV infected individuals	Immigrants from high-prevalence countries	Any person, including persons with no known risk factors for TB. **Note:** Targeted skin testing programs should only be conducted among high-risk groups.
A recent contact of a person with TB disease	Persons with clinical conditionis that place them at high risk (See Section II.E, bullets #10-14)	
Persons with fibrotic changes of CXR consistent with prior TB	Residents and employees of high-risk congregate settings	
Patients with organ transplants	Mycobacteriology laboratory personnel	
Individuals immunocompromised for other reasons (e.g. taking TNF-alpha inhibitors, taking equivalent of ≥15 mg/day of prednisone for ≥ 1 month)	Infants, children, and adolescents exposed to adults in high-risk categories	
	Children < 5 years old	
	Injection drug users	

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About IGRAs

The QFT-Gold Plus

an enzyme-linked immunosorbent assay (ELISA) **whole blood** test

2 TB antigen tubes: tuberculosis antigen tube 1 (TB1) tuberculosis antigen tube 2 (TB2)

TB1 contains peptides designed to elicit an immune response from **$CD4^+$** T-helper lymphocytes

TB2 contains an **additional set of peptides** targeted for a cell-mediated immune response **from $CD8^+$** cytotoxic T lymphocytes, included to bolster overall test sensitivity

+ when the IFN-λ response to the TB antigens is above the test cutoff of 0.35 IU/mL (after subtracting the negative control value from the test antigen value)

Can get an indeterminate result (+control failure from immunosuppression or neg control has high background response from something like high baseline IFN-gamma from inflammation) Need to **REPEAT** the test in this case

The T-Spot

is an enzyme-linked immunosorbent **spot** (ELISPOT) assay performed **on peripheral blood** mononuclear cells that have been incubated with peptides

The result is reported as the number of IFN-λ producing T-cells (spot-forming cells). **The test is + when the number of spots** in the test sample, **after subtracting the number of spots in the negative control**, exceeds a specific threshold of **≥8 spots**; the test result is **negative if there are 4 or fewer spots**

Results with a corrected **spot count of 5, 6, or 7** are considered **borderline/equivocal** & **retesting** on a different specimen is recommended, which is also the case if the positive control shows a poor response (<20 spots), or if the background response in the negative control is too high (≥10 spots), the result is termed **invalid or indeterminate** (neither negative nor positive)

QFT GOLD PLUS

Unlike the TST, IGRAs do not cross-react with the *M. bovis* bacillus Calmette-Guérin (BCG) vaccine and NTM, with the exception of

M. kansasii,

M. szulgai, &

M. marinum

Mitogen: measures antigen-independent T-cell response

Nil: measures background IFN-λ response

TB1 primarily CD4+

TB2: both CD4+ & CD8+ T-cell response

QuantiFERON®-TB Gold Plus

Mitogen – Positive Control	Low response may indicate inability to generate IFN-γ
Nil – Negative Control	Adjusts for background IFN-γ
TB1 – Primarily detects CD4 T cell response	
TB2 – Optimized for detection of CD4 and CD8 T cell responses	

- Essentially 2 tests in one blood draw
- TB1 and TB2 should be close in value

QFT Gold + interpretation

Test is indeterminate if either:

The nil is >8.0

Or

The mtiogen-Nil is <0.50

(You don't have to do the math!)

You SHOULD look at the TB1 and TB2 values

- they should not be super far apart in value

-low + is generally <1 or 1.1 (read your lab report) May consider if it is a true+ or not. FP? Retest??

Interpretation of QFT-Plus test results

Nil (IU/ml)	TB1 minus Nil (IU/ml)	TB2 minus Nil (IU/ml)	Mitogen minus Nil (IU/ml)	QFT-Plus Result	Result interpretation
≤8.0	≥0.35 and ≥25% of Nil	Any	Any	Positive	*M. tuberculosis* infection likely
	Any	≥0.35 and ≥25% of Nil			
	<0.35 or ≥0.35 and <25% of Nil	<0.35 or ≥0.35 and <25% of Nil	≥0.50	Negative	*M. tuberculosis* infection NOT likely
	<0.35 or ≥0.35 and <25% of Nil	<0.35 or ≥0.35 and <25% of Nil	<0.50	Indeterminate	Likelihood of *M. tuberculosis* infection cannot be determined
>8.0	Any				

Results table excerpted from QuantiFERON-TB Gold Plus packet insert: https://www.quantiferon.com/us/products/quantiferon-tb-gold-plus-us/package-inserts/

Lab reports: QFT Gold Plus Results

LAB OFTEN (SOMETIMES?) GIVES YOU GOOD INFO IF YOU TAKE THE TIME TO READ IT, PARTICULARLY ABOUT INTERPRETATION & REPEAT TESTING

QUANTIFERON TB GOLD PLUS
QUANTIFERON TB GOLD PLUS POSITIVE A NEGATIVE

Interpretive guidelines:
Positive: Indicates active or latent infection by MTB complex. May also be positive with M. kansasii, M. szulgai and M. marinum. Not positive with BCG therapy. To establish a diagnosis of active disease, correlate with clinical and radiographic data.
Indeterminate: May occur from excessive levels of gamma interferon, heterophil antibodies, anergy or handling issues. Repeat analysis is recommended.
Negative: Presumptive negative for active or latent MTB infection. False negatives may occasionally be seen with impaired immune function or testing too early after exposure.

***** GAMMA INTERFERON RESULTS *****

TB1-NIL	0.378 H	IU/ML	<0.35
TB2-NIL	0.428 H	IU/ML	<0.35

Patients with an interpretation of positive and TB-nil values between 0.35 and 1.11 IU/mL should be considered low positive. Longitudinal studies of specific patients demonstrate sufficient fluctuation within this low positive range in serial testing to cause test interpretations to alternate between negative and low positive when the test results are near the cutoff value of 0.35 IU/mL. For such patients, repeat analysis after a clinically suitable period of time or alternate testing may be informative.

MITOGEN-NIL	5.860	IU/ML
NIL	0.110	IU/ML

Test	Within Range	Outside Range	Units	Reference Range

QUANTIFERON TB GOLD PLUS
QUANTIFERON TB GOLD PLUS POSITIVE A NEGATIVE

Interpretive guidelines:
Positive: Indicates active or latent infection by MTB complex. May also be positive with M. kansasii, M. szulgai and M. marinum. Not positive with BCG therapy. To establish a diagnosis of active disease, correlate with clinical and radiographic data.
Indeterminate: May occur from excessive levels of gamma interferon, heterophil antibodies, anergy or handling issues. Repeat analysis is recommended.
Negative: Presumptive negative for active or latent MTB infection. False negatives may occasionally be seen with impaired immune function or testing too early after exposure.

***** GAMMA INTERFERON RESULTS *****

TB1-NIL		1.38 H	IU/ML	<0.35
TB2-NIL		1.29 H	IU/ML	<0.35
MITOGEN-NIL	>10		IU/ML	
NIL	0.04		IU/ML	

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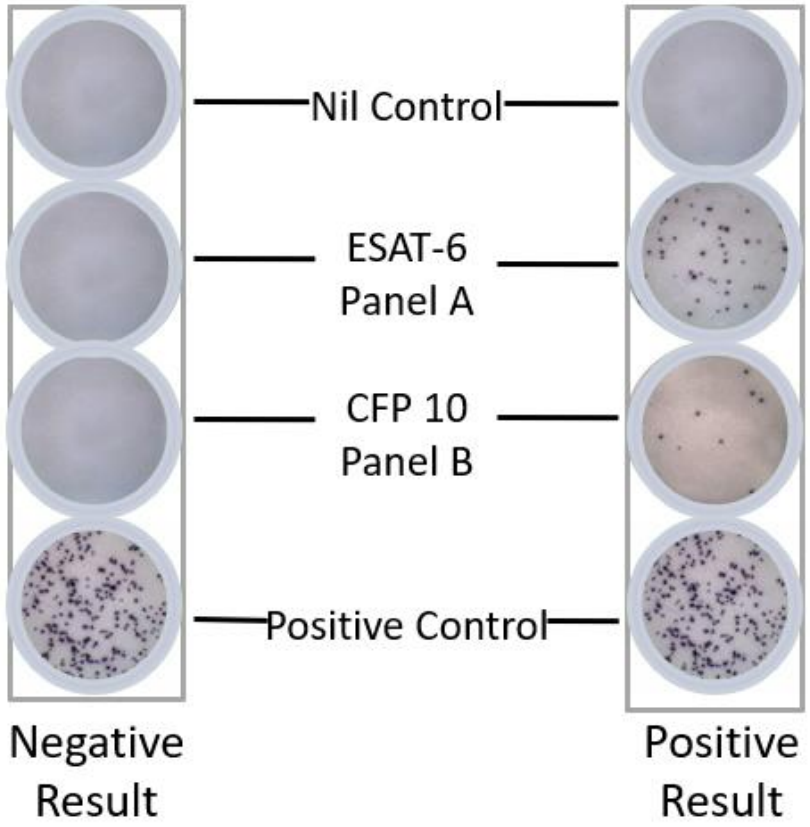
T-Spot Interpretation

dark blue spots are counted

Interpretation of Results



Interpretation of T-spot

Nil (Spots)	Mitogen-Nil (spots)	Panel A - Nil (spots)	Panel B - Nil (spots)	T-SPOT® Result	Interpretation
≤ 10 spots	≥ 20 spots	≥ 8 spots	≥ 8 spots	Positive	*M. tuberculosis* infection likely
	< 20 spots				
	≥ 20 spots	5, 6, or 7 spots	5, 6, or 7 spots	Borderline	Equivocol
	< 20 spots				
	≥ 20 spots	≤ 4 spots	≤ 4 spots	Negative	*M. tuberculosis* infection NOT likely
	< 20 spots	≤ 4 spots	≤ 4 spots	Invalid	Repeat Test
> 10 spots	Any			Invalid	Repeat Test

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Lab reports: T-SPOT. TB Results

Test Name	In Range	Out Of Range	Reference Range
T-SPOT(R).TB			
T-SPOT.TB		POSITIVE	SeeBelow

Normal Value: Negative
Diagnosing or excluding tuberculosis (TB) disease and assessing the probability of latent TB infection (LTBI) requires a combination of epidemiological, historical, medical and diagnostic findings that should be taken into consideration when interpreting T-SPOT.TB test results. A positive test result does not rule in active TB disease caused by Mycobacterium tuberculosis (M. tuberculosis); active TB disease should be confirmed by other tests such as sputum smear and culture, PCR, and chest radiography. Uncommonly, a positive T-SPOT.TB result may be due to infection with other Mycobacterium species including M. kansasii, M. szulgai, M. gordonae, or M. marinum. Alternative tests would be required if these infections are suspected. The T-SPOT.TB test is qualitative and results are reported as positive, borderline or negative, given that the test controls perform as expected. In line with the Centers for Disease Control and Prevention's 2010 recommendation to report quantitative measurements alongside the qualitative result, the laboratory provides spot counts for informational purposes only. The T-SPOT.TB test should not be interpreted as a quantitative test.

PANEL A SPOT COUNT CORRECTED FOR NEG CONTROL	40
PANEL B SPOT COUNT CORRECTED FOR NEG CONTROL	>50
NEGATIVE CONTROL	Passed
POSITIVE CONTROL	Passed

F T-SPOT.TB POSITIVE A

Normal Value: Negative
Diagnosing or excluding tuberculosis (TB) disease and assessing the probability of latent TB infection (LTBI) requires a combination of epidemiological, historical, medical and diagnostic findings that should be taken into consideration when interpreting T-SPOT.TB test results. A positive test result does not rule in active TB disease caused by Mycobacterium tuberculosis (M. tuberculosis); active TB disease should be confirmed by other tests such as sputum smear and culture, PCR, and chest radiography. Uncommonly, a positive T-SPOT.TB result may be due to infection with other Mycobacterium species including M. kansasii, M. szulgai, M. gordonae, or M. marinum. Alternative tests would be required if these infections are suspected. The T-SPOT.TB test is qualitative and results are reported as positive, borderline or negative, given that
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ecommendation to report quantitative measurements alongside
he qualitative result, the laboratory provides spot counts
or informational purposes only. The T-SPOT.TB test should
ot be interpreted as a quantitative test.

PANEL A SPOT COUNT CORRECTED FOR NEG CONTROL	8
PANEL B SPOT COUNT CORRECTED FOR NEG CONTROL	25
NEGATIVE CONTROL	Passed
POSITIVE CONTROL	Passed

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Downside of IGRAs

Say it isn't so!

Issues of reproducibility of results on serial performance

unexplained cases of low-level positive IGRA results reverting to negative on repeat testing

-this is known as conversion/reversion

occur among low-level results, usually between 0.35 and 1.0 IU/mL for QFT

exact cause(s) unknown

Efforts to reduce test variability through better specimen collection and handling and laboratory standardization will minimize low-level false-positive results.

Ok. But which one should I use? One is better than the other, right?

the preponderance of evidence supports the conclusion that....

the preponderance of evidence supports the conclusion that, in terms of accuracy, neither IGRA is strongly preferred over the other

it is recommended that if a patient has an unexpected low-level positive IGRA result, either the same test should be repeated or a different test should be performed, and action should be taken on the second result.

TB Blood Test Result	Interpretation
Positive	*M. tuberculosis* infection likely.
Negative	*M. tuberculosis* infection unlikely, but cannot be excluded, especially if 1. Patient has signs and symptoms consistent with TB disease. 2. Patient has a high risk for developing TB disease once infected with *M. tuberculosis* (e.g., the patient is immunosuppressed).
Indeterminate (QFT-Plus only) or Invalid (T-Spot only)	The test did not provide useful information about the likelihood of *M. tuberculosis* infection. Repeating a TB blood test or performing a TST may be useful.
Borderline (T-Spot only)	Repeating a TB blood test or performing a TST may be useful.

~~FIGHT CLUB~~ IGRA CLUB

First rule of IGRA Club:

Don't trust a negative IGRA, *especially over other evidence!
(pro tip: never take any negative test at face value in the world of TB)
Please note: I am NOT saying it's wrong. I'm just saying to be cautious. Does the result make sense?

The IGRA is a piece of the puzzle. *ONE PIECE* Don't overlook the other pieces!
For some, labs are Shiny and Bright. Oooo! Don't get distracted.

Remember, context matters. More accurate in high risk pts. More FP in low risk pts, potentially leading to unnecessary w/u &/or tx.

IGRA testing has been expanded to any pediatric age (previously was 2 years and older) **All ages now!** in the "Red Book" (the American Academy of Pediatrics Report of the Committee on Infectious Diseases 33rd Edition, just published.)
Caveat: no test is reliable for <6mo

No test (TST or IGRA) overrides clinical, epidemiologic or historical data**

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TBI is a DIAGNOSIS OF EXCLUSION

Something to remember: Discordance between the TST and IGRAs has been measured up to 20% in patients known to be infected with MTB. Don't order both tests, pick the right test to start with!

You don't order an IGRA or TST to w/u TB though. It's a test looking for TBI! But… sometimes you have it anyway…

The nice thing is, you basically only have to exclude one disease… tuberculosis!

Before you treat….Know the Dx

When you make a dx of TBI, you are saying the patient, to the best of your knowledge, does not have TB disease

To know that, you need more than a TB test and a CXR

Back to Basics

H&P

Talk to the patient

Examine the patient

Do they have s/sx?

TB can be almost anywhere…

Recently completed and currently treating pts with TB @ APH:
73 pulm (at least 17 cavitary)
10 pleural
12 lymph
5 eye (4 ant scleritis, 1 chorioretinitis)
3 spine
2 other bones (knee, finger/dactylitis)
2 GU
1 mesenteric
1 peritoneal
1 skin
1 meningitis
1 epiglottis

Sources

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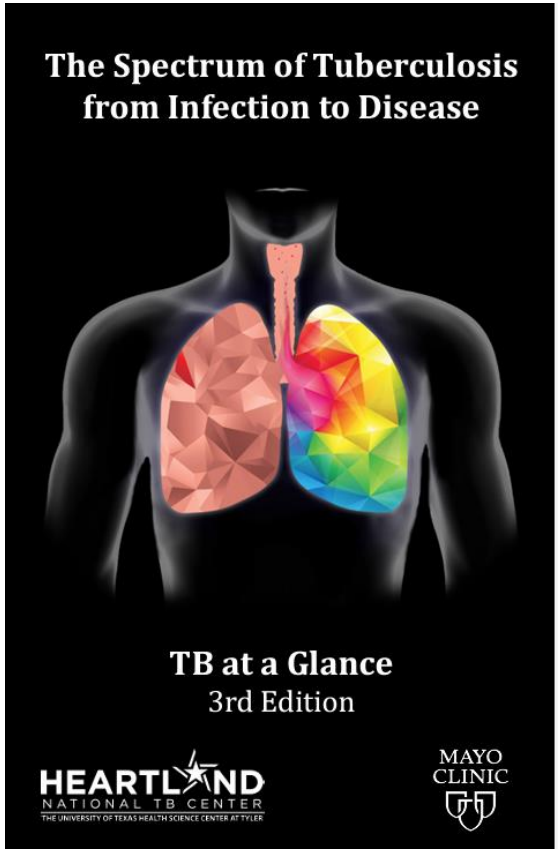
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7448650/

https://www.cdc.gov/tb/statistics/reports/2022/Exec_Commentary.html




Latent Tuberculosis Infection Resources

Print

Updated February 22, 2024

LATENT TB INFECTION

Online Resource Hub

Your one-stop-shop for information, guidance & education

The online latent TB infection (LTBI) resource hub is a one-stop shop for resources related to:

- Education and training
- Guidelines
- Testing and diagnosis
- Infection control and prevention
- Treatment

To order free latent TB infection resources, visit CDC-INFO on Demand.

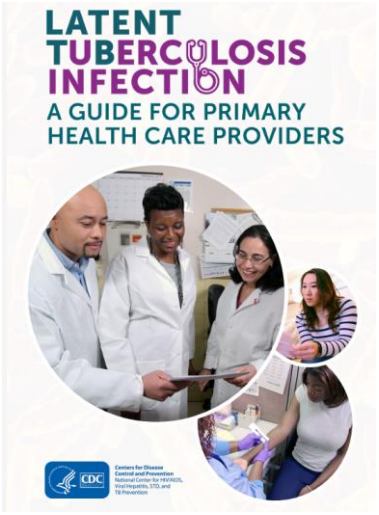
On This Page

Resources for Providers

Resources for Patients

LTBI Reporting Laws, by State

Graphics, Web Buttons, Infographics



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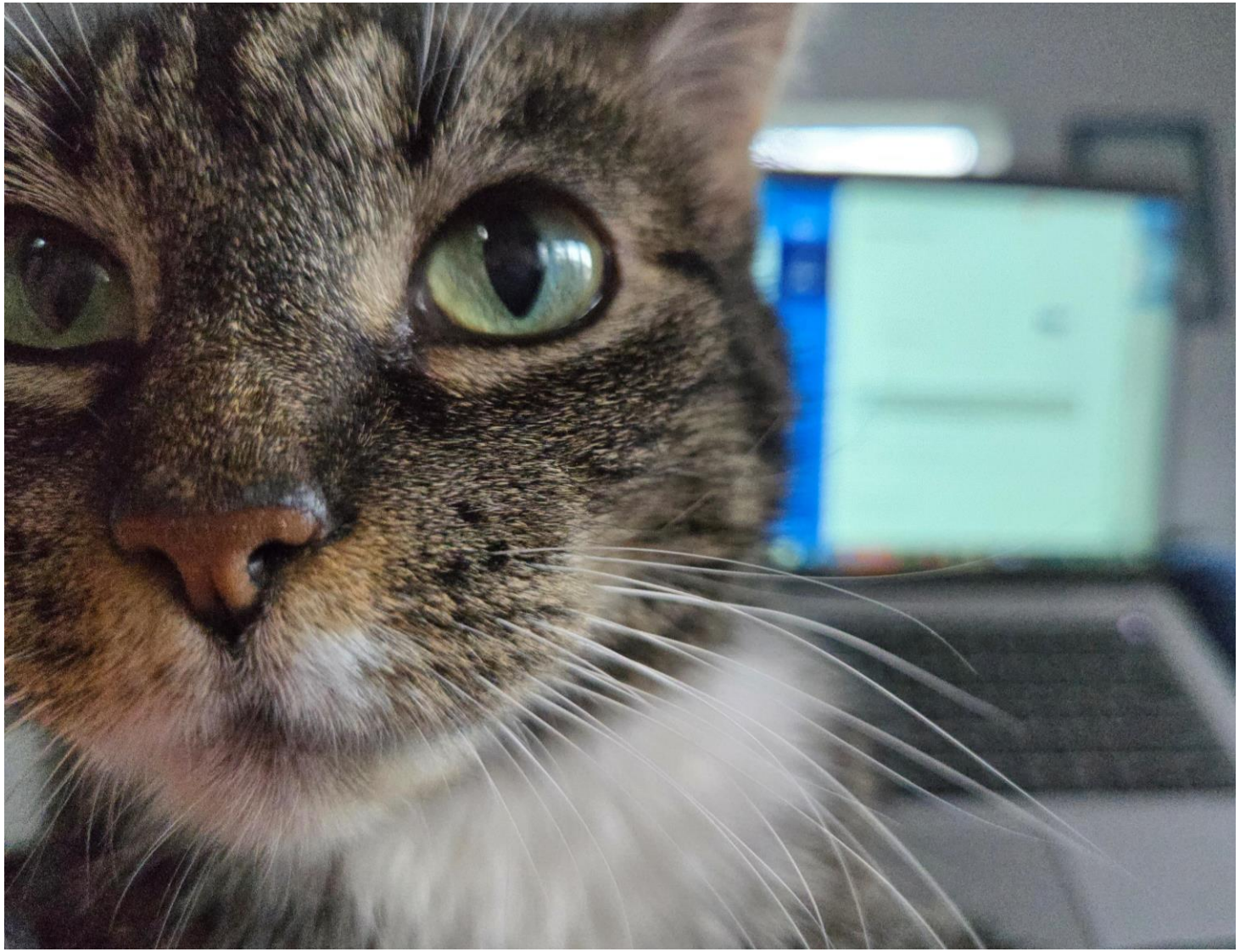


Ruby had suggestions

She was SUPER helpful.

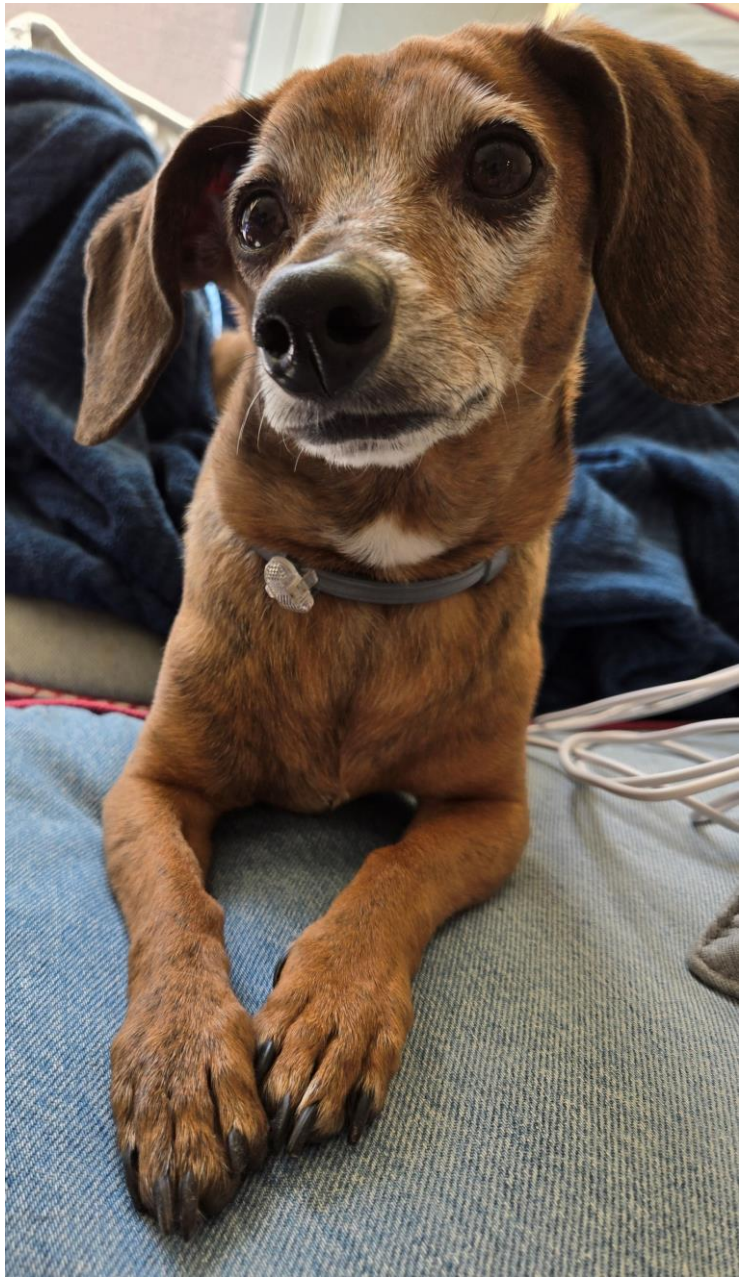
If you haven’t made a power point with a cat sitting on your chest and patting your face with a paw every time you tried to type instead of petting her, my recommendation is…

Don’t try it

Feel free to call or email. I love to talk about TB!

Questions?

And if you are tired of talking about TB, we can talk about Mr! Or your dog, I guess (just kidding! We can!)



Mr's human, aka

Ellen Elmore MD

Physician | Communicable Disease Unit

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