



Chicken & Fish

CID conference
Hunter Ratliff
09/05/2024

Ages, dates, and other less-relevant (and identifying) information may have been changed

Shortcuts



Case 1: [Start](#) | [Summary slide](#)

Case 2: [Start](#) | [Summary slide](#)

Takeaway slide

Nocardia

- **Background** | microbio & AST | pathophys
- **Clinical Syndromes** | lung | skin | CNS
- **Treatment**

NTM infections and MTB testing

- **NTM overview** | rapid & slow | environmental reservoirs
- **NTM geography**
- **Select NTMs** | avium | kansasii | abscessus | marinum
- **Latent TB screening** algorithm

Case #1

Case 1: HPI

A **58 y/o M** with PMH including central serous retinopathy, Afib, T2DM, HTN, HLD, OSA, CKD, hypothyroidism, hypogonadism p/w **multiple abscesses**

Case 1: HPI

A **58 y/o M** with PMH including central serous retinopathy, Afib, T2DM, HTN, HLD, OSA, CKD, hypothyroidism, hypogonadism p/w **multiple abscesses**

- One month ago, had a large, heavy **chicken coup** fall across him
 - Fell on top of his right chest to left thigh
 - Unclear if puncture wound, but coup was covered in chicken wire
- A few days later, **developed SQ abscesses** at site of injury
 - Rx: **Keflex & doxy** but no improvement in symptoms
- Seen in surgery clinic where he was lethargic, mildly confused, and ill-appearing
 - Sent to ED and found to have sepsis

Case 1: Past medical history

A **58 y/o M** with PMH including central serous retinopathy, Afib, T2DM, HTN, HLD, OSA, CKD, hypothyroidism, hypogonadism p/w **multiple abscesses**

- **Central serous retinopathy**: Follows with Cleveland clinic, has been on high dose steroids, up to prednisone 60 mg / day, tapering recently
- **Hx of cellulitis**: Treated with IV antibiotics two years ago, unclear history
- Numerous **dental issues** in the past as well as **recurrent sinus infections**
- Hx of a few surgeries (multiple spine surgeries, TKR) w/ hardware

Case 1: Social History, Exposures, Risk Factors

Geographic & Occupational: The patient lives in West Virginia. He denies recent foreign or domestic travel. They are retired, used to sell pharma

Substance: They deny alcohol use and he does not use tobacco . They report no recreational drug use

Sexual History: Sexual activity with only women. Denied using any condoms or barriers. Denied ever testing positive for STIs

Environmental exposures: Denies freshwater exposure. Though he cannot recall if the coop caused a puncture wound, he thinks **if it did cause puncture injury there would have been soil exposure**

Animal Exposures: **Cats, dogs, chickens**

Tattoos & Piercing: They have previously gotten tattoos (professionally done)

Case 1: Initial exam

Hypotensive requiring low dose levophed

Gen: alert and oriented, NAD, vitals reviewed

Head/Neck: NCAT; trachea appears midline, no gross LAD

ENT: EOMI grossly, anicteric sclerae; MMM

Resp: normal respiratory effort, symmetric chest rise

CV: RRR; extremities perfused

GI: non-distended; no rebound or guarding

Extremities: **3+ BLE edema, + redness LLE**, no tenderness in the calves or thighs, no varicosities

Neurologic: gait is normal, DTR intact bilaterally. Alert and oriented x3. **Drowsy on exam.**

Case 1: Initial workup

WBC: 21 (90% NΦ)

ESR 27; **CRP** 8.6

Cr: 1.9

Lactate: 4

A1c: 9.7

CT C/A/P

- Multiple probable subcutaneous abscesses overlying (up to 5.7cm) the right anterolateral upper abdominal soft tissues, with overlying cellulitis.
- No extension into the peritoneum evident.

CT LLE

16.2 cm subcutaneous abscess in the soft tissues of the medial left mid to distal thigh with invasion of adjacent musculature

Case 1: Summary

A **58 y/o M** with PMH including central serous retinopathy (on **steroids**), Afib, T2DM, HTN, HLD, OSA, CKD p/w **multiple abscesses** one month after **chicken coop** fell on him.

- Rx: **Keflex & doxy** but no improvement in symptoms
- Unclear if puncture injury
- Recurrent sinusitis & dental issues

Exam

Hypotensive, BLE swelling, ?confused

Labs

WBC 21, lactate 4, A1c 9.7

CT C/A/P

Multiple probable subcutaneous abscesses overlying (up to 5.7cm) the right anterolateral upper abdominal soft tissues, with overlying cellulitis

CT LLE

16.2 cm subcutaneous abscess in the soft tissues of the medial left mid to distal thigh with invasion of adjacent musculature

Case 1: Summary

A **58 y/o M** with PMH including central serous retinopathy (on **steroids**), Afib, T2DM, HTN, HLD, OSA, CKD p/w **multiple abscesses** one month after **chicken coop** fell on him.

- Rx: **Keflex & doxy** but no improvement in symptoms
- Unclear if puncture injury
- Recurrent sinusitis & dental issues

Exam

Hypotensive, BLE swelling, **?confused**

Labs

WBC 21, lactate 4, A1c 9.7

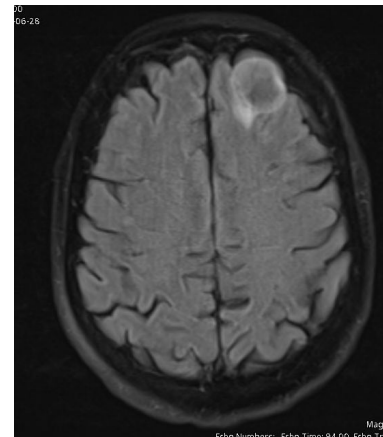


CT Head

2.3 cm rounded hypodense mass lesion within or adjacent to the **left anterior frontal lobe** possibly representing a cystic neoplasm or even abscess in the appropriate setting

MRI Brain

3 cm rim enhancing cerebral abscess within the left anterior frontal lobe with adjacent rim of edema.

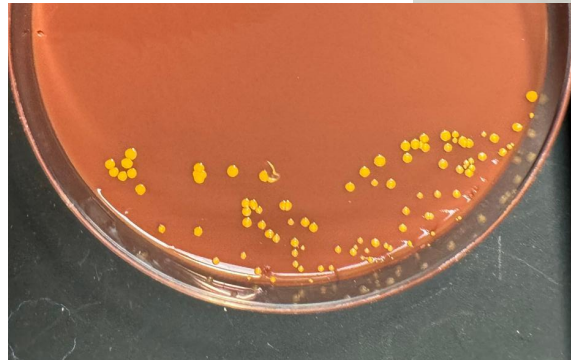
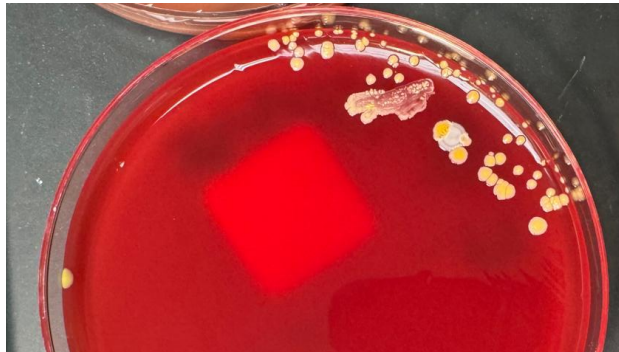
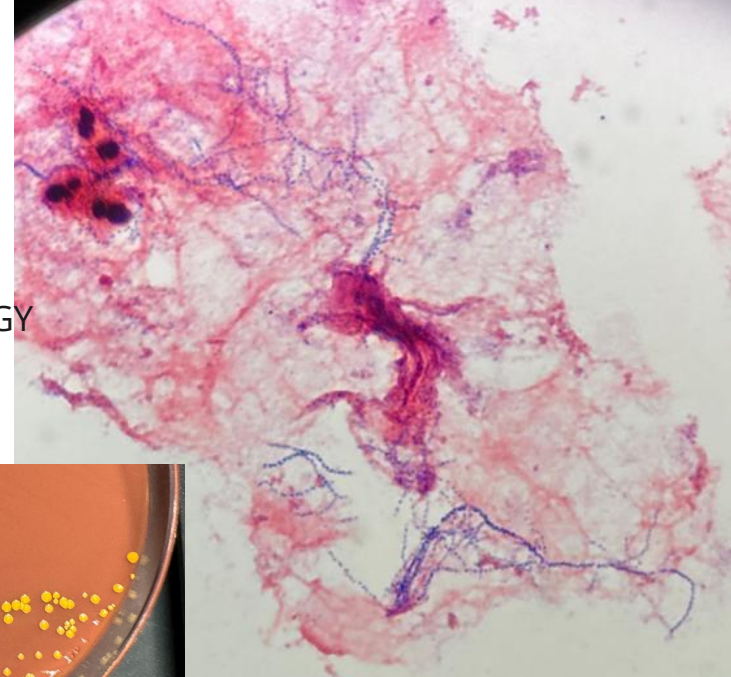


Case 1: Hospital Course

- Taken from ED by surgery for emergent I&D of left leg & abdominal wall abscesses
- Operative cultures
 - Abdomen: *Raoultella planticola*
 - Leg: No growth at time of chart review
- Admitted to MICU for shock, transferred to Ruby for NSGY evaluation
- ID consulted (on my first day of fellowship)

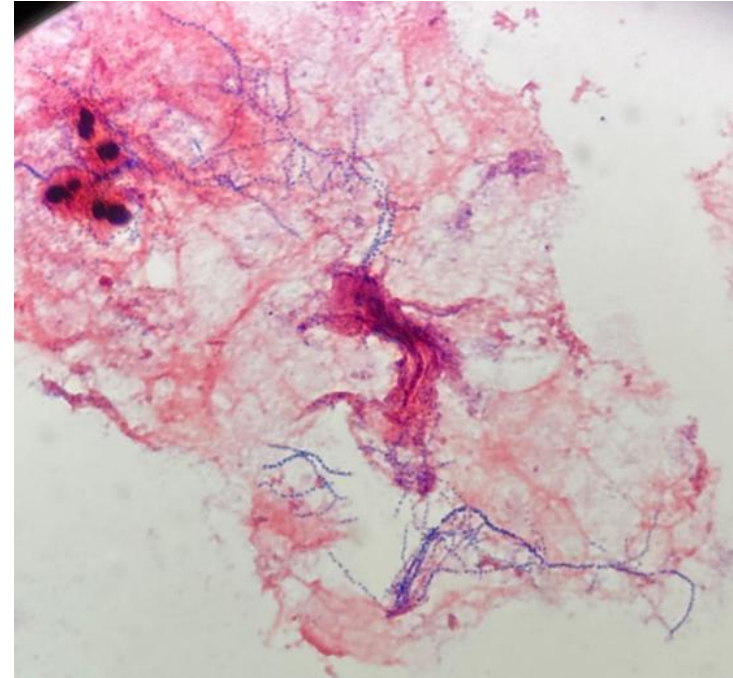
Case 1: Hospital Course

- Taken from ED by surgery for emergent I&D of left leg & abdominal wall abscesses
- Operative cultures
 - Abdomen: *Raoultella planticola*
 - Leg: No growth at time of chart review
- Admitted to MICU for shock, transferred to Ruby for NSGY evaluation
- ID consulted (on my first day of fellowship)



Case 1: Hospital Course

- Operative cultures
 - Abdomen: *Raoultella planticola*, *S epi*
 - Leg: ***Nocardia farcinica***
 - Brain: *Nocardia*, *S epi*
- s/p multiple abdominal & leg washouts
- NSGY I&D of brain abscess



Case 1: Hospital Course

- Uncomplicated first admission
- Discharged on
 - Bactrim + Zyvox (CNS: Nocardia + MRSE)
 - Augmentin (SQ: Raoultella)

Antimicrobial course

- Bactrim / Imi / Linezolid (empiric)
- Discharge:
 - Bactrim + Zyvox (Nocardia + MRSE)
 - Augmentin (Raoultella)

Micro data

- Abdomen: *Raoultella planticola*, *S epi*
- Leg: ***Nocardia farcinica***
- Brain: *Nocardia*, *S epi*

Case 1: Readmission

- Readmitted for unrelated reasons, but family wanted IV treatment
- Susceptibilities returned. Discharged on
 - CNS nocardia: Moxi + Bactrim
 - CNS MRSE: Vanco (DOT: 4 weeks) d/t TCP
- At discharge, had finished 2 weeks of Raoultella coverage for SQ infection

Antimicrobial courses

- Bactrim / Imi / Linezolid (empiric)
- Discharge #1:
 - Bactrim + Zyvox (Nocardia + MRSE)
 - Augmentin (Raoultella)
- Discharge #2:
 - CNS nocardia: Moxi + Bactrim
 - CNS MRSE: Vanco (DOT: 4 weeks)

Micro data

- Abdomen: *Raoultella planticola*, *S epi*
- Leg: ***Nocardia farcinica***
- Brain: *Nocardia*, *S epi*

Nocardia susceptibilities

Tobramycin	32 Resist
Linezolid	4 Suscept
Bactrim	2/38 Suscept
Doxycycline	8 Resist
Ciprofloxacin	0.5 Suscept
Amoxicillin/Clavulanate	8/4 Suscept
Moxifloxacin	0.25 Suscept
Amikacin	1 Suscept
Imipenem	32 Resist
Ceftriaxone	>=128 Resist
Clarithromycin	>=32 Resist
Minocycline	4 Intermed

Case 1: Clinic #1

- During OPAT, developed AKI so vanco stopped a little early (but likely still had ~4 weeks)
- Having GI intolerance (maybe to Bactrim?)
- Kept on Moxi & Bactrim until 6 weeks

Antimicrobial courses

- Bactrim / Imi / Linezolid (empiric)
- Discharge #1:
 - Bactrim + Zyvox (Nocardia + MRSE)
 - s/p 2 weeks Augmentin (Raoultella)
- Discharge #2:
 - CNS nocardia: Moxi + Bactrim
 - s/p 4 weeks Vanco
- Clinic #1:
 - CNS nocardia: Moxi + Bactrim

Micro data

- Abdomen: *Raoultella planticola*, *S epi*
- Leg: ***Nocardia farcinica***
- Brain: *Nocardia*, *S epi*

Nocardia susceptibilities

Tobramycin	32 Resist
Linezolid	4 Suscept
Bactrim	2/38 Suscept
Doxycycline	8 Resist
Ciprofloxacin	0.5 Suscept
Amoxicillin/Clavulanate	8/4 Suscept
Moxifloxacin	0.25 Suscept
Amikacin	1 Suscept
Imipenem	32 Resist
Ceftriaxone	>=128 Resist
Clarithromycin	>=32 Resist
Minocycline	4 Intermed

Case 1: Clinic #2

- During OPAT, developed AKI (again) so Bactrim stopped at 6 weeks. GI symptoms resolved
- Added Augmentin for SQ disease

Nocardia susceptibilities

Tobramycin	32 Resist
Linezolid	4 Suscept
Bactrim	2/38 Suscept
Doxycycline	8 Resist
Ciprofloxacin	0.5 Suscept
Amoxicillin/Clavulanate	8/4 Suscept
Moxifloxacin	0.25 Suscept
Amikacin	1 Suscept
Imipenem	32 Resist
Ceftriaxone	>=128 Resist
Clarithromycin	>=32 Resist
Minocycline	4 Intermed

Antimicrobial courses

- Bactrim / Imi / Linezolid (empiric)
- Discharge #1:
 - Bactrim + Zyvox (Nocardia + MRSE)
 - s/p 2 weeks Augmentin (Raoultella)
- Discharge #2:
 - CNS nocardia: Moxi + Bactrim
 - s/p 4 weeks Vanco
- Clinic #1:
 - CNS nocardia: Moxi + Bactrim
- OPAT: Had to stop bactrim 2/2 AKI
- Clinic #2:
 - c/w Moxi
 - Added Augmentin

Case 1 discussion



Links to articles discussed
here



Nocardia

Objectives

- Review microbiology & risk factors
- Describe clinical syndromes
- Review treatment options



Articles

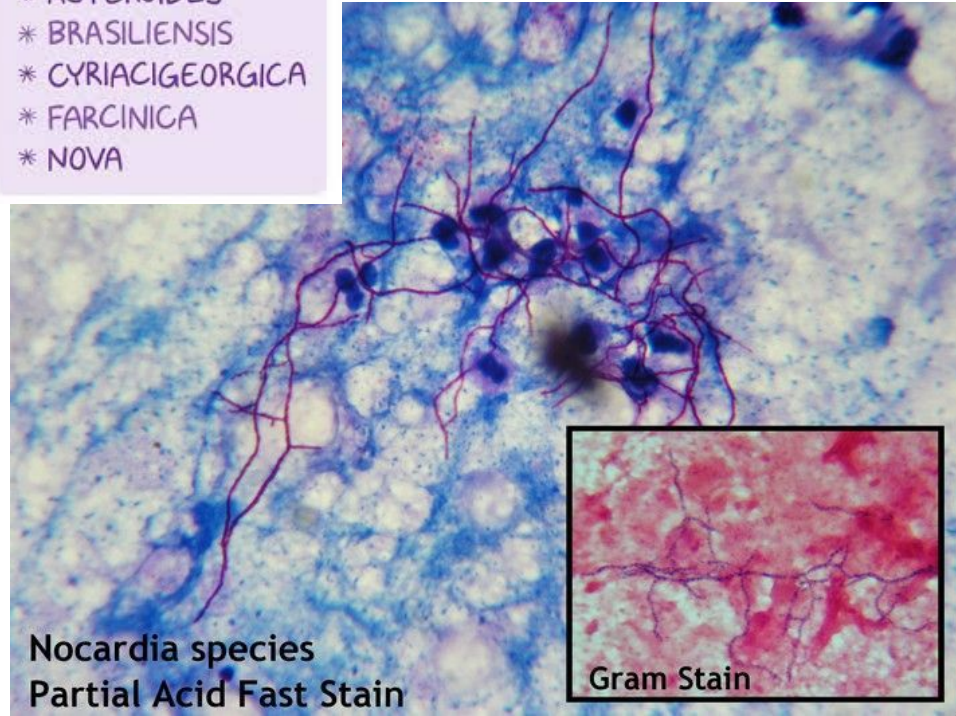
Nocardia: Microbiology

- Delicate **filamentous gram-positive branching rods**
- Weakly acid fast
- Aerobic growth

Numerous species

- Species can be helpful in predicting susceptibilities (Toyokawa 2021)

NOCARDIA
* ASTEROIDES
* BRASILIENSIS
* CYRIACIGEORGICA
* FARCINICA
* NOVA



Nocardia species
Partial Acid Fast Stain

Gram Stain

Nocardia: Antimicrobial susceptibilities

	N. farcinica	N. nova	N. brasiliensis	N. cyriacigeorgica	N. abscessus	N. otitidiscaviarum
Bactrim	S	S	S	S	S	S
Imipenem	S	S	R	S	S	R
Amikacin	S	S	S	S	S	S
Linezolid	S	S	S	S	S	S
Tobramycin	R	R	S	S	S	S
Augmentin	S	R	S	R	S	R
Ceftriaxone	R	S	R	S	S	R
Ciprofloxacin	R	R	R	R	R	R
Clarithromycin	R	S	R	R	R	R
Doxycycline	R	R	R	R	S	R
Minocycline	R	R	R	R	S	R
Erythromycin	R	S	R	R	R	R

Adapted from UpToDate

Nocardia: Risk factors

- Natural reservoir is **soil & decaying vegetation**
- Transmission via **inhalation** or **direct inoculation**
- **Immunosuppression** is major risk factor (though can occur in immunocompetent)
 - **Steroids** are most frequently reported risk factor
 - Solid organ transplant

Nocardia: Clinical Syndromes

- Subacute infection
- Main sites of infections
 - Lungs
 - Skin
 - CNS
- Hematogenous spread is common in disseminated disease

Nocardia: Clinical Syndromes

- Subacute infection
- Main sites of infections
 - **Lungs**
 - Skin
 - CNS
- Hematogenous spread is common in disseminated disease

Pulmonary disease

- Most **common site** of disease
- Variable presentation:
 - Pneumonia
 - Lung abscess
 - Cavitory lesion
 - Empyema
- **More likely to go to CNS** (vs skin)
- Can mimic flares of chronic lung disease (e.g. sarcoid patient who is on steroids)

Nocardia: Clinical Syndromes

- Subacute infection
- Main sites of infections
 - Lungs
 - **Skin**
 - CNS
- Hematogenous spread is common in disseminated disease

Skin / soft tissue

- Often in setting of trauma
- Primary skin infection is most common in immunocompetent

Types

1. **Localized:** Cellulitis or SQ abscess +/- drainage
2. **Lymphocutaneous:** Nodular lymphangitis "sporotrichoid nocardiosis"
 - If thinking sporotrichosis (e.g. thorn injury) consider nocardia
3. **Mycetoma:** chronic cutaneous infection that coalesces to large necrotic abscess with draining sinus tracts

Nocardia: Clinical Syndromes

- Subacute infection
- Main sites of infections
 - Lungs
 - Skin
 - **CNS**
- Hematogenous spread is common in disseminated disease

CNS disease

- Nocardia loves to go to the brain
- One or more abscesses
- May or **may not be symptomatic**
- If someone has nocardia, **you should scan their head!**

Nocardia: Initial treatment

- Bactrim is the mainstay treatment
 - Resistance can occur, so send for susceptibilities
- Initial therapy often **Bactrim** + **something else**
 - Often imipenem or amikacin
 - If CNS, **some use all three**

- Disseminated disease (including CNS) induction therapy:
 - At least six weeks of double coverage
 - Frequently IV

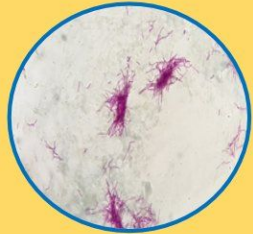
Nocardia: Long term treatment

- Always guided by susceptibilities and clinical response
 - **High risk of relapse** / treatment failure
- **PO stepdown:** After 3-6 weeks and clinical response:
 - **Non-CNS:** After **3 weeks**, consider PO monotherapy
 - **CNS &/or immunocompromised:** After **6 weeks**, consider switch to PO combo therapy
- Duration of therapy
 - Not well defined
 - **Isolated cutaneous:** 3-6 months (immunocompetent), 6-12 months (immunocompromised)
 - **CNS or immunocompromised:** At least one year
- Secondary prophylaxis:
 - May be some role for Bactrim PPx (1 DS daily) if immunosuppressed and no expected recovery (e.g. BMT, SOT)

NOCARDIA Spp

Pathogen

Filamentous gram-positive branching rod



Grows in acid fast staining and anaerobic conditions. ✓

Different from Actinomyces.

Risks Factors

- Glucocorticoid therapy
- Malignancy
- Organ Transplant recipient
- HIV
- Immunotherapy

Treatment

Allergy to sulfonamides
=
Desensitization



Clinical Presentation

Systemic (≥ 2 sites involved) 32%

Diagnosis

Tissue : Gram stain, modified acid-fast staining. Culture (5 to 21 days for growth). PCR.



Pulmonary

Primary site of Infection. 39%

- Fever
- Night sweats
- Fatigue
- Anorexia
- Weight loss
- Dyspnea
- Cough
- Hemoptysis
- Pleuritic chest pain



Immunocompetent: TMP (5 -10 mg/kg) -SMX. PO, BID
Immunocompromised: TMP (10 -15 mg/kg) -SMX,PO BID

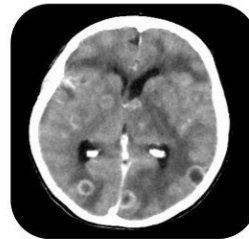


CNS

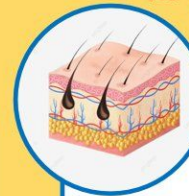
CNS infection alone: 9%. Up to 20% with Lung involvement

Brain abscess most common finding. Meningitis is rare

- Fever
- Headache
- Meningismus +/-
- Seizures
- Focal neurologic deficits



TMP(15mg/Kg)-SMX IV + imipenem 500 mg IV + amikacin (7.5 mg/kg IV)



Cutaneous

Cutaneous infection alone : 8%. direct inoculation from trauma.

Primary cutaneous
Ulcerations, pyoderma, cellulitis, nodules, and subcutaneous abscesses

Lymphocutaneous
Similar syndrome caused by *Sporothrix schenckii*.



Mycetoma
chronic cutaneous infection

TMP (5 -10 mg/kg) -SMX. PO, BID (3-6mo)

Mycetoma MP(10 mg/kg) -SMX. PO, BID W/wo Dapsone 100mg (6-12 mo)

Case #2

Case 2: HPI

A **25 y/o M** with PMH of bipolar (on Lamictal) is referred to ID clinic for a **positive PPD**

- Feels well, ROS entirely negative
- No known exposure to TB
- Prior TB testing (both TST & IGRA) have all been negative

Case 2: Social History, Exposures, Risk Factors

Geographic: He has **never traveled abroad** (all of his military work was stateside). During his time in the military, was **stationed in Louisiana** for most of the time, but also a few months in North Carolina. When he left the military two years ago, he moved from Louisiana to WV and hasn't traveled out of WV since

Occupational / Hobbies: Joined Army six years ago. Primarily **worked in healthcare** (his base's clinic) doing mostly **administrative work**. Would provide **limited patient care** when needed (e.g. triage) and only off-base work was during EMT training. While in Louisiana, he went out to the **bayous to fish**. Still enjoys **fishing in WV**, but not as good crayfishing up here. Now working in athletics department here, which prompted TB testing.

Case 2: Social History, Exposures, Risk Factors

Infectious PMH: **No history of BCG vaccine**. No known household contacts with TB or who are immunocompromised. Aside from what was mentioned in occupational section, no other worrisome possible exposures to TB (incarceration exposure, homeless shelters)

Animal Exposures: Has pets (**cats and fish**). Otherwise denies farm animal exposures, bird/reptile exposures, or other animal exposure.

Substance: They only drink socially and he does not use tobacco. They report no recreational drug use

Sexual History: They are sexually active with only their female partner (of many years). The patient reports consistent condom use. No history of STIs

Tattoos & Piercing: They have previously gotten tattoos (professionally done) and no piercings .

Case 2: TB testing history

- Initial TST when he joined the military was **negative**
- While in the military, had TB testing (both TST and IGRA) **every six months** that were **all negative**
 - Was not told that any of his clinic patients were positive for TB
- He had testing at the end of his time in the service which was **negative**
- Had two step PPD for pre-employment screen

Date	PPD induration
-3mo	0mm
-3mo + 9 days	12mm
1 week ago	15mm



Case 2: Summary

A **25 y/o M** with PMH of bipolar (on Lamictal) is referred to ID clinic for a **positive PPD**

- Pre-military: TST **negative**
- q6mo: **all negative**
- End of service: **negative**

Date	PPD induration
-3mo	0mm
-3mo + 9 days	12mm
1 week ago	15mm

Case 2: Conclusion

A **25 y/o M** with PMH of bipolar (on Lamictal) is referred to ID clinic for a **positive PPD**

- Pre-military: TST **negative**
- q6mo: **all negative**
- End of service: **negative**

Date	PPD induration
-3mo	0mm
-3mo + 9 days	12mm
1 week ago	15mm

HIV screen negative

QuantGold negative


Treated PPD as false positive

- Possibly from NTM exposure given fishing history & time in Louisiana

Case 2 discussion



Links to articles discussed
here



NTM infections & Mtb testing

NTM = nontuberculous mycobacterial

Mtb = Mycobacterium tuberculosis



Articles

Objectives

- Review the classification of mycobacteria
- Review features of NTM
 - Transmission & exposures
 - Clinical syndromes
- Describe geographic distribution of NTM infections in US
- Discuss LTBI screening guidelines
 - Focus on distinguishing NTM from Mtb

Types of mycobacteria

Mycobacterium tuberculosis complex

- *M. tuberculosis*
- *M. bovis*
- *M. africanum*
- *M. microti*
- *M. canetti*

M. leprae

Rapidly growing NTM

Slow growing NTM

Types of mycobacteria

Mycobacterium tuberculosis complex

M. leprae

Rapidly growing NTM

- *M. fortuitum complex*
 - *M. fortuitum*
 - *M. peregrinum*
 - *M. porcinum*
- *M. chelonae*
- *M. abscessus complex*
- *M. smegmatis*
- *M. mucogenicum*

Slowly growing NTM

Photochromogens

- *M. kansasii*
- *M. marinum*

Scotochromogens

- *M. goodnae*
- *M. scrofulaceum*

Nonchromogens

- *M. avium complex*
 - *M. avium*
 - *M. intracellulare*
 - *M. chimaera*
- *M. terrae complex*
- *M. ulcerans*
- *M. xenopi*
- *M. simiae*
- *M. malmoense*
- *M. szulgai*
- *M. asiaticum*
- *M. haemophilum*

NON-TUBERCULOUS MYCOBACTERIA (NTM)

Ubiquitous environmental organisms

Higher rates of isolation and clinical disease in SE US

NTMs often classified as rapidly growing (RGM) and slowly growing mycobacteria

RGM = usually grow within 7 days*

*specifically means growth on solid media after subculture -- growth in liquid media influenced by quantity of inoculum!

Runyon classification can help with phenotypic identification

- **Photochromogens**: slow growing; yellow-orange pigment only with light exposure
- **Scotochromogens**: pigment +/- light exposure
- **Nonchromogens**: produce no pigment (all RGMs!)

Transmission via:

- Inhalation of infected aerosols from environment (shower head, hot tub)
- Ingestion of organism (presumed route for disseminated MAC)
- Direct inoculation in skin breaks or trauma
- No human-human or animal-human transmission (not communicable)



Inoculate clinical specimens in both:

Solid media

Middlebrook 7H11 media
Lowenstein-Jensen media

Liquid media
MGIT broth



Clinical syndromes typically classified into 4 categories

- | | | | |
|---|---------------------------------|--|--|
| 1 | Pulmonary infection | | Caused mostly by:
MAC
M. abscessus
M. kansasii |
| 2 | Lymphadenitis | | MAC
M. scrofulaceum |
| 3 | Skin, soft tissue, bone disease | | M. fortuitum
M. chelonae
M. marinum
M. abscessus
M. ulcerans |
| 4 | Disseminated infection (ICH) | | M. avium,
M. kansasii
M. abscessus
M. chelonae |

Where does NTM live?

Habitat	Reference
Natural waters	Falkinham <i>et al.</i> 1980; von Reyn <i>et al.</i> 1993
Drinking water distribution systems	Covert <i>et al.</i> 1999; Falkinham <i>et al.</i> 2001
Biofilms in drinking water distribution systems	Falkinham <i>et al.</i> 2001; Torvinen <i>et al.</i> 2004
Building, hospital, and household plumbing	Du Moulin <i>et al.</i> 1988; Wallace <i>et al.</i> 1998; Nishiuchi <i>et al.</i> 2007; Falkinham <i>et al.</i> 2008
Hot tubs and spas	Embil <i>et al.</i> 1997; Kahana <i>et al.</i> 1997; Mangione <i>et al.</i> 2001; Marras <i>et al.</i> 2005
Natural and household/building aerosols	Falkinham <i>et al.</i> 2008
Boreal forest soils and peats	Iivanainen <i>et al.</i> 1997, 1999
Acidic, brown-water swamps	Kirschner <i>et al.</i> 1992
Potting soils	De Groote <i>et al.</i> 2006
Metal removal fluid systems	Bernstein <i>et al.</i> 1995; Shelton <i>et al.</i> 1999; Moore <i>et al.</i> 2000

Table 2: Habitats of environmental opportunistic mycobacteria
Falkinham 2009

Mycobacterium avium complex

Exposures:

- Soil
- Water (aerosolized from showerheads; hot tubs, natural surface water)
- Animals
- Higher rates near gulf coast

Disease:

- Lung disease
- Disseminated in immunocompromised

Slow growers

- *M. avium complex*
- *M. kansasii*
- *M. marinum*
- *M. ulcerans*
- *M. xenopi*
- *M. simiae*
- *M. malmoense*

Rapid growers

- *M. abscessus complex*
- *M. fortuitum complex*
- *M. chelonae*
- *M. abscessus* subspecies *massiliense*
- *M. abscessus* subspecies *bolletii*

Mycobacterium kansasii

Exposures:

- Also high predisposition for south coast & central plains
- Not found in soil or natural water supply
- Has been found in city water supply

Disease:

- Can cause lung disease like MTB
- Similar to MAC, mostly occurs in those with existing lung disease or immunocompromised

Slow growers

- *M. avium complex*
- *M. kansasii*
- *M. marinum*
- *M. ulcerans*
- *M. xenopi*
- *M. simiae*
- *M. malmoense*

Rapid growers

- *M. abscessus complex*
- *M. fortuitum complex*
- *M. chelonae*
- *M. abscessus* subspecies *massiliense*
- *M. abscessus* subspecies *bolletii*

Mycobacterium abscessus complex

Exposures:

- Similar environmental exposures (soil, water, animals)
- Hospital tap water
- Breast implant outbreak

Disease:

- Lung disease (even in immunocompetent)
- SSTI
- Disseminated in immunocompromised

Slow growers

- *M. avium complex*
- *M. kansasii*
- *M. marinum*
- *M. ulcerans*
- *M. xenopi*
- *M. simiae*
- *M. malmoense*

Rapid growers

- *M. abscessus complex*
- *M. fortuitum complex*
- *M. chelonae*
- *M. abscessus* subspecies *massiliense*
- *M. abscessus* subspecies *bolletii*

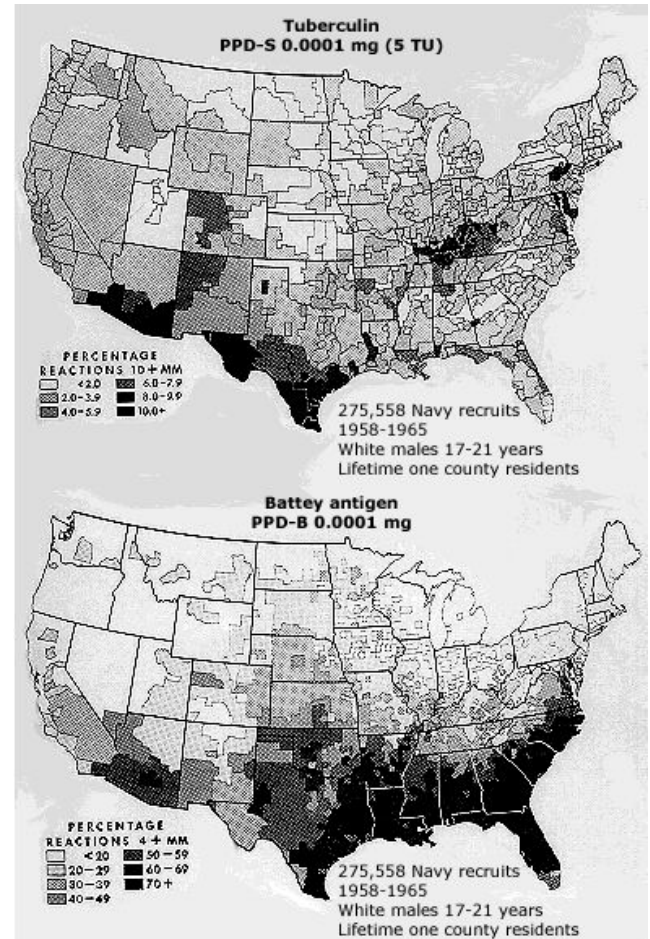
NTM Geography

Very old study of 275,000 Navy recruits (1969)

- I can't access the article but sounds like they all lived their entire lives in one county
- Over 70% of those in southeastern or gulf coast states had been exposed or infected with MAC

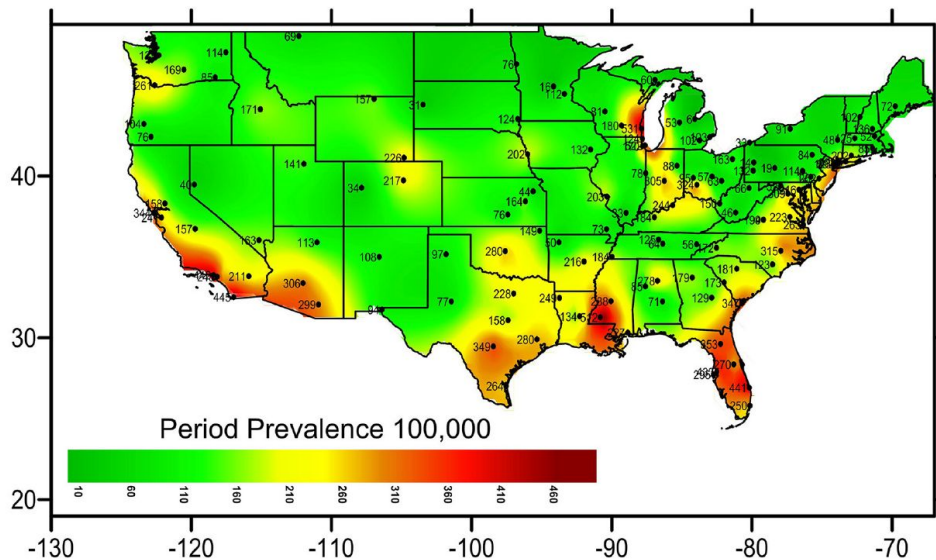
Geographic variation in the frequency of reactors to PPD-S (top) and to PPD-B 9 (bottom).

Edwards, et al, Am Rev Respir Dis 1969; 99(Suppl):1.

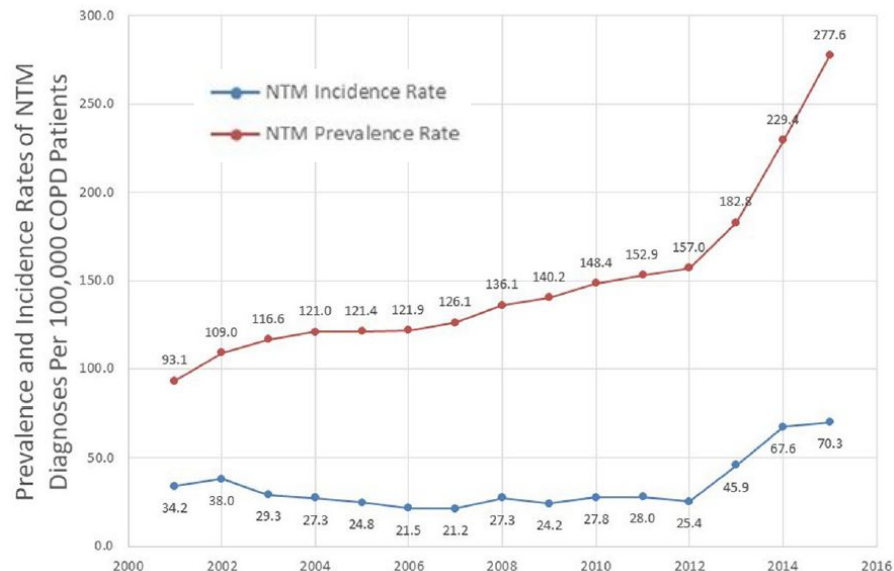


NTM Geography

- VA administrative data (2001 - 2015)
 - Only looked at COPD patients
 - Rising incidence in 2012



Prevalence and Incidence Rates of NTM

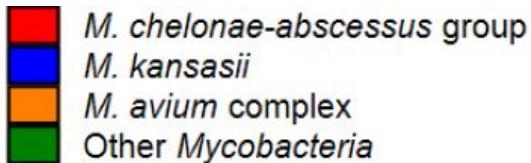
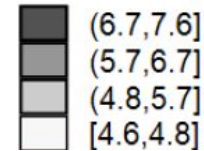
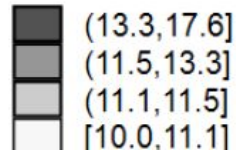
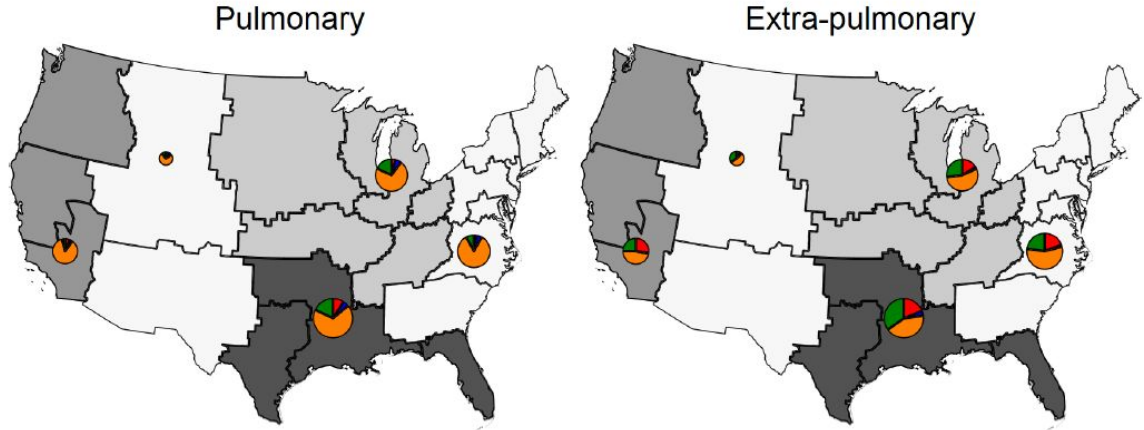


Left: Period prevalence of NTM infections (figure 1)
 Above: Prevalence & incidence (figure 2)
 Pyarali et al (2018)

NTM Geography

- Also VA patients (2009 - 2012)
 - Not restricted to COPD patients
- Identified cases by ICD code and natural language processing of micro data

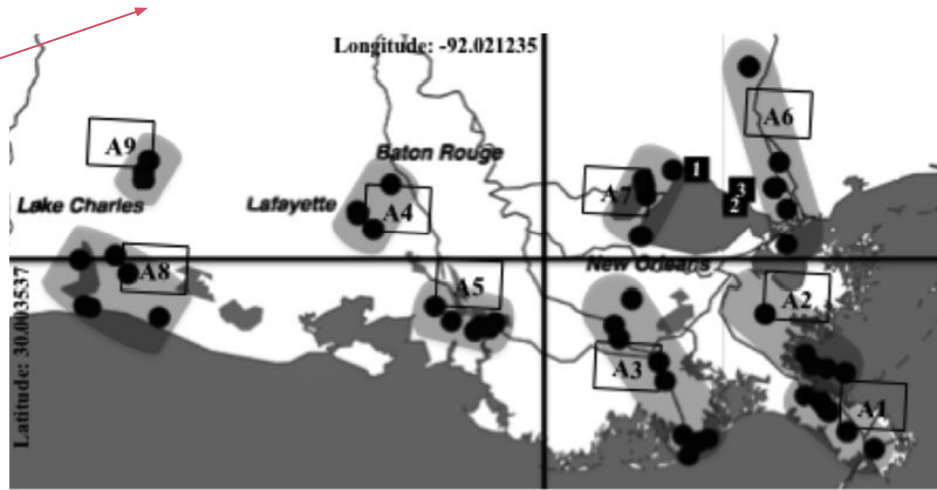
Cases per 100k patient-years



Incident rates of NTM infections in VA patients (2009-2012)
Jones et al (2018), Figure 1

NTM Geography

Military base



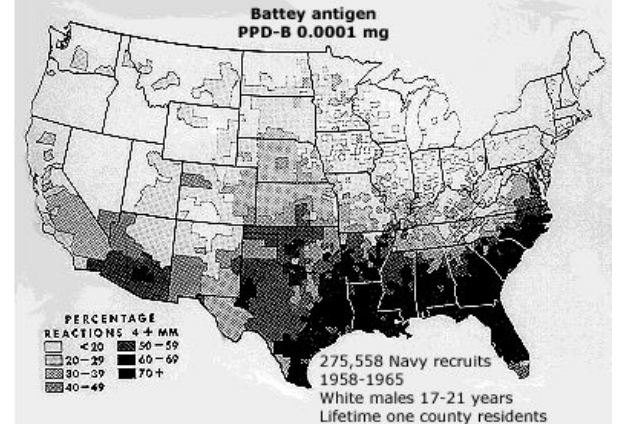
- Environmental study out of LSU & Tulane (summer of 2011)
- PCR for *M. ulcerans*
 - So far no human cases in US from *M. ulcerans*
- Samples collected from 9 sites
 - High rates (47%) found in water samples
 - Similar rates for fresh / brackish / salt water

No. of *M. ulcerans*-positive samples/total no. of samples (%)

Location	Aquatic vegetation	Water	Combined
Area 1	1/6	2/6	3/12 (25)
Area 2	1/8	4/6	5/14 (36)
Area 3	1/6	4/6	5/12 (42)
Area 4	1/9	3/9	4/18 (22)
Area 5	1/7	3/6	4/13 (31)
Area 6	3/6	1/6	4/12 (33)
Area 7	0/6	3/6	3/12 (25)
Area 8	0/5	4/6	4/11 (36)
Area 9	1/6	3/6	4/12 (33)
Total	9/59 (15)	27/57 (47)	36/116 (31)

Top: Sampling sites in Louisiana study of *M. ulcerans* (Figure 1)
Bottom: Sample PCR positivity for *M. ulcerans*, by type & source (Table 3)
 Hennigan (2013)

But back to the Cajun food



Mycobacterium marinum

- Infection is less common
- Found in water (fresh & salt): marine environment, swimming pools, and fish tanks
- **Fish tank granuloma:** Sink infection from contaminated fish tank, often when preexisting skin injury

Slow growers

- *M. avium complex*
- *M. kansasii*
- *M. marinum*
- *M. ulcerans*
- *M. xenopi*
- *M. simiae*
- *M. malmoense*

Rapid growers

- *M. abscessus complex*
- *M. fortuitum complex*
- *M. chelonae*
- *M. abscessus* subspecies *massiliense*
- *M. abscessus* subspecies *bolletii*

Mycobacterium marinum

- Infection is less common
- Found in water (fresh & salt): marine environment, swimming pools, and fish tanks
- **Fish tank granuloma:** Sink infection from contaminated fish tank, often when preexisting skin injury
- Can cause **false positive TST test**
- Case series of patients (n=7) who had SSTI infection with M marinum (Lewis 2003)
 - 100% had PPD \geq 10mm
 - 29% had PPD \geq 15mm
 - Four patients had negative PPD documented before infection

Slow growers

- *M. avium complex*
- *M. kansasii*
- *M. marinum*
- *M. ulcerans*
- *M. xenopi*
- *M. simiae*
- *M. malmoense*

Rapid growers

- *M. abscessus complex*
- *M. fortuitum complex*
- *M. chelonae*
- *M. abscessus* subspecies *massiliense*
- *M. abscessus* subspecies *bolletii*

Mycobacterium marinum

- Infection is less common
- Found in water (fresh & salt): marine environment, swimming pools, and fish tanks
- **Fish tank granuloma:** Sink infection from contaminated fish tank, often when preexisting skin injury
- Can cause **false positive TST test** (Lewis 2003)
- Case series of NTM SSTI (n=78) from **UTMB**, which is on the gulf coast (Philips 2019)
 - M. abscessus (47%)
 - M. fortuitum (26%)
 - M. marinum (21%)

Slow growers

- *M. avium complex*
- *M. kansasii*
- *M. marinum*
- *M. ulcerans*
- *M. xenopi*
- *M. simiae*
- *M. malmoense*

Rapid growers

- *M. abscessus complex*
- *M. fortuitum complex*
- *M. chelonae*
- *M. abscessus* subspecies *massiliense*
- *M. abscessus* subspecies *bolletii*

IDSA: LTBI screening

- Persons at low risk for Mtb infection and disease progression NOT be tested for Mtb infection

Risk of Infection ↑	Groups with Increased Likelihood of Infection with Mtb	Benefit of Therapy	LTBI Testing Strategy		
			Risk of Developing Tuberculosis if Infected →		
			Low	Intermediate (RR 1.3 -3)	High (RR 3-10)
	Household contact or recent exposure of an active case	Yes	Likely to be Infected Low to Intermediate Risk of Progression (TST ≥ 10mM)		Likely to be Infected High Risk of Progression (TST ≥ 5mM)
	Mycobacteriology laboratory personnel	Not demonstrated			
	Immigrants from high burden countries (>20 / 100,000)	Not demonstrated			
	Residents and employees of high risk congregate settings	Yes	Unlikely to be Infected (TST > 15mM)		
	None	Not demonstrated			
			Benefit of Therapy		
			Not demonstrated		Yes

LTBI = latent tuberculosis infection
Mtb = Mycobacterium tuberculosis

Paradigm for evaluation of those with LTBI based on risk of infection, risk of progression to tuberculosis, and benefit of therapy. (figure 1, 2017 IDSA guidelines)

IDSA: LTBI screening

- Persons at low risk for Mtb infection and disease progression NOT be tested for Mtb infection
- If you *have* to test them
 - Favor IGRA over TST (if >5 y.o.)
- If **initial test is positive**, suggest a **second diagnostic test**

Group	Testing Strategy	Considerations
Likely to be Infected High Risk of Progression (TST \geq 5mM)	Adults Acceptable: IGRA OR TST Consider dual testing where a positive result from either result would be considered positive Children \leq 5 years of age Preferred: TST Acceptable: IGRA OR TST Consider dual testing where a positive result from either would be considered positive ¹	Prevalence of BCG vaccination Expertise of staff and/or laboratory Test availability Patient perceptions Staff perceptions Programmatic concerns
Likely to be Infected Low to Intermediate Risk of Progression (TST \geq 10mM)	Preferred: IGRA where available Acceptable: IGRA or TST	
Unlikely to be Infected (TST > 15mM)	Testing for LTBI is not recommended If necessary: Preferred: IGRA where available. Acceptable: Either IGRA OR TST For serial testing: Acceptable: Either IGRA OR TST Consider repeat or dual testing where a negative result from either would be considered negative ²	

Summary of recommendations for testing for LTBI (figure 2, 2017 IDSA guidelines)

LTBI = latent tuberculosis infection
 Mtb = Mycobacterium tuberculosis
 IGRA = interferon- γ release assay
 TST = tuberculin skin test

JAMA study with CDC (April 2024)

- Prospective diagnostic trial of 22,000 subjects at high risk for TB infections
- Compared TST & the two IGRA

Table 3. Incremental Value Gained by Second Test: Change in PPV

Test A ^a	Test B	Incremental change estimate in PPV (95% CI) ^b
TST ⁺	QFT ⁻ GIT ⁺	1.64 (1.40-1.93)
TST ⁺	QFT ⁻ GIT ⁻	0.36 (0.18-0.75)
TST ⁺	TSPOT ⁺	1.94 (1.65-2.27)
TST ⁺	TSPOT ⁻	0.29 (0.13-0.65)
QFT ⁻ GIT ⁺	TST ⁺	1.10 (0.98-1.24)
QFT ⁻ GIT ⁺	TST ⁻	0.54 (0.19-1.59)
QFT ⁻ GIT ⁺	TSPOT ⁺	1.24 (1.09-1.41)
QFT ⁻ GIT ⁺	TSPOT ⁻	0.39 (0.13-1.12)
TSPOT ⁺	TST ⁺	1.10 (1.02-1.18)
TSPOT ⁺	TST ⁻	0.31 (0.05-2.13)
TSPOT ⁺	QFT ⁻ GIT ⁺	1.08 (1.00-1.17)
TSPOT ⁺	QFT ⁻ GIT ⁻	0.34 (0.05-2.33)

Results of the second test are highlighted in **red** if it was **positive** and **green** if it was **negative** (Table 3, Ayers 2024)

Learning points & take aways

Learning points & take aways



Sources

- Nocardia is a G(+) branching rod, often **found in soil**, that can cause infections in **immunocompromised hosts**
- Common sites of infection are **skin** and **lungs**, with a high predisposition to go to the **CNS**
- **Bactrim** is a key back bone in **multidrug therapy**, which should be **tailored to susceptibilities**
- Despite **prolonged treatment** (up to one year), **high rates of recurrence**

- Nontuberculous mycobacterial (NTM) is everywhere, including **water and soil**
- Epidemiological studies show higher rates in the **south/gulf coast**
- Some NTM (e.g. *M. ulcerans* & ***M. marinum***) have unique associations (e.g. **fish tanks**)
- NTM can cause **false positive PPDs** (*M. marinum*)
- If positive PPD (and low pretest probability), **repeat IGRA** may be of some utility

