



**National Jewish
Health[®]**

Breathing Science is Life.[®]

NTM
Lecture Series
for Providers

April 25-26, 2024

Radiologic Evaluation of Pulmonary NTM Infection

Tilman Koelsch, MD
National Jewish Health – Department of Radiology

Disclosures

None

Goals

- Identify the imaging features of pulmonary NTM infection on CT and X-ray
- Understand radiological phenotypes of pulmonary NTM infection
- Understand the role of PET/CT in NTM

Overview

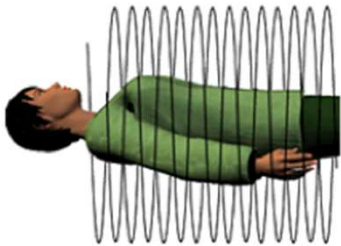
- I. CT technique
- II. NTM imaging signs
- III. Radiological/Clinical Phenotypes
- IV. NTM & Underlying Lung Disease



CT Technique

“Regular” CT - Spiral & Volumetric

- **Quick** - One breath hold (10-30 sec)
- Reconstruct in: Any plane, Any thickness, 3D



Spiral/Volumetric Reconstruction

CT Technique

- **Low Dose**

- ~ 1/3 to 1/5 Dose (smaller patients need less dose)
- “Noisy” - but often **Still Diagnostic Quality**



Regular Dose – Initial CT



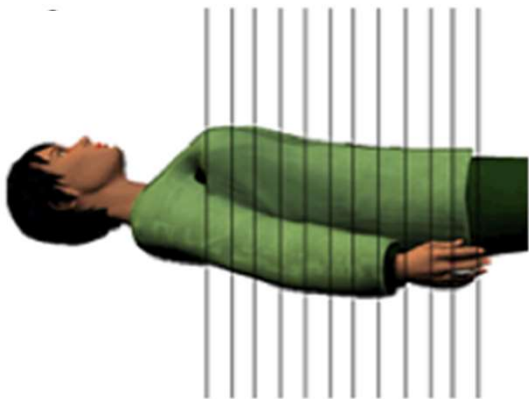
Low Dose – Follow-Up

At NJH we “automatically” use low dose for:

- **NTM Follow-Up**
- Pulm. Nodule Follow-Up
- Lung Cancer Screening

CT Technique

- **HRCT (1 mm) THIN**



Also:

- 1) End Expiration (for Air Trapping)
- 2) Prone (Mild Pulm. Fibrosis)

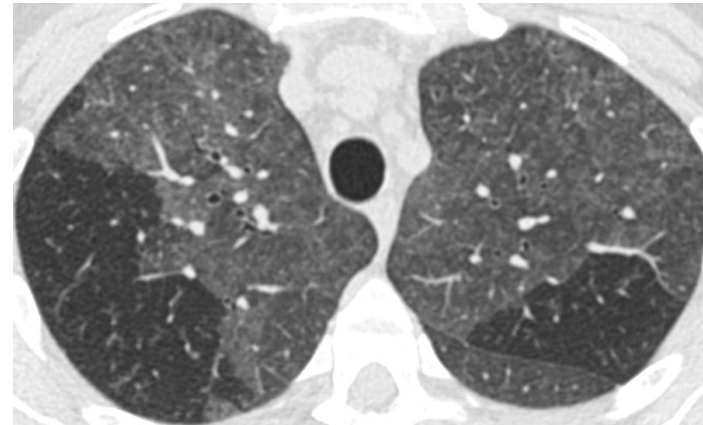


- When to order? (*examples*)
 - Possible HP / Hot Tub Lung!
 - Mild interstitial disease / fibrosis

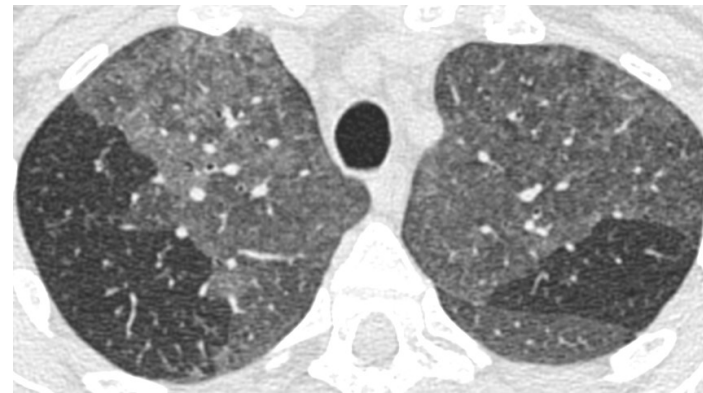
HRCT



Hot Tub Lung



Inspiratory Thin Cut Images



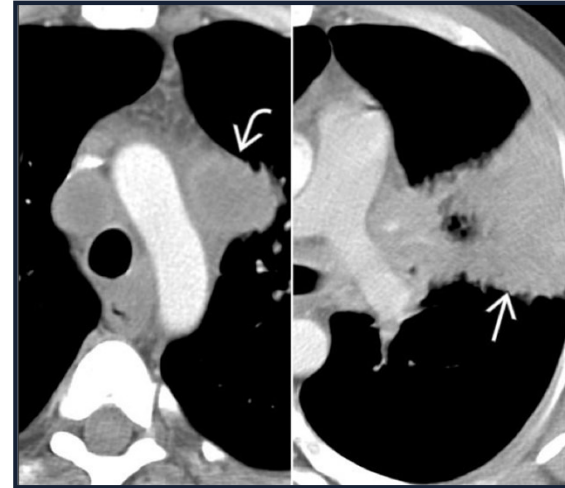
Expiratory – AIR TRAPPING
(areas that stay dark)

CT Technique

- **Contrast?**

- Usually not needed for LUNG

- Use for “Soft Tissue”
 - Mediastinum/Hila?
 - Pleura/Chest Wall?



TB – Note Necrotic “Non-enhancing” LN

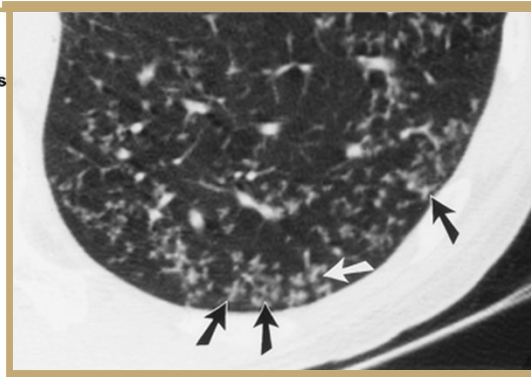
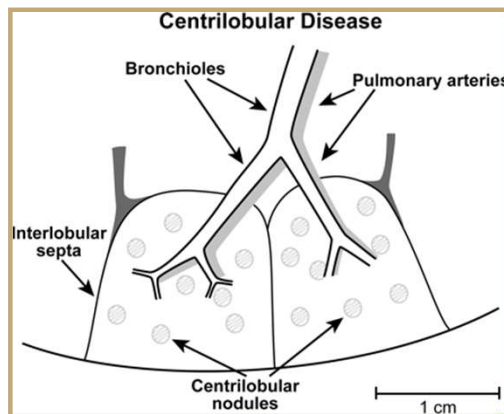


Empyema – Enhancing Plural Rind

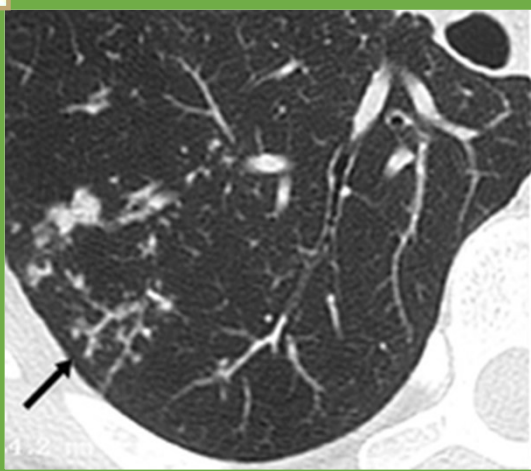
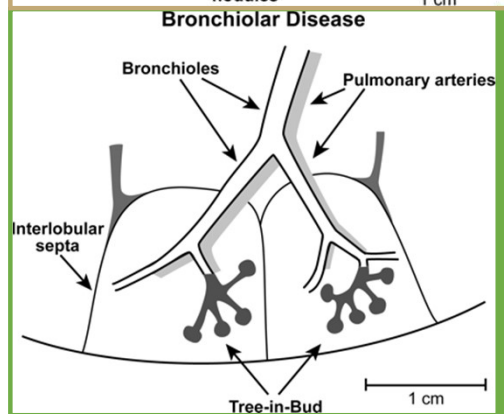
NTM Imaging Signs

- Tree-In-Bud and Centilobular Nodules
- Bronchiectasis
- Cavities
- Ground-Glass and Consolidation
- Atelectasis

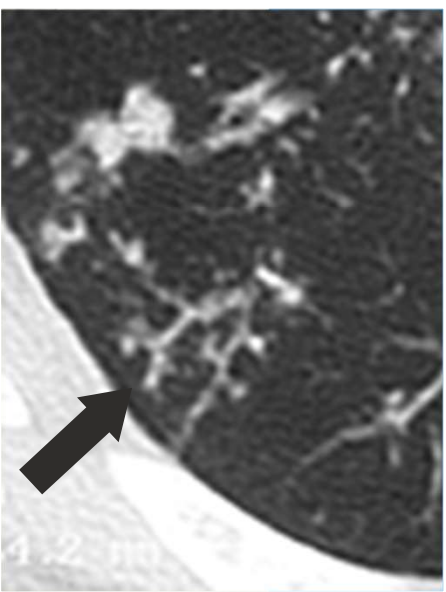
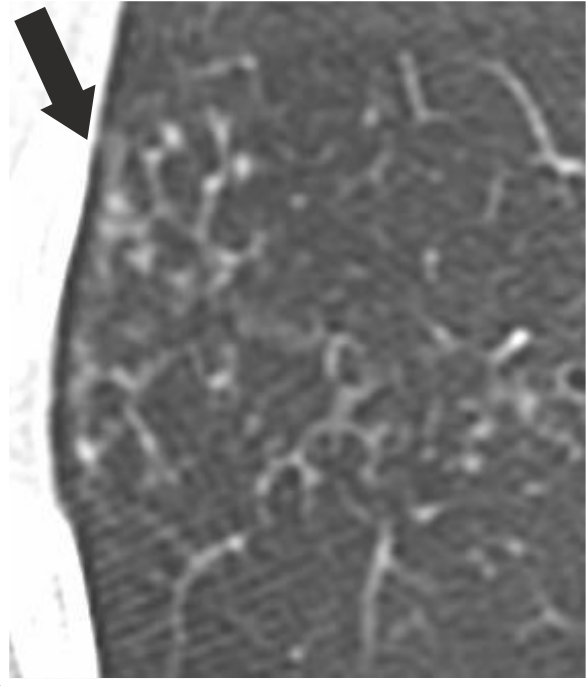
Centrilobular Nodules and Tree-In-Bud



- Typically from Airways
- (i.e. infection, HP, smoking)

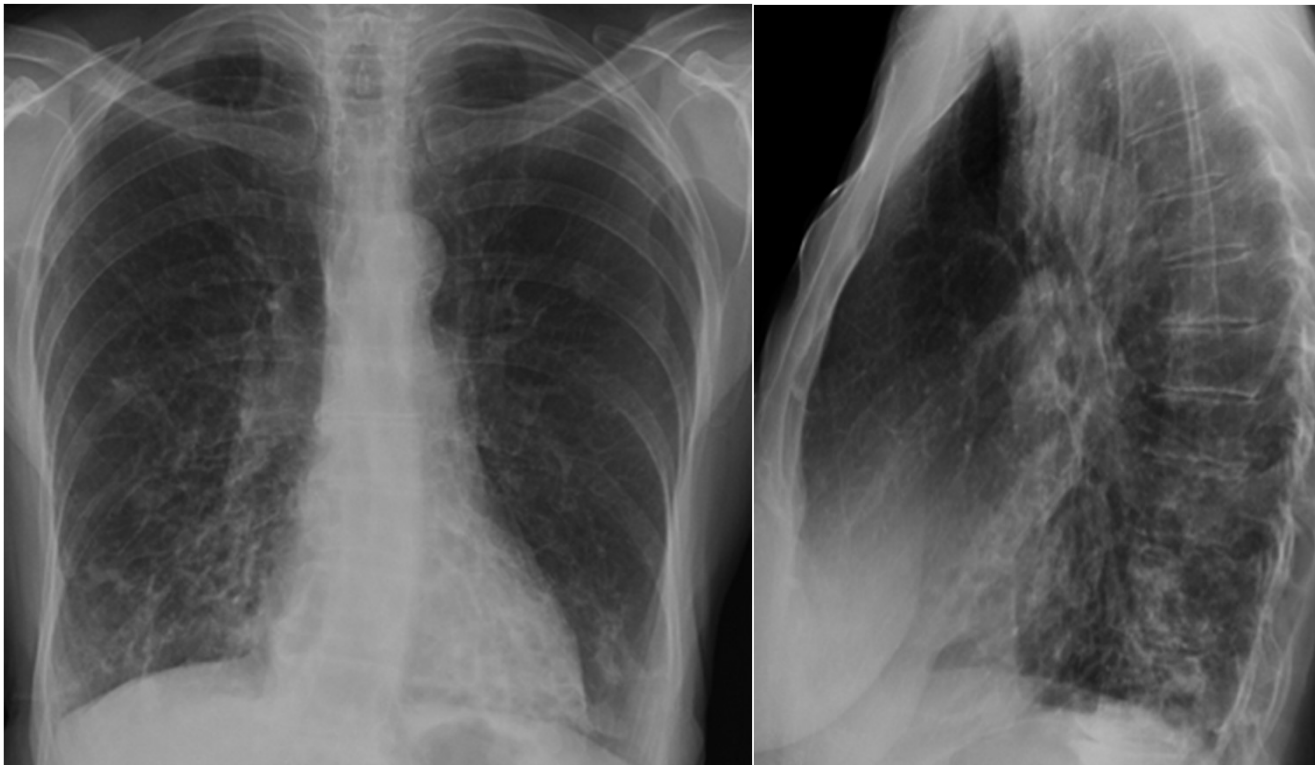


- Infection, Infection, Aspiration/Mucus Plugs...

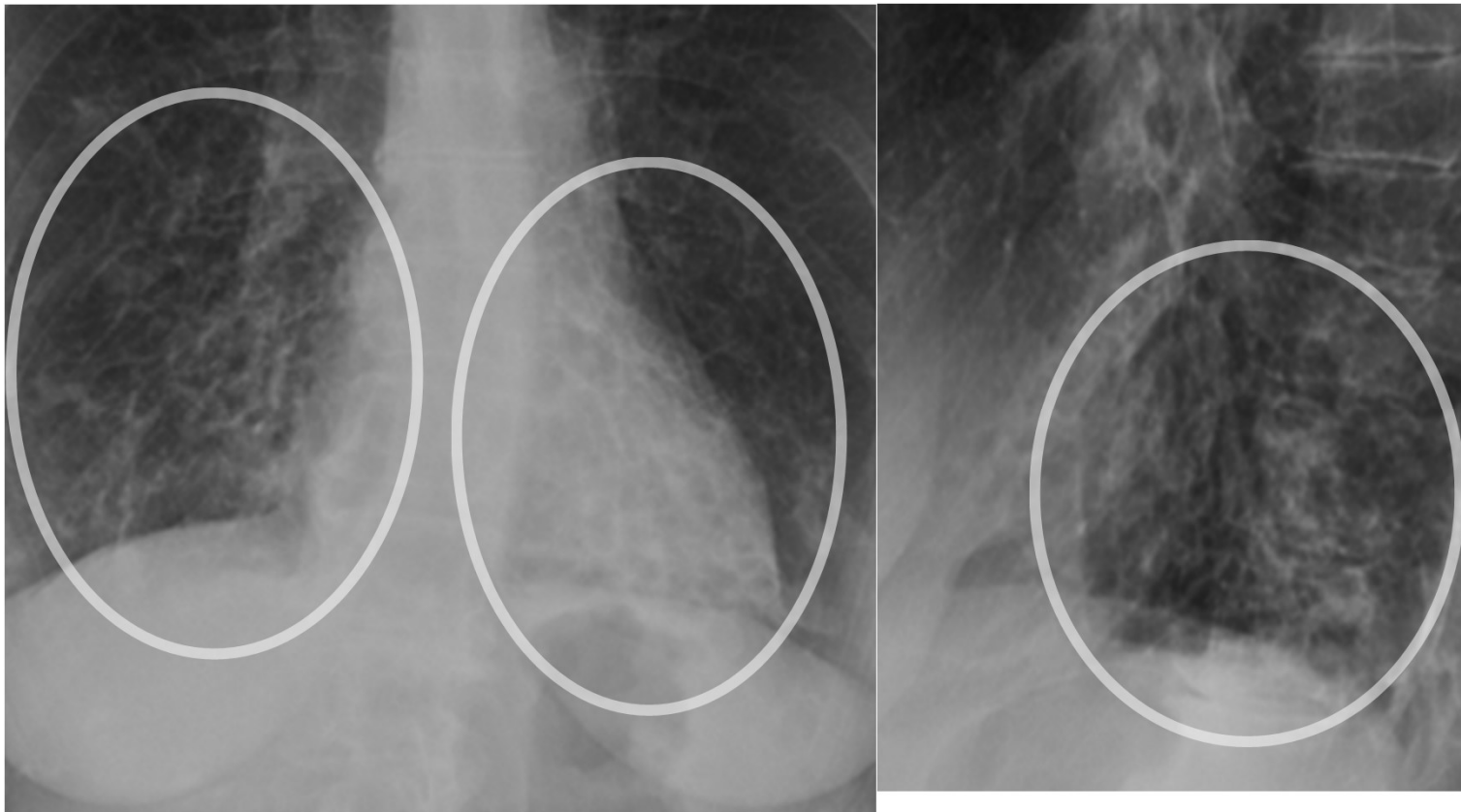


Bronchiectasis

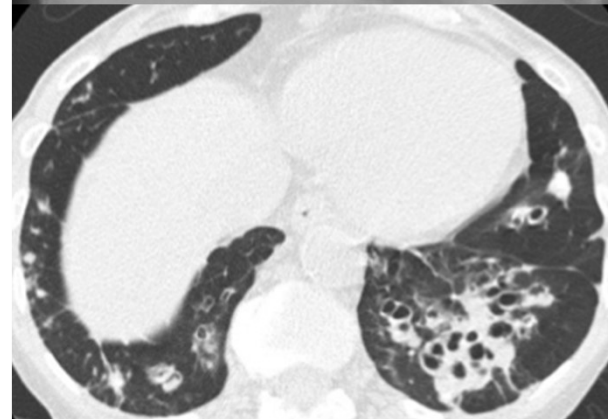
*Chest X-ray “Tram-Track” lines and Rings
HARD TO SEE ON X-RAY*



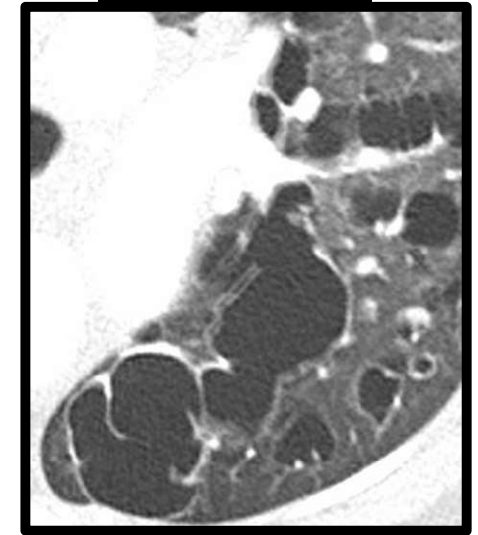
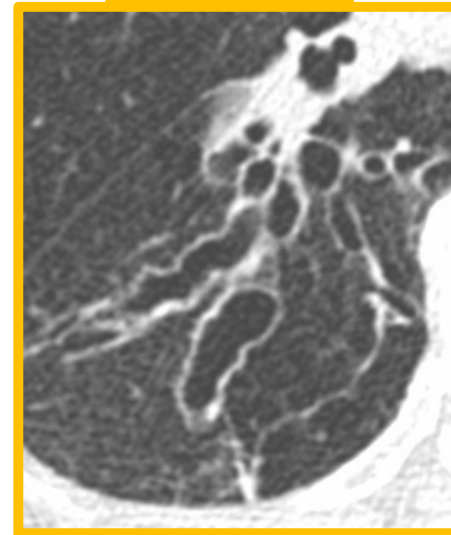
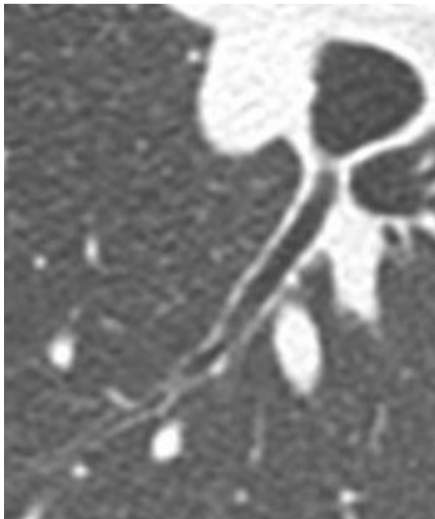
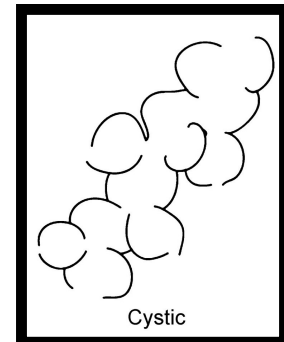
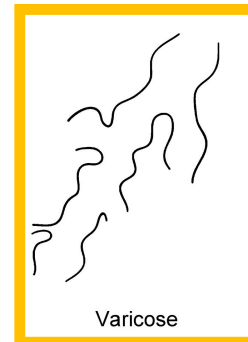
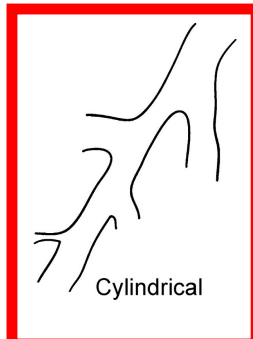
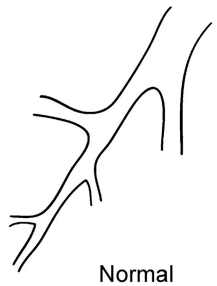
Bronchiectasis



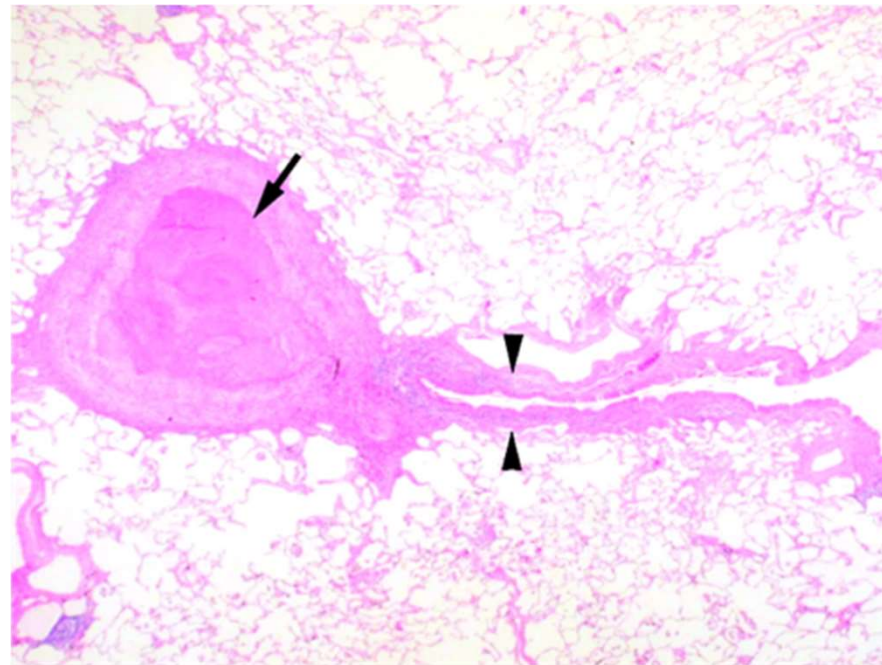
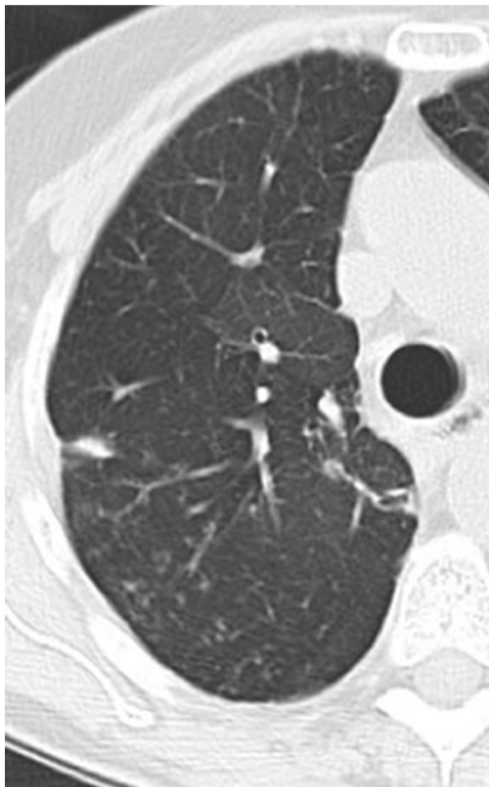
Bronchiectasis



Bronchiectasis

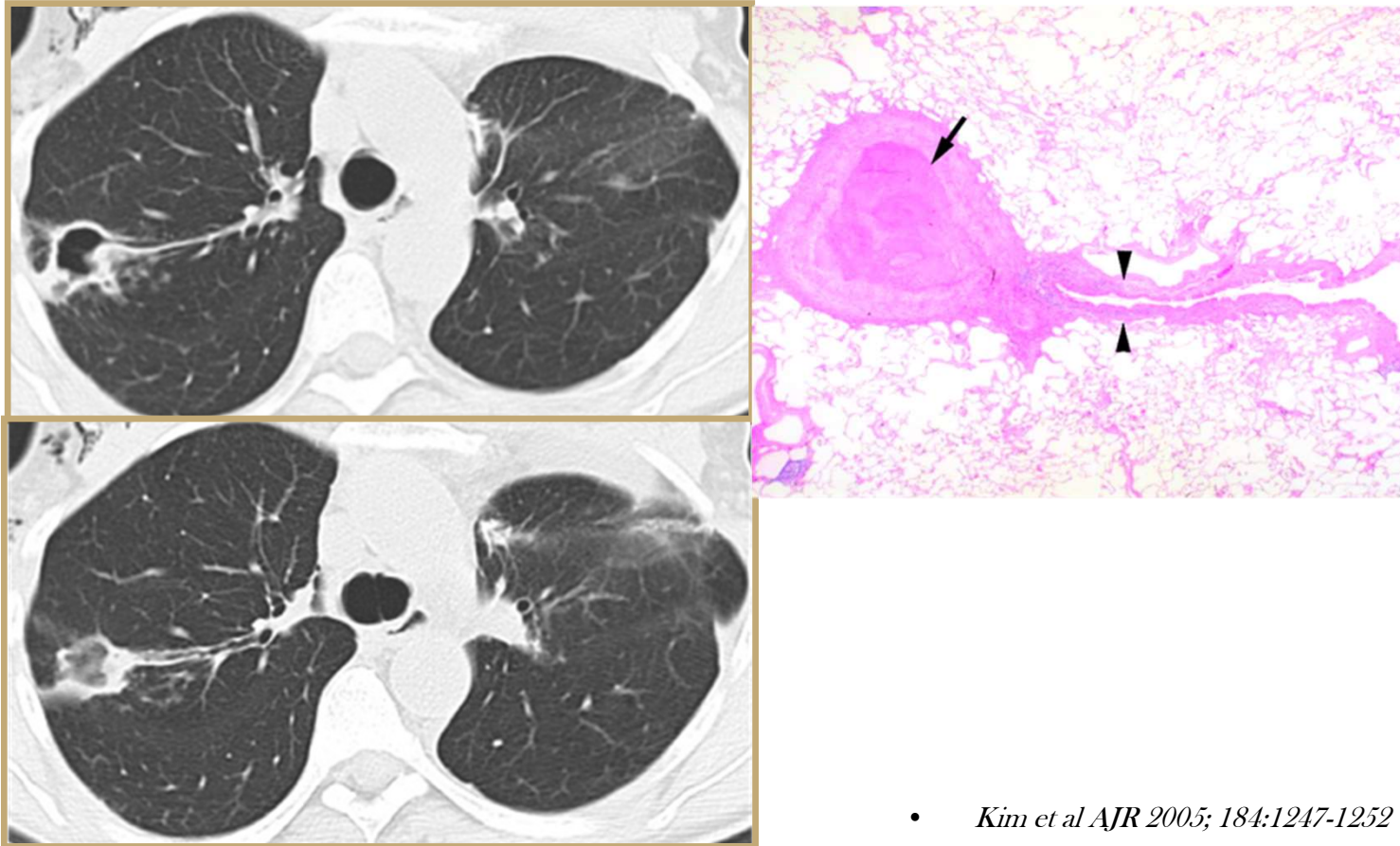


Cavities - and “feeding bronchus” sign



- *Kim et al AJR 2005; 184:1247-1252*

Cavities - and “feeding bronchus” sign



- *Kim et al AJR 2005; 184:1247-1252*

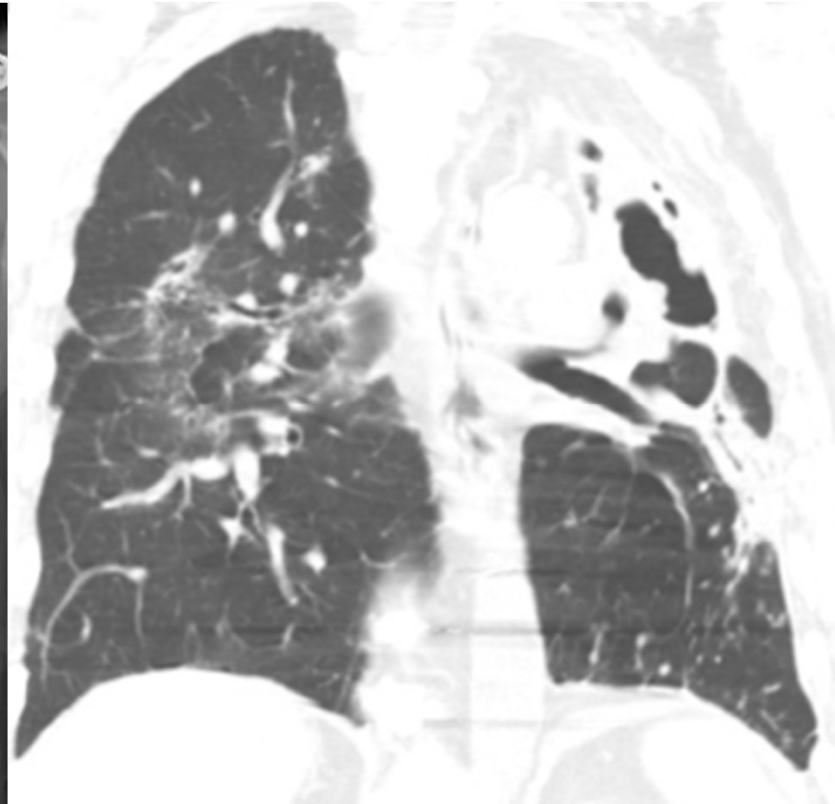
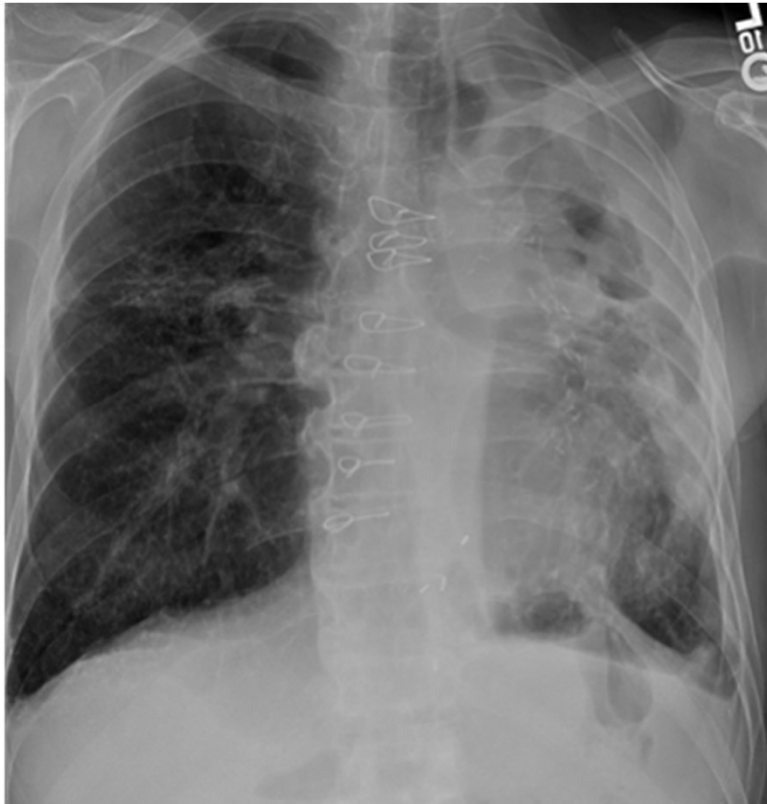
Cavities



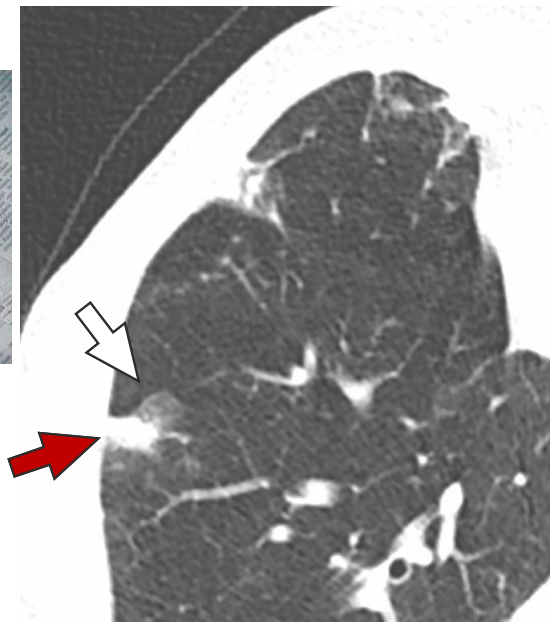
CAN BE HARD TO SEE ON X-RAY



Cavities



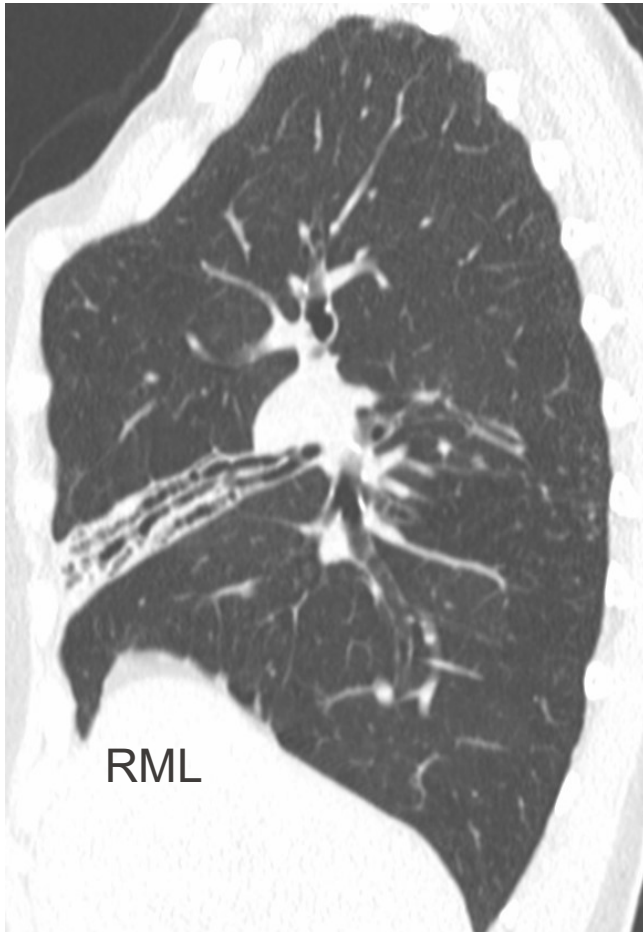
Consolidation and Ground-Glass



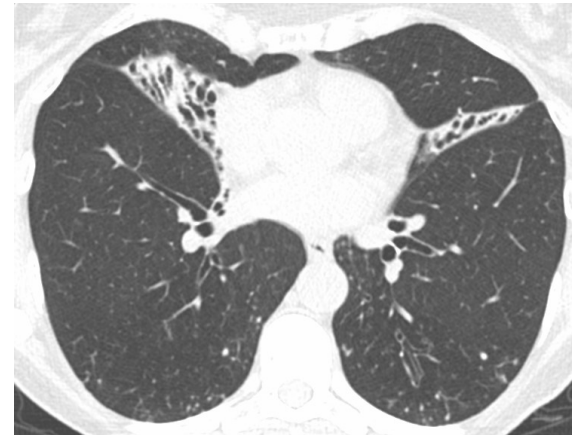
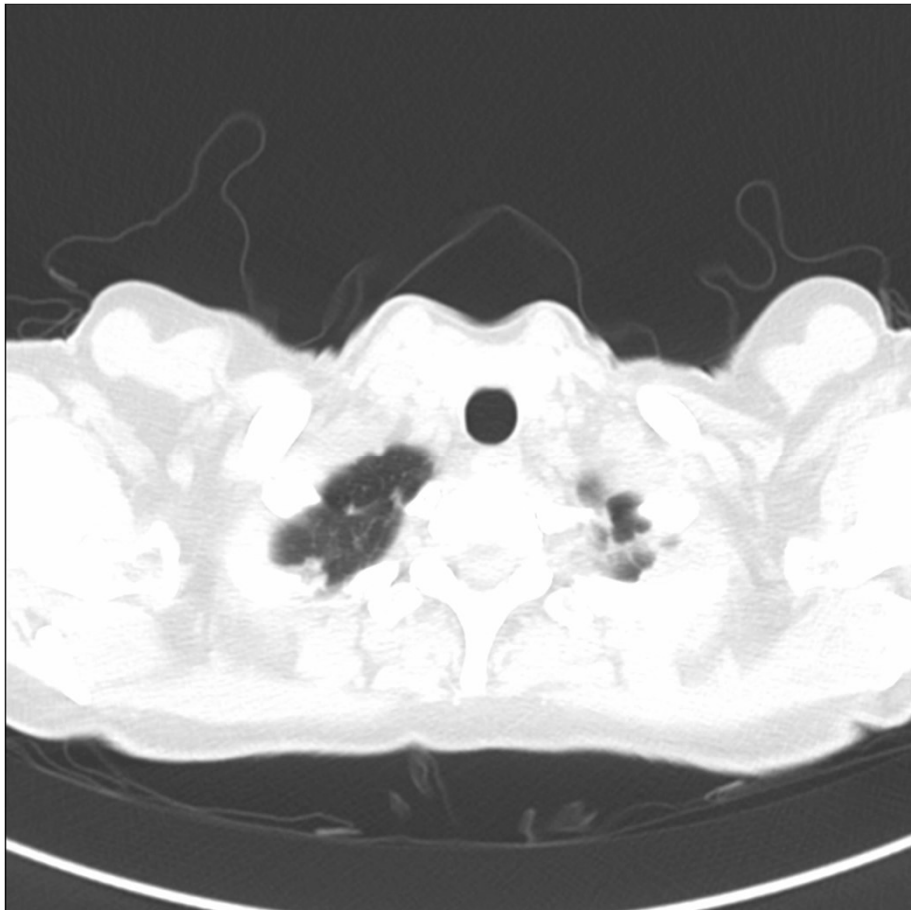
Atelectasis



Atelectasis

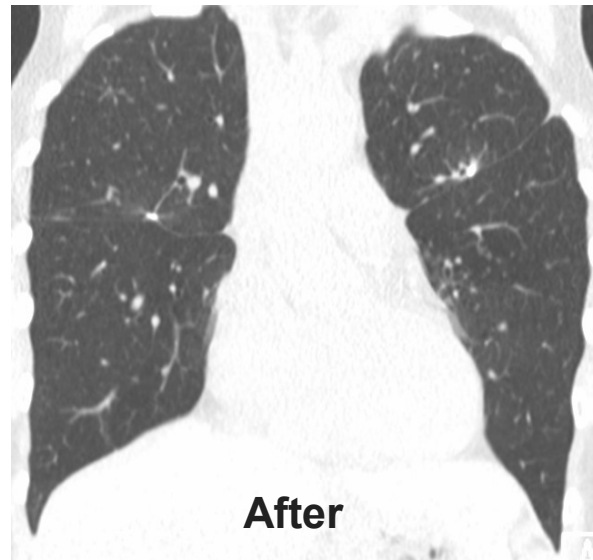
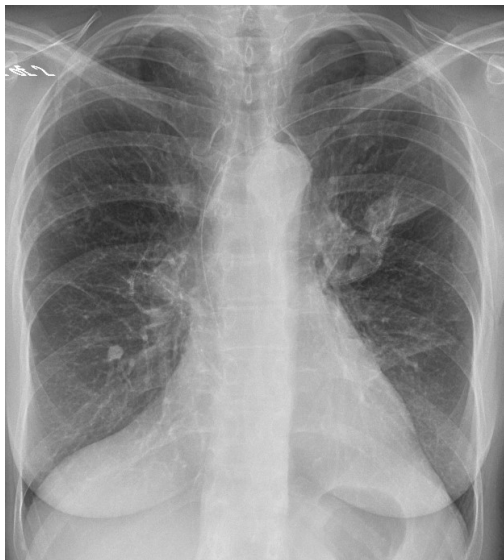


Atelectasis

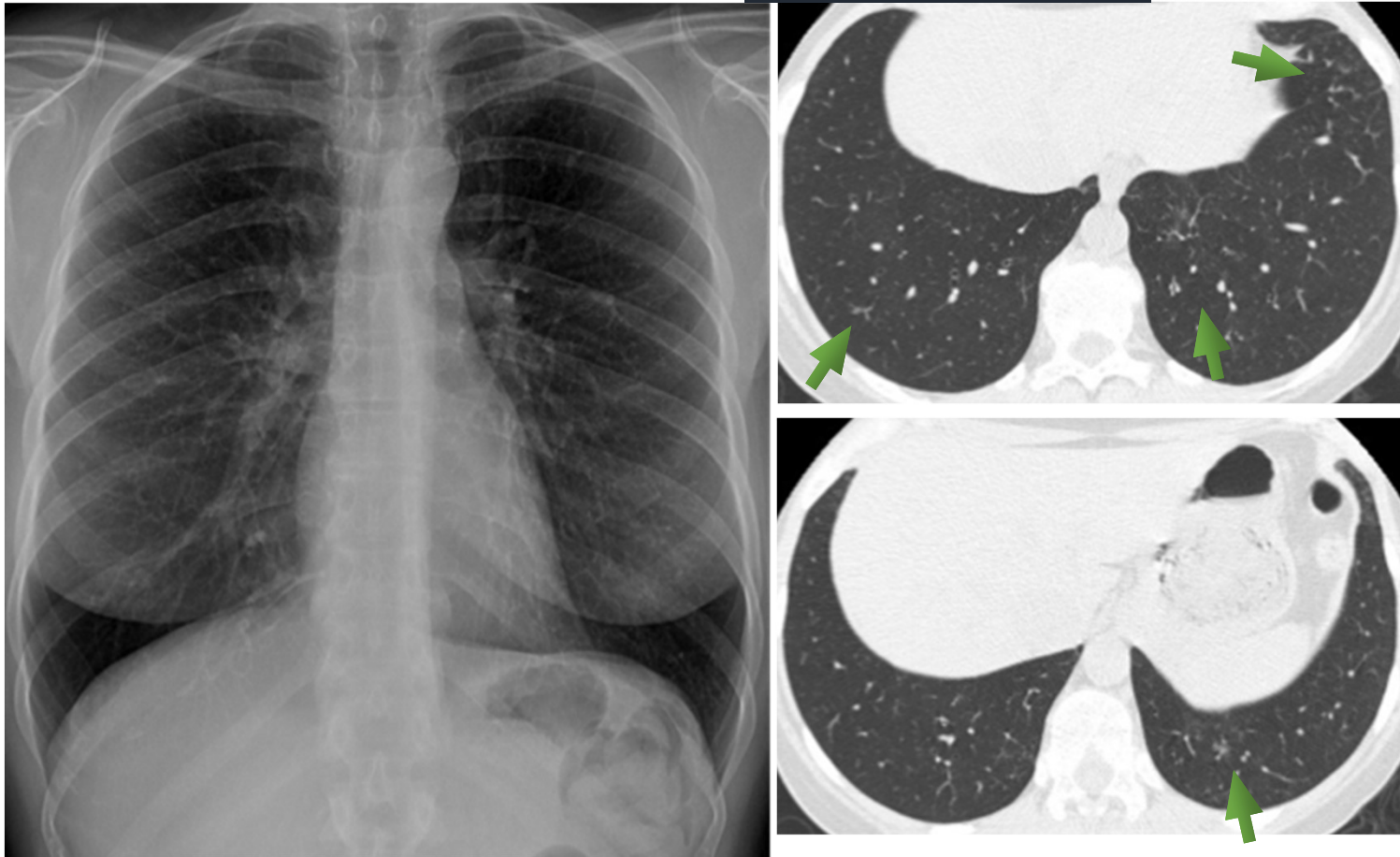




Pt. had surgery to remove RML and Lingula



Aside: NTM with *Normal CXR*



Overview

- I. CT technique
- II. NTM imaging signs
- III. Radiological/Clinical Phenotypes
- IV. NTM & Underlying Lung Disease



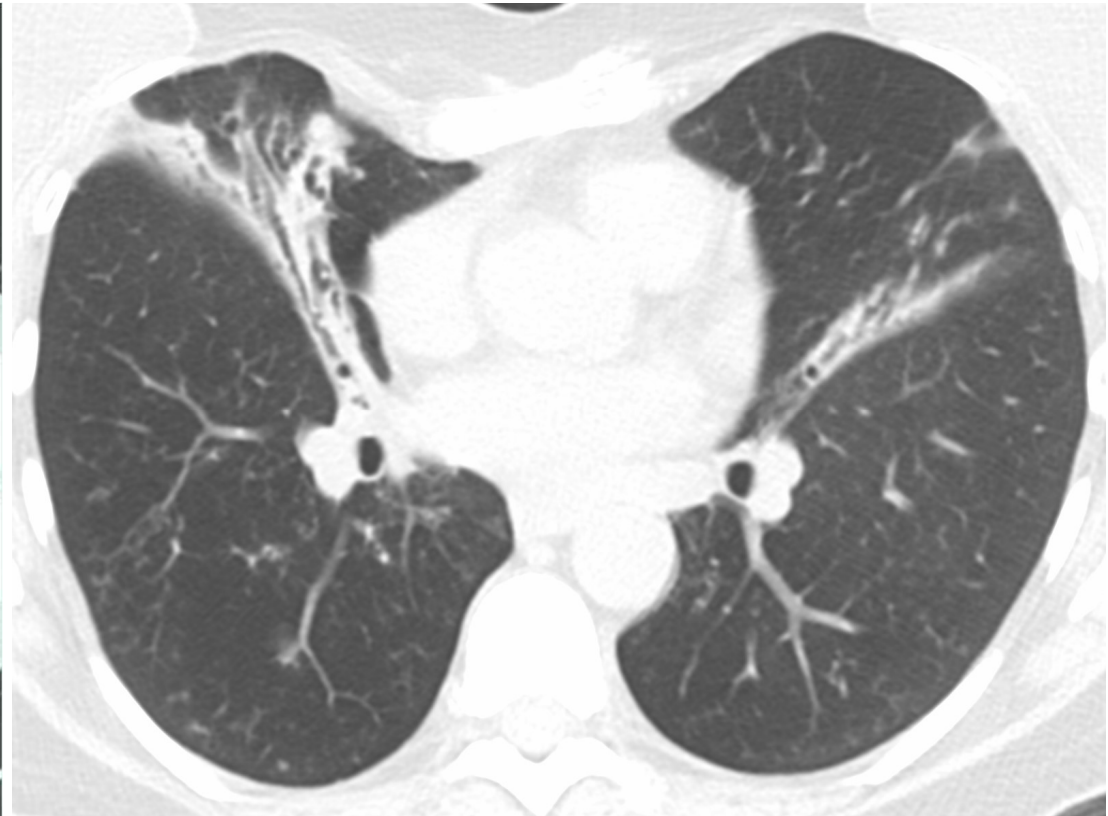
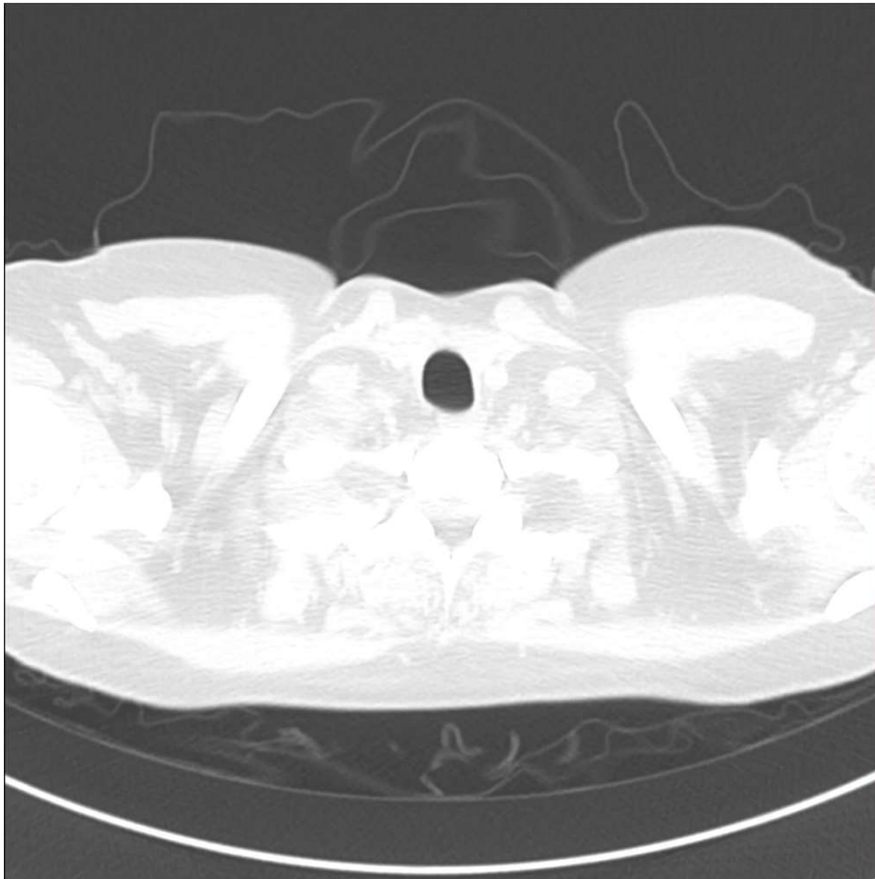
Radiological/Clinical Phenotypes of NTM

I. Nodular Bronchiectatic Type

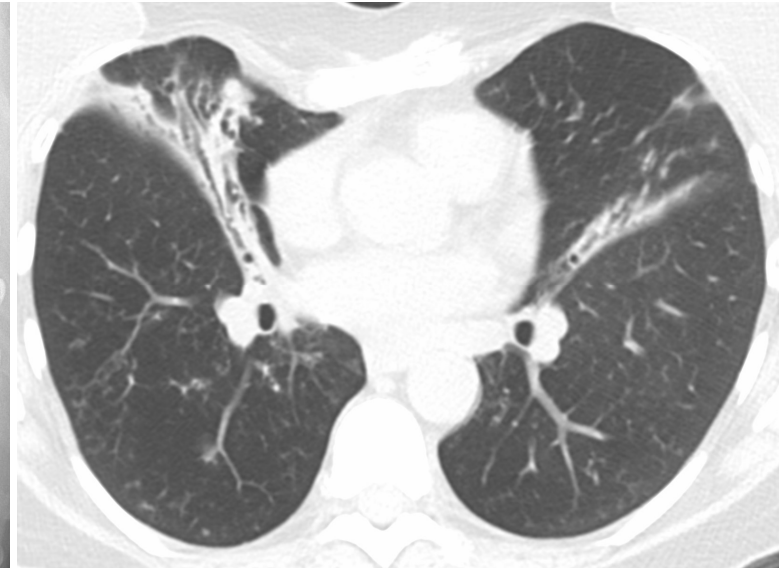
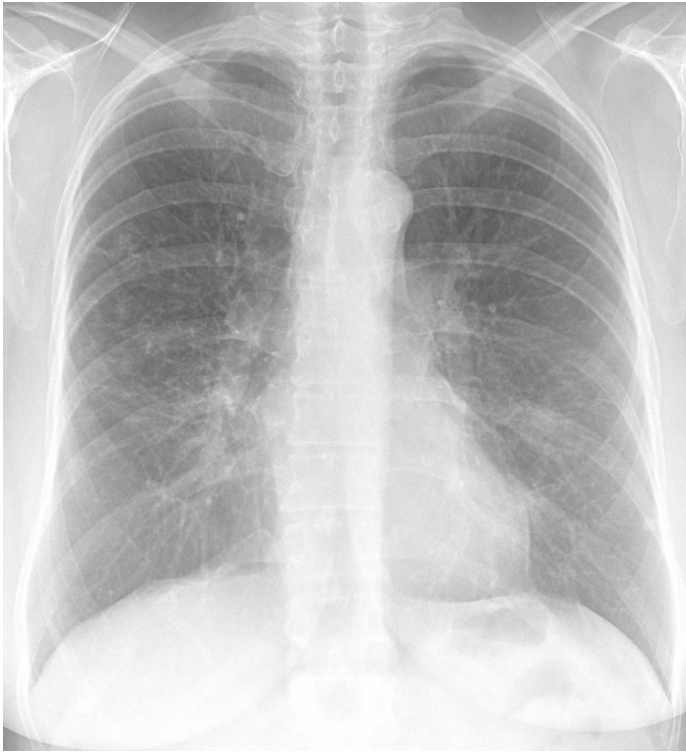
II. Fibrocavitary Type

*III. Hot Tub Lung (Hypersensitivity
Pneumonitis)*

I. Nodular Bronchiectatic Type - CASE 1

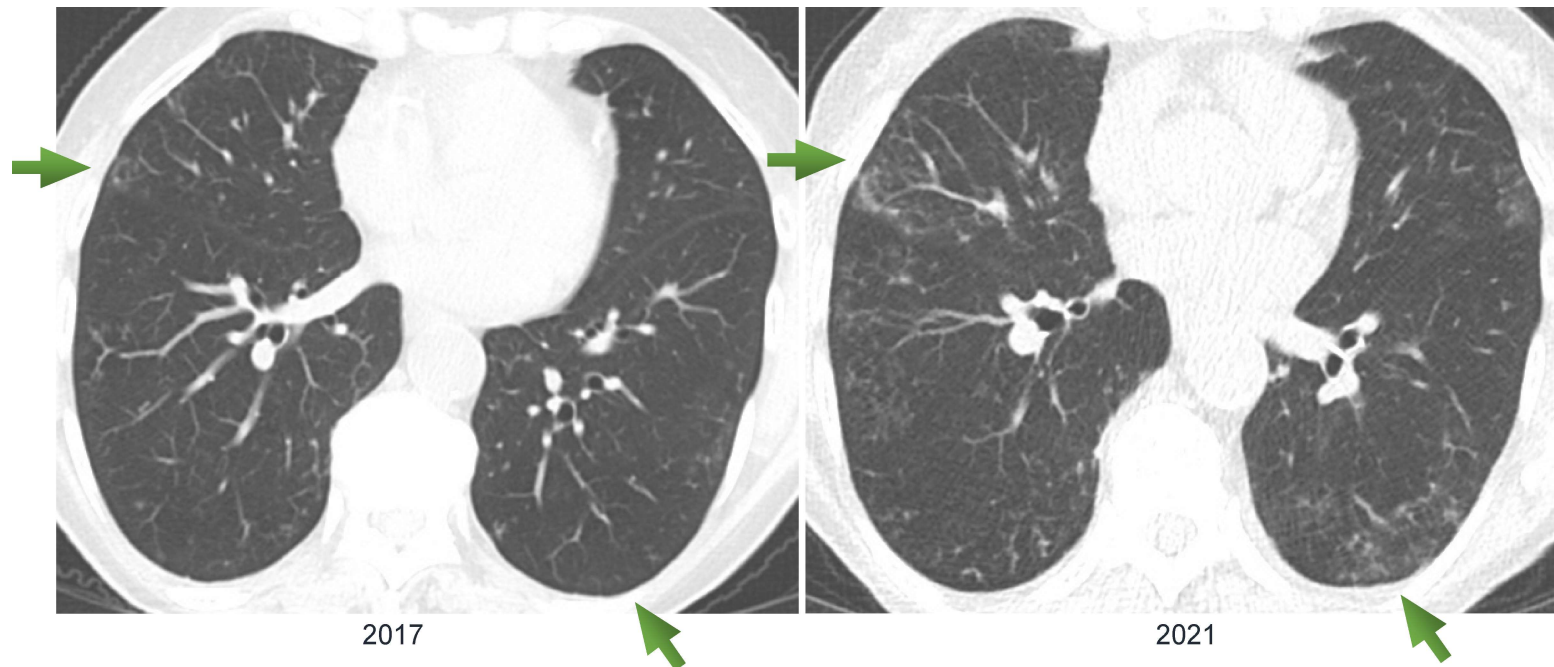


I. Nodular Bronchiectatic Type - CASE 1



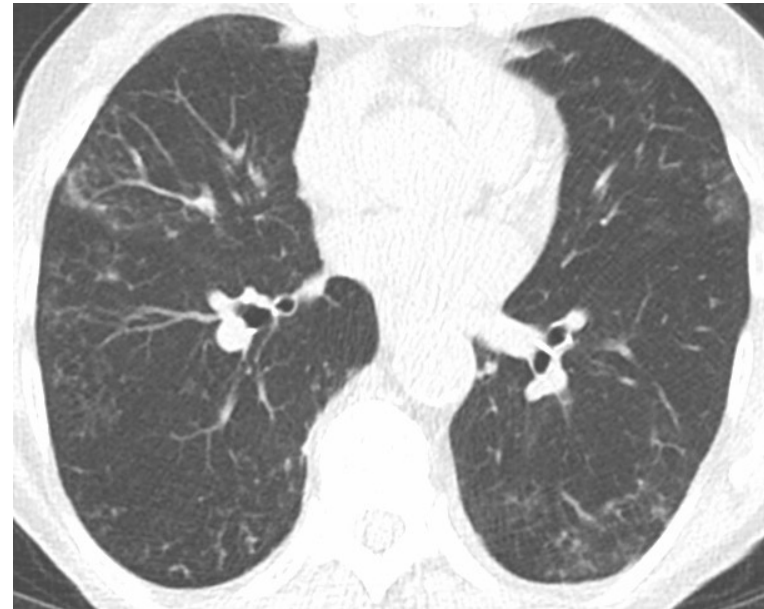
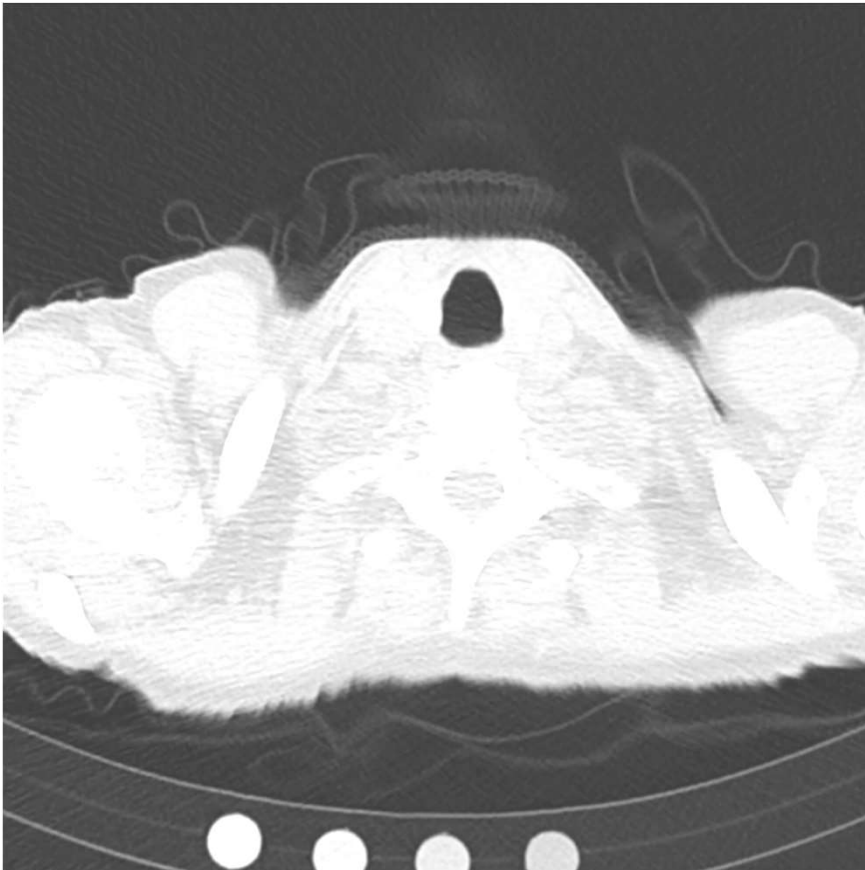
Chest X-ray often much more subtle

I. Nodular Bronchiectatic Type - CASE 2



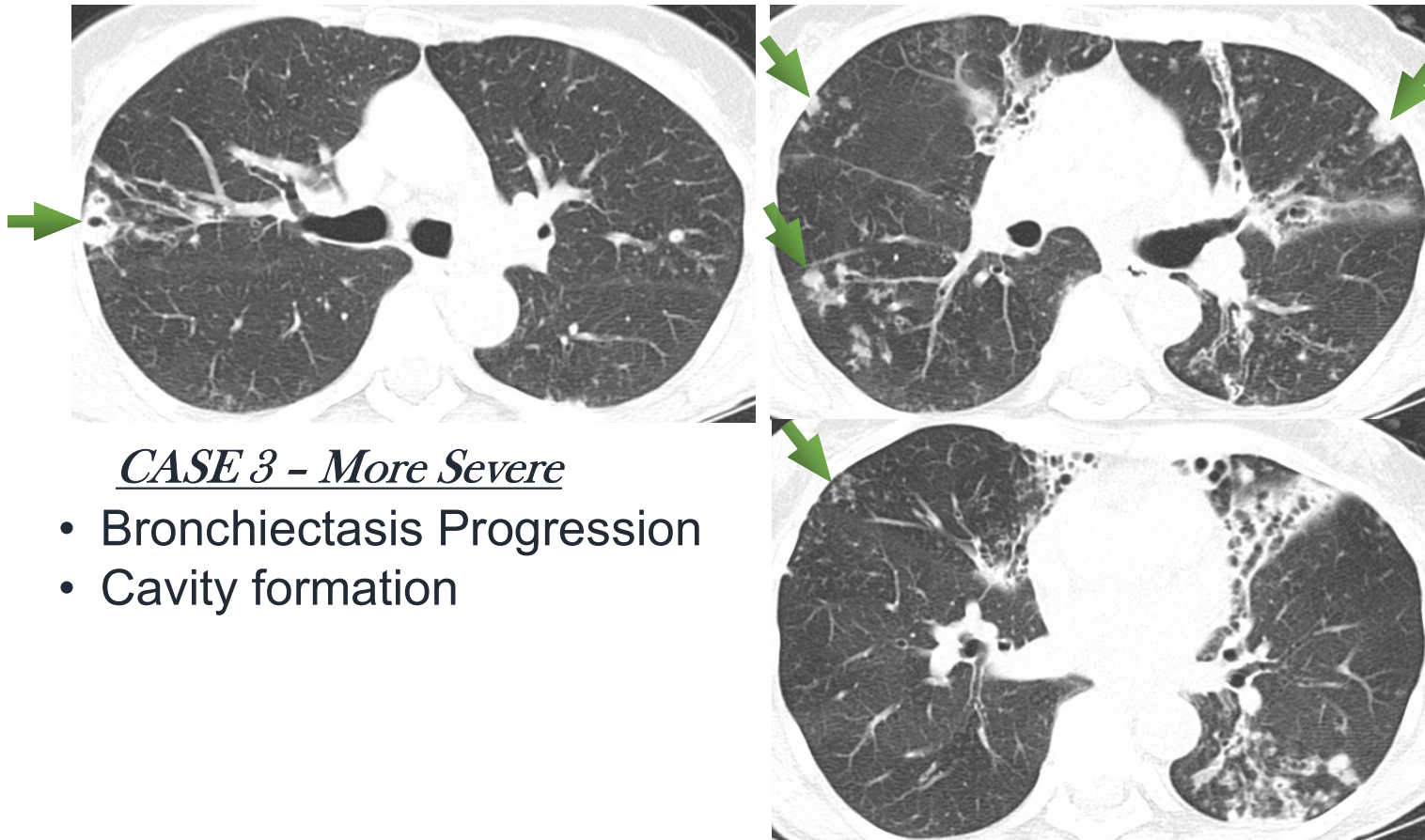
- **Follow-Up** - Look for active disease
 - Tree-in-bud, consolidation
 - look for stability, (& *clinical*)
 - Bronchiectasis, Cavities

I. Nodular Bronchiectatic Type - CASE 2



2021

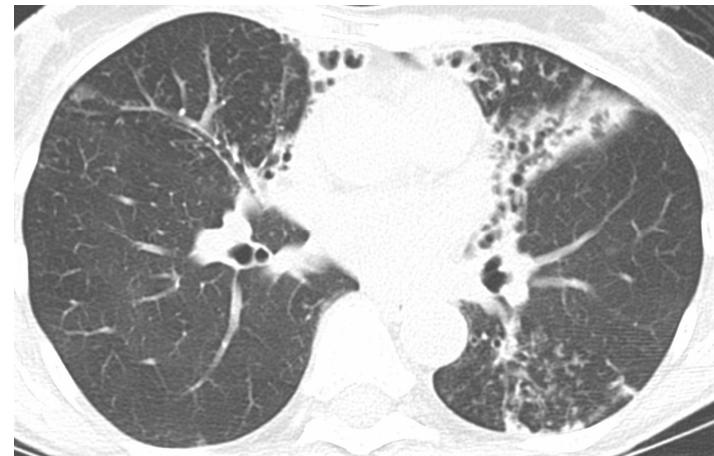
I. Nodular Bronchiectatic Type - CASE 3



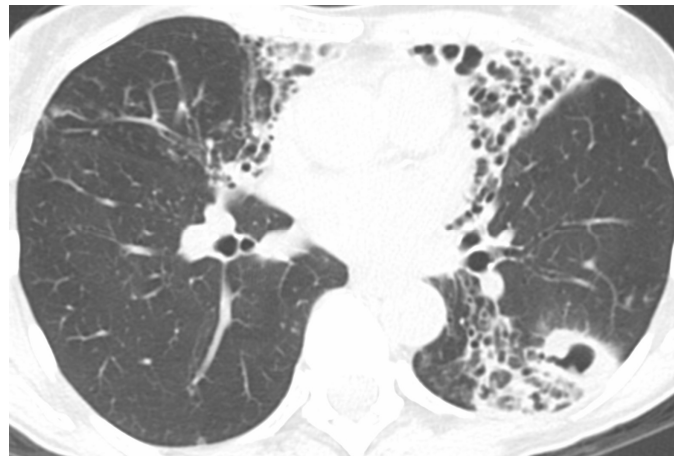
CASE 3 - More Severe

- Bronchiectasis Progression
- Cavity formation

I. Nodular Bronchiectatic Type - CASE 3



2011



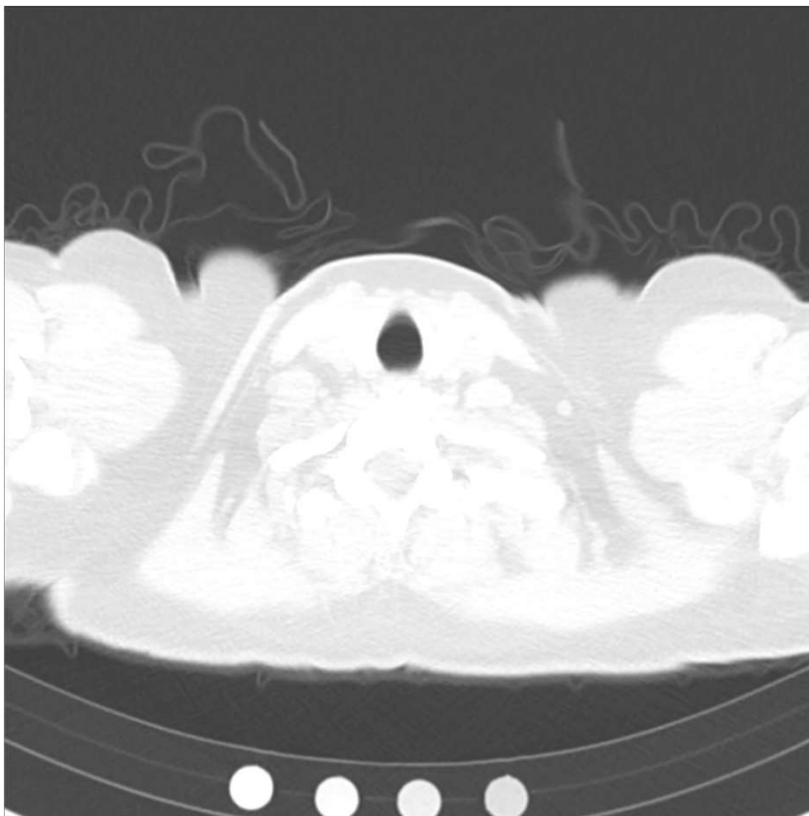
2014



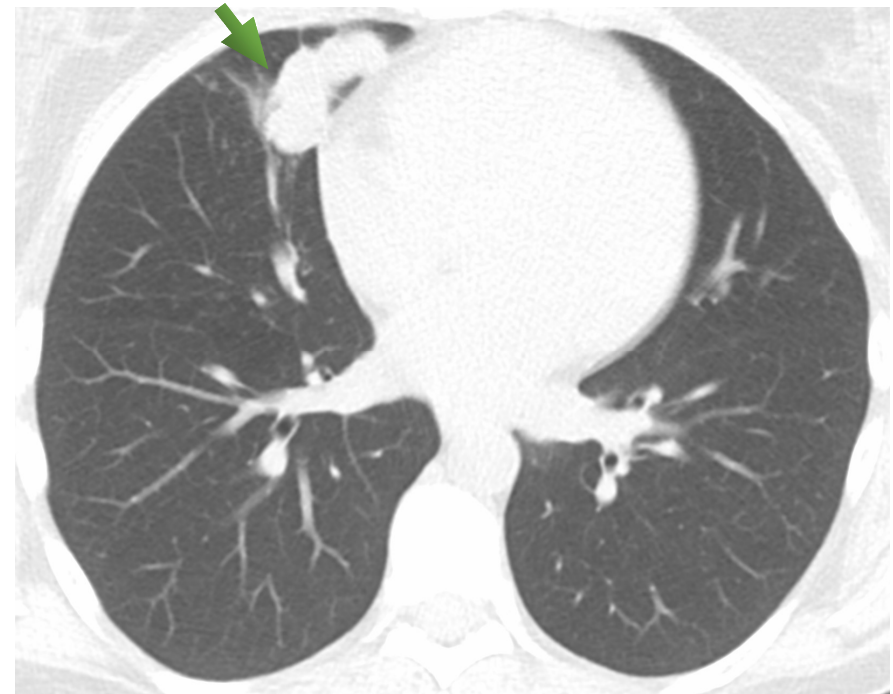
2016

I. Nodular Bronchiectatic Type - CASE 4

CASE 4 - Focal Solitary Nodule

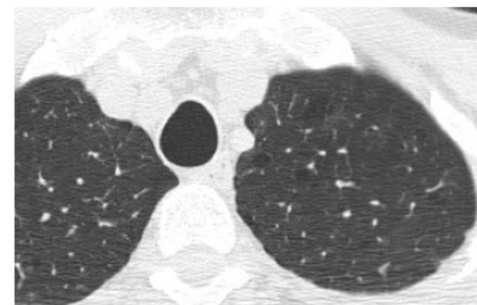
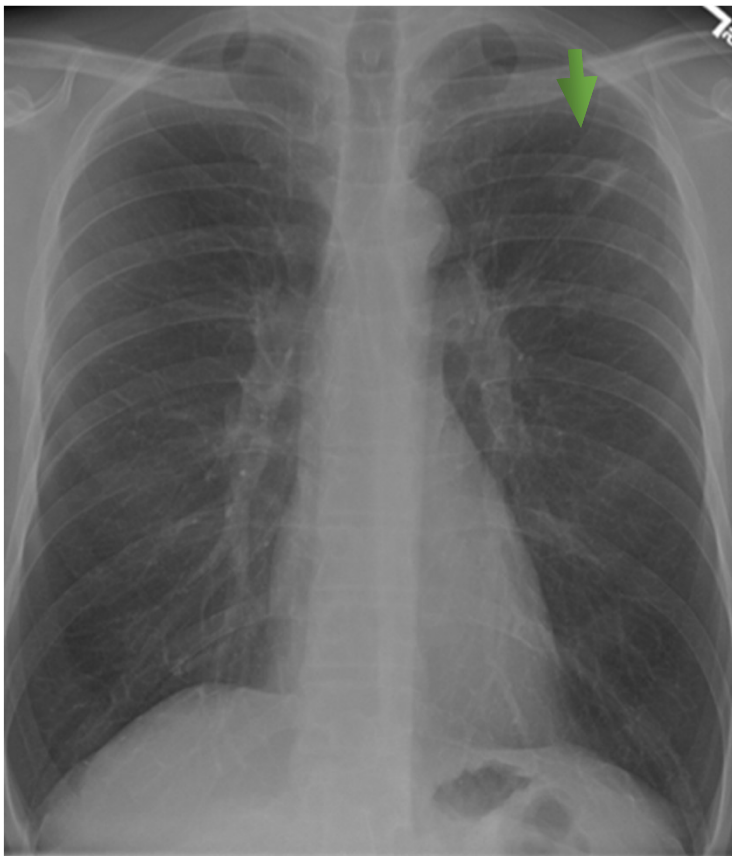


- Uncommon.
- Must still rule out other causes of nodule (*i.e neoplasm*)



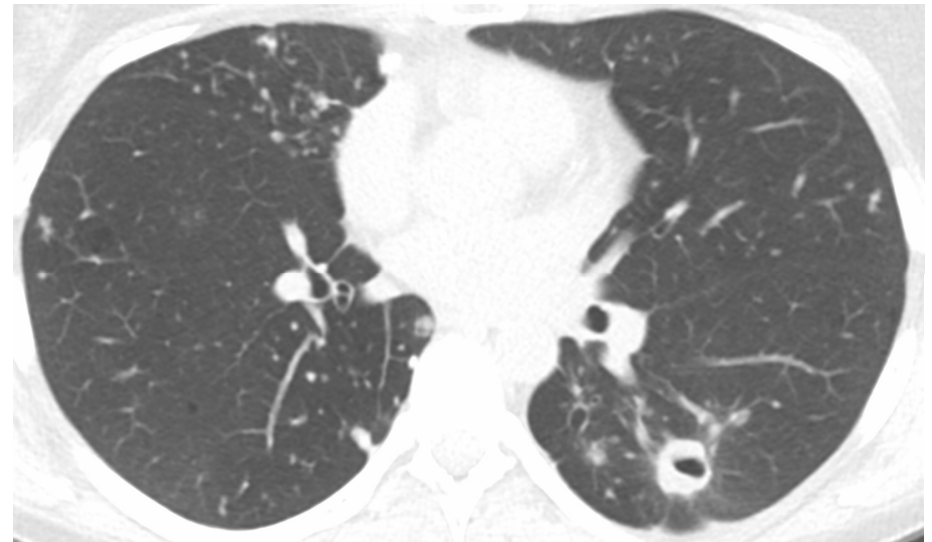
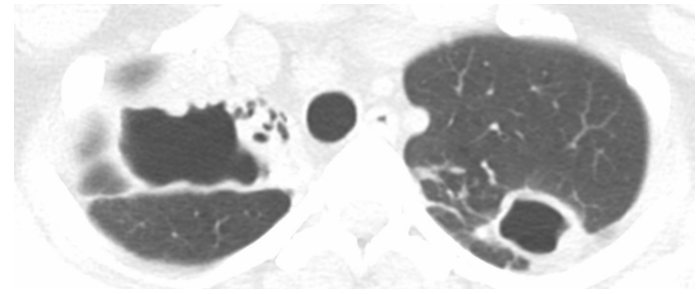
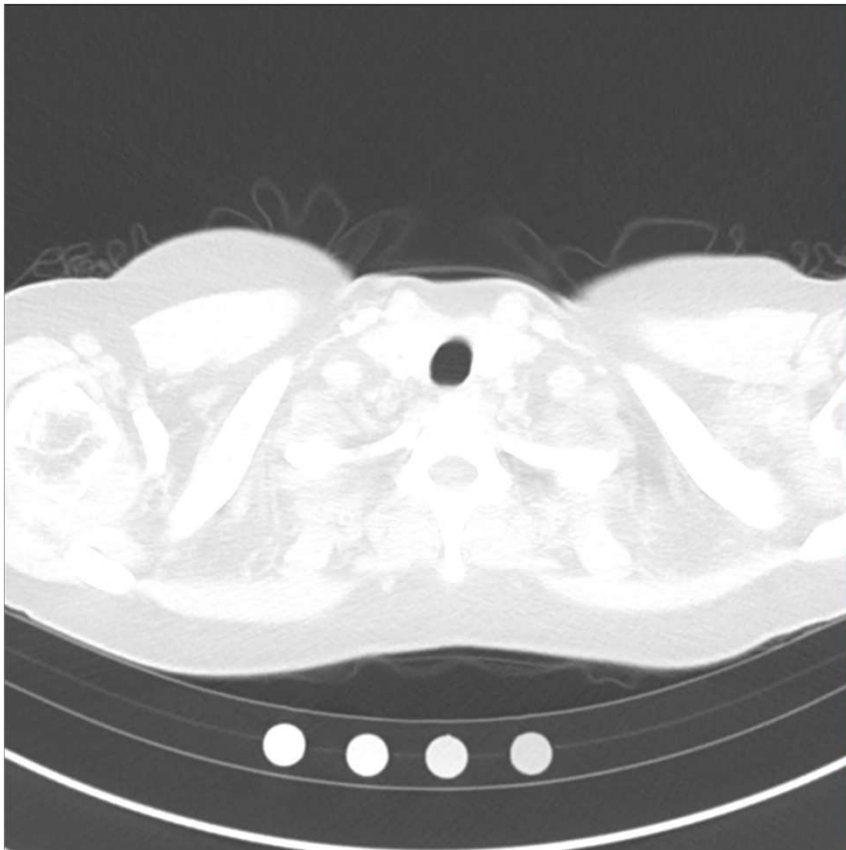
I. Nodular Bronchiectatic Type - CASE 5

CASE 5 - Focal Solitary "Cavity"

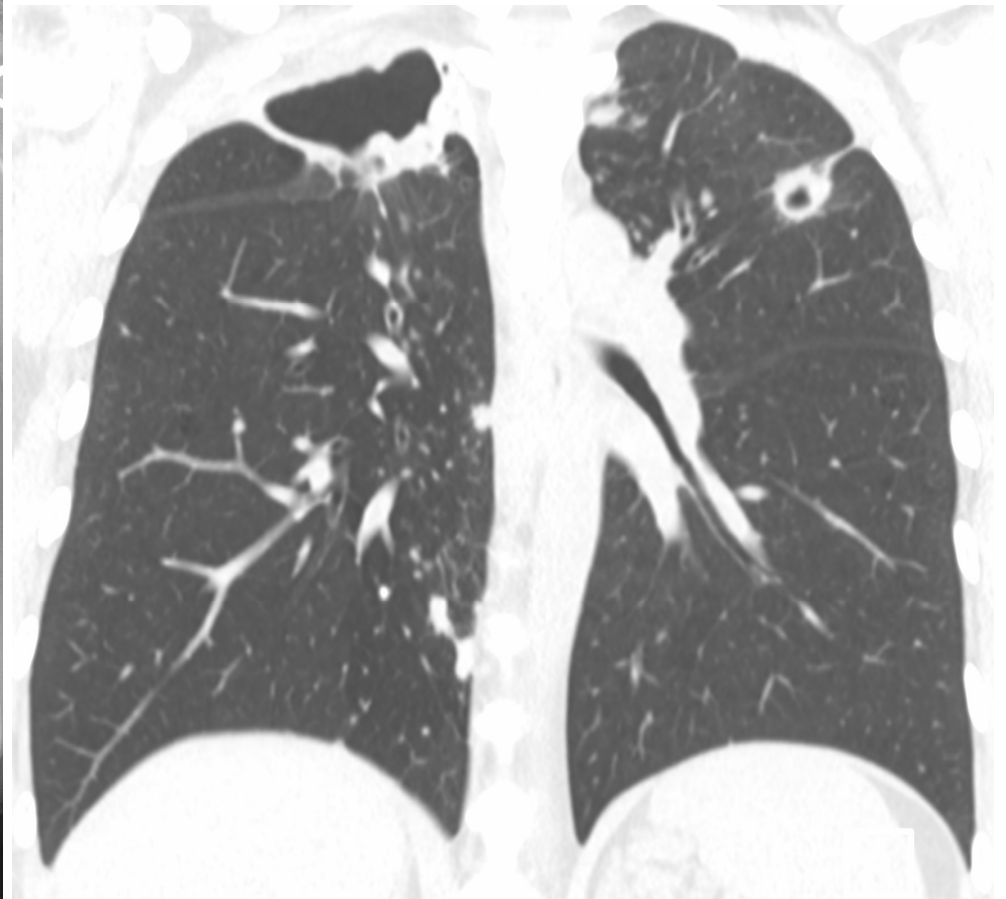
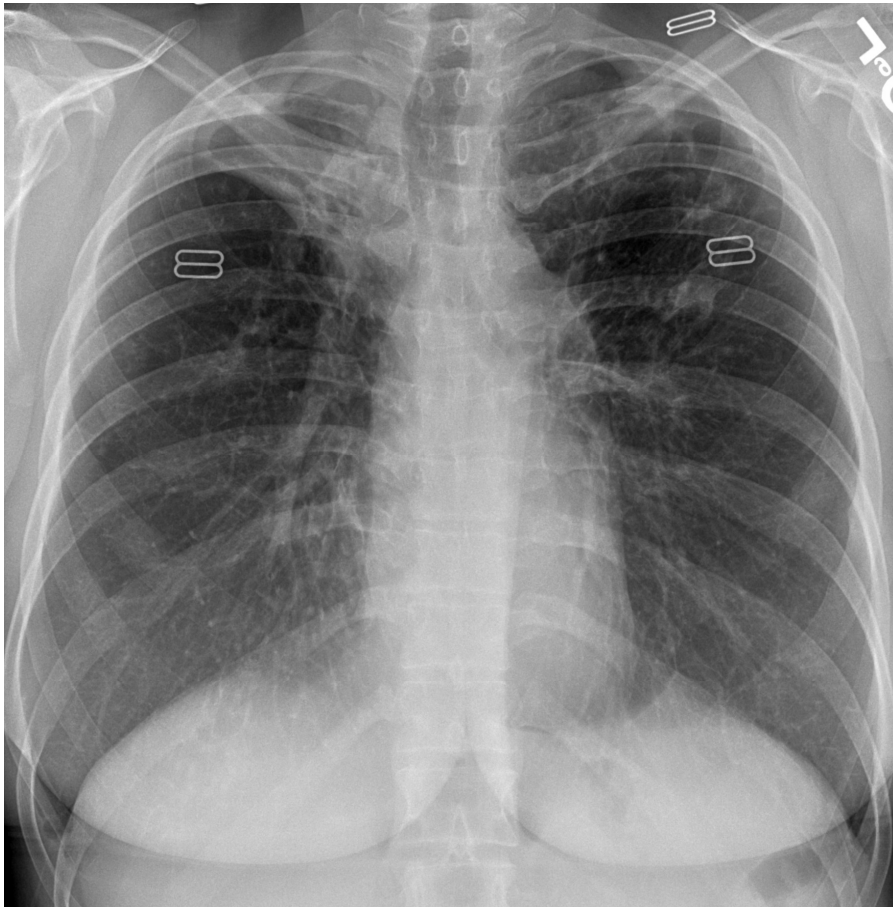


- *Rule out lung cancer*

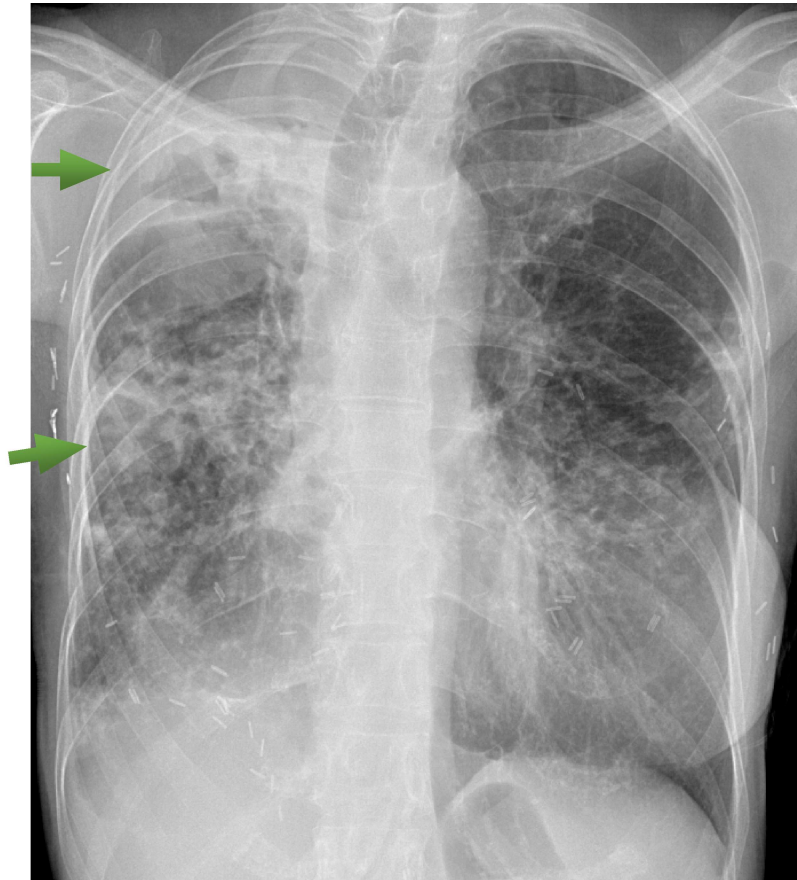
II. Fibrocavitary Type - CASE 1



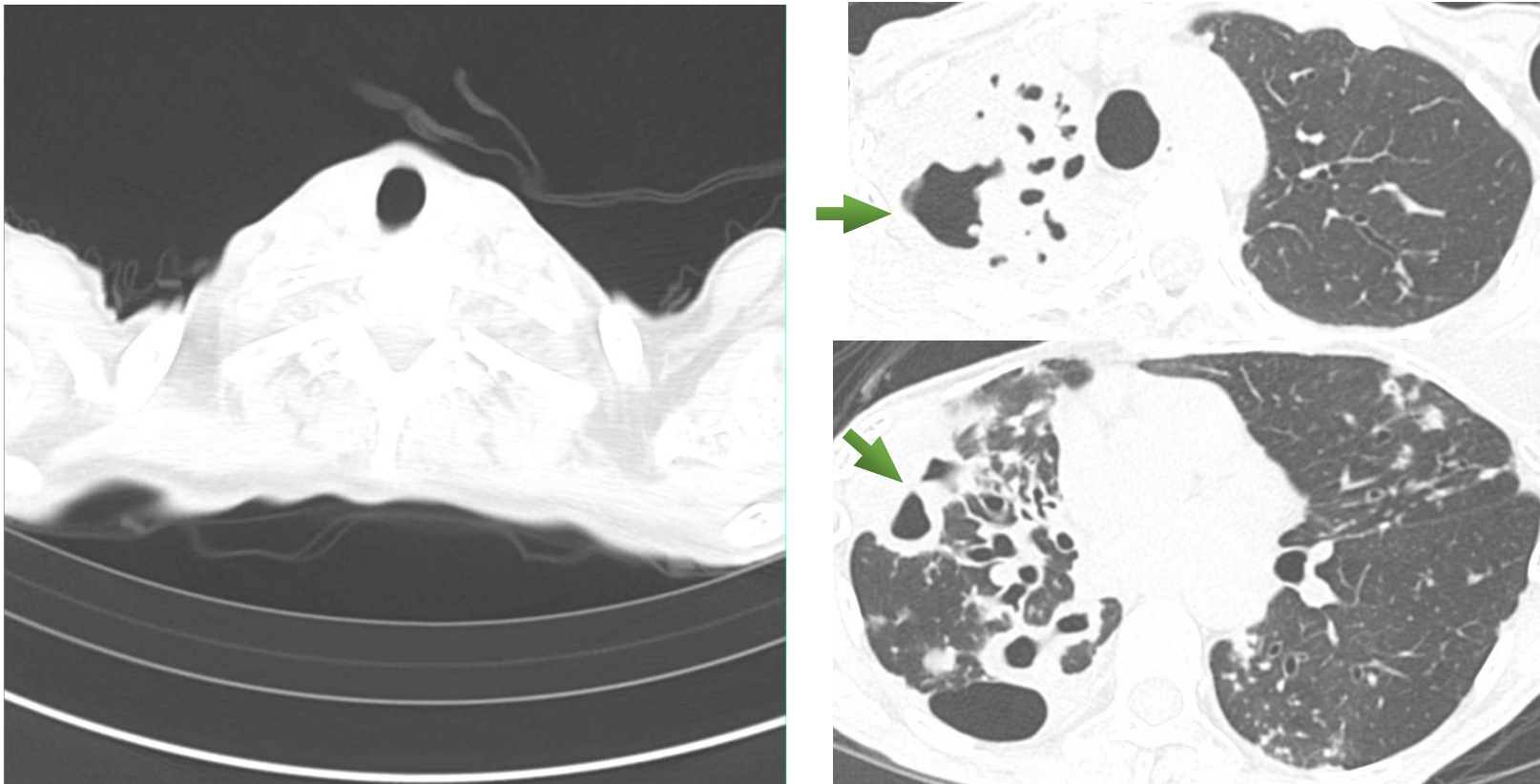
II. Fibrocavitary Type - CASE 1



II. Fibrocavitary Type - CASE 2

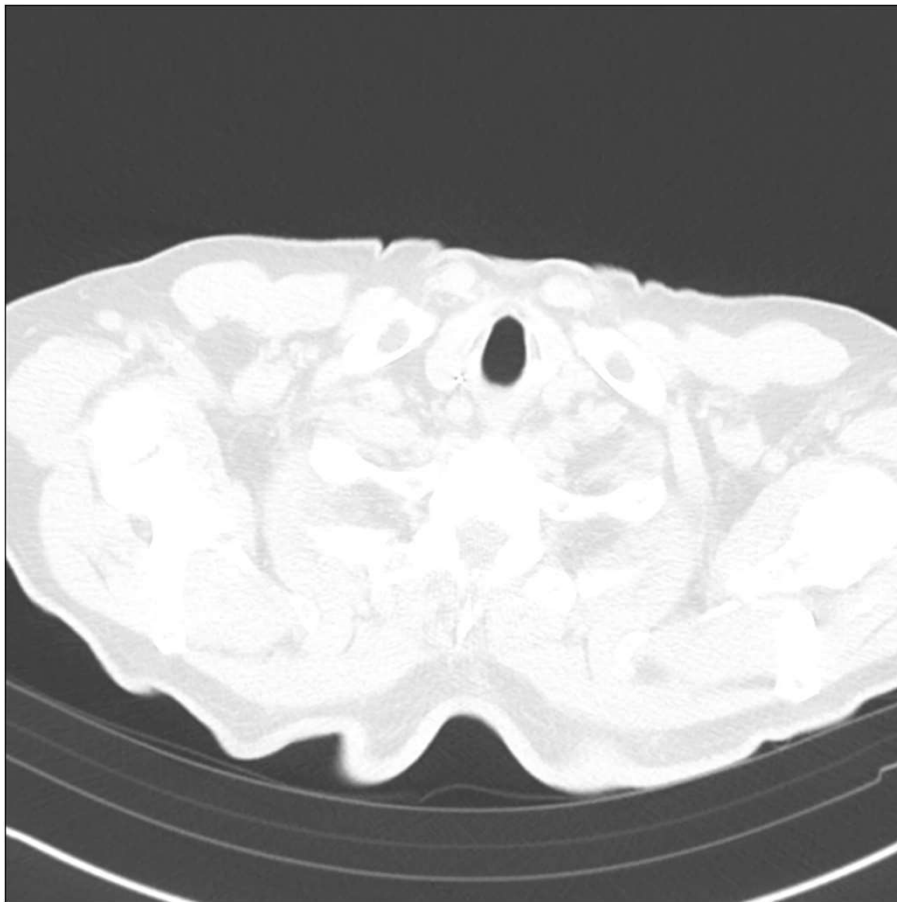


II. Fibrocavitary Type - CASE 2



CASE 2 - Severe upper lobe cavitory dz.

III. *Hot Tub Lung (Hypersensitivity Pneumonitis)*



- Air-trapping is very often present (**HRCT helpful!**)
- Normal CXR in 20+%

Overview

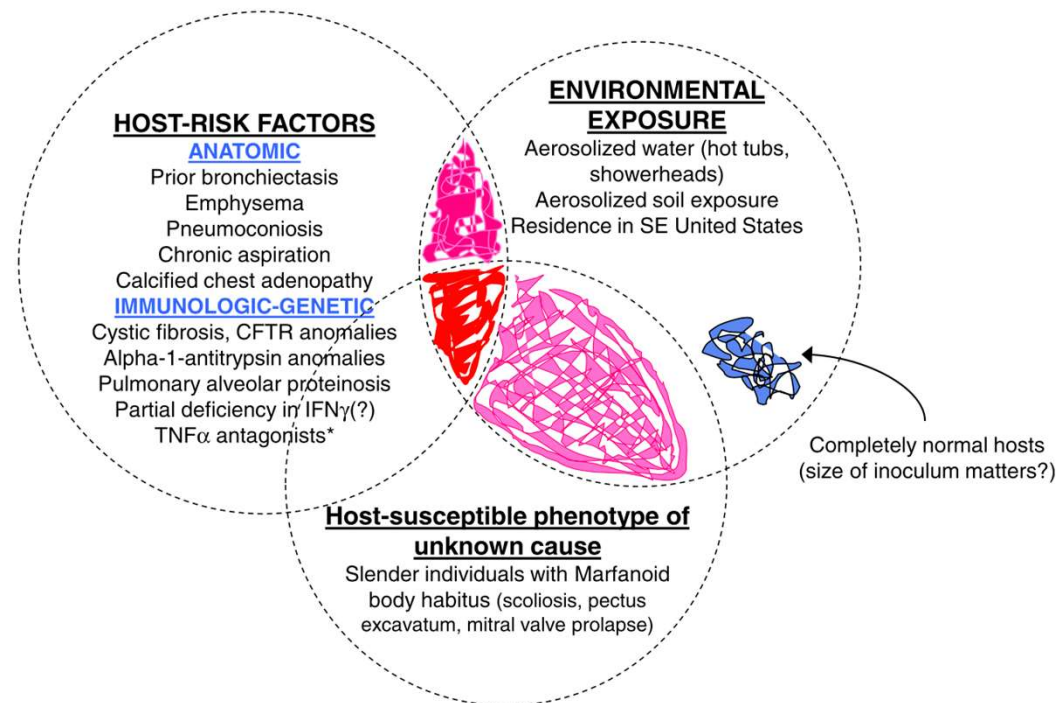
- I. CT technique
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NTM & Underlying Lung Disease

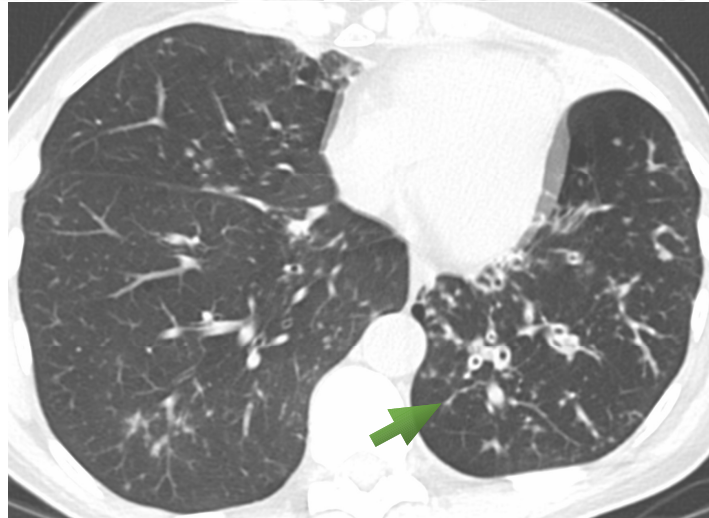
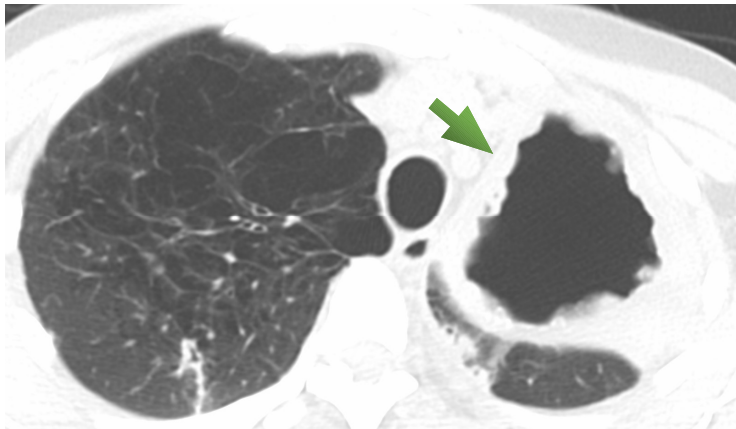
Risk factors for pulmonary NTM

- *Often underlying lung disease*
 - Structural
 - Non-structural
- Radiology also has role also in underlying disease

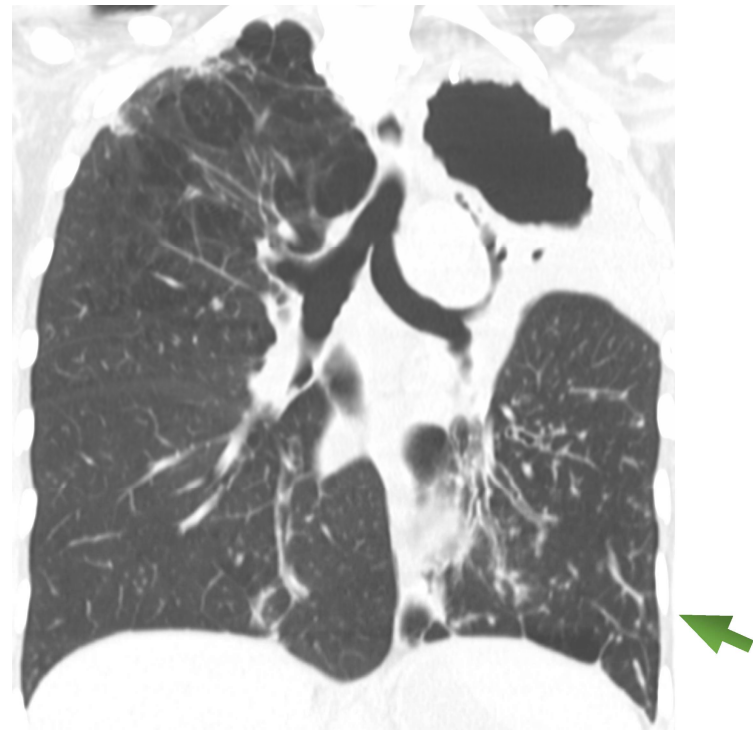


• *Honda et al Clin Chest Med 2015; 36:1-11*

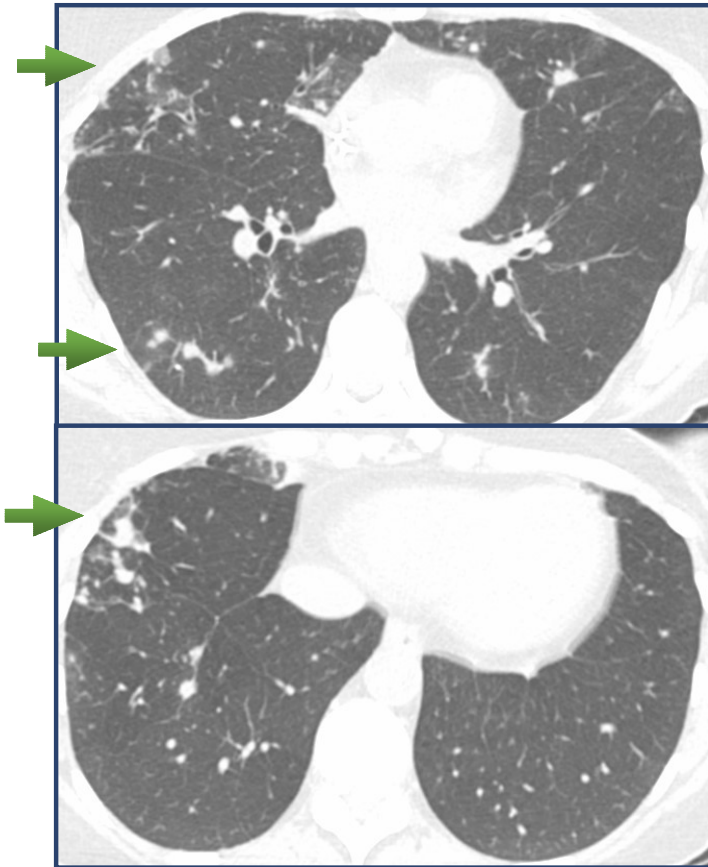
NTM in COPD/Emphysema



- Cavities can form in emphysema
- Any cavity can “spill” contents leading to worsening disease in lower lung.

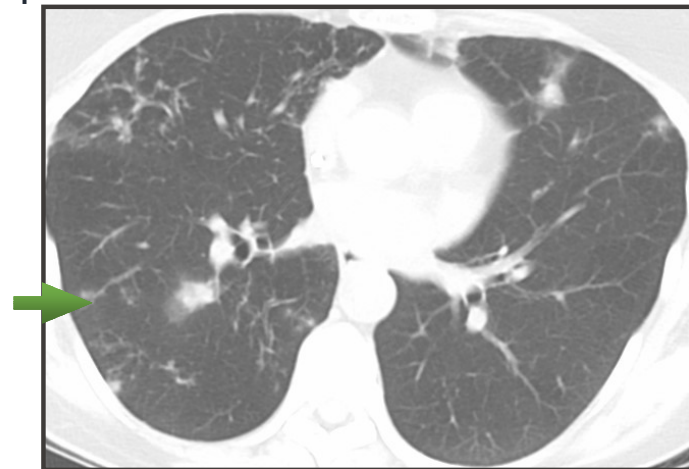


NTM in Chronic Aspiration



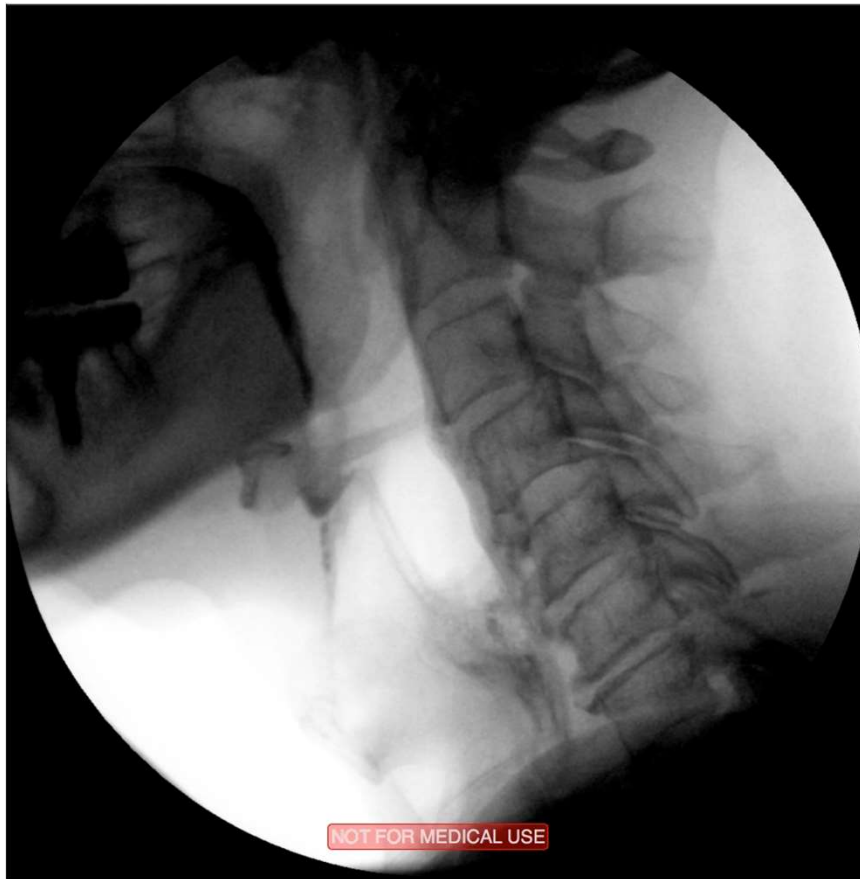
- Nothing Specific with known NTM

Few months
later



- Migratory Ground-Glass/Consolidation most suggestive
- Location? Anywhere, but:
 - lower-posterior - most common.
 - unilateral - sided sleeper?
 - upper - gardening, yoga, cough?

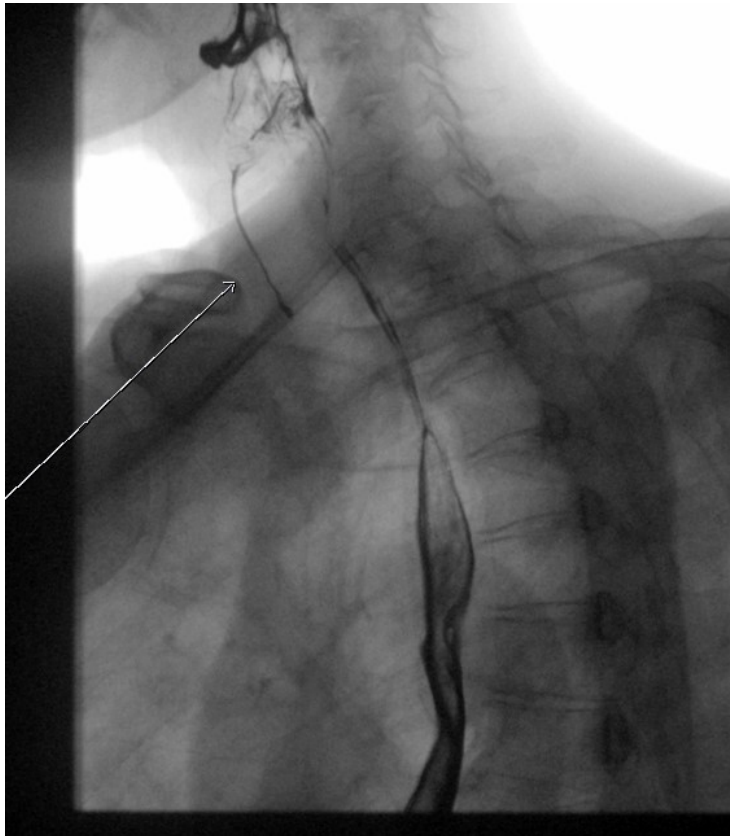
NTM in Chronic Aspiration



Aspiration Work-up

1. Esophogram
 - Also evaluates dysmotility
 - Only 2 min intermittent for GERD
2. Tailored Barium Swallow with Speech Pathology
 - Oral motility issues
3. Esophageal pH testing

NTM in Chronic Aspiration

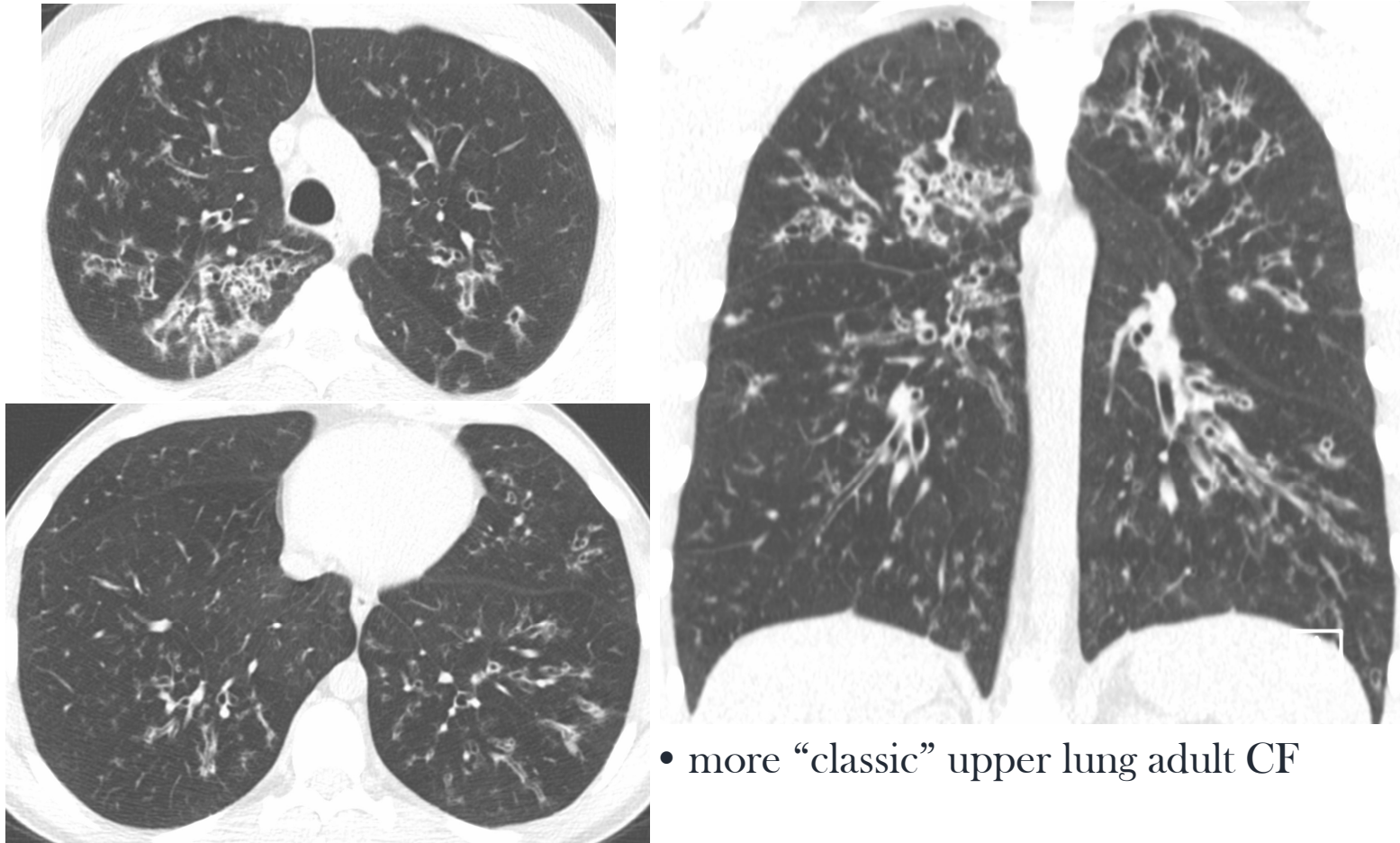


• Aspiration on Esophogram

Aspiration Work-up

1. Esophogram
 - Also evaluates dysmotility
 - Only 2 min intermittent for GERD
2. Tailored Barium Swallow with Speech Pathology
 - Oral motility issues
3. Esophageal pH testing

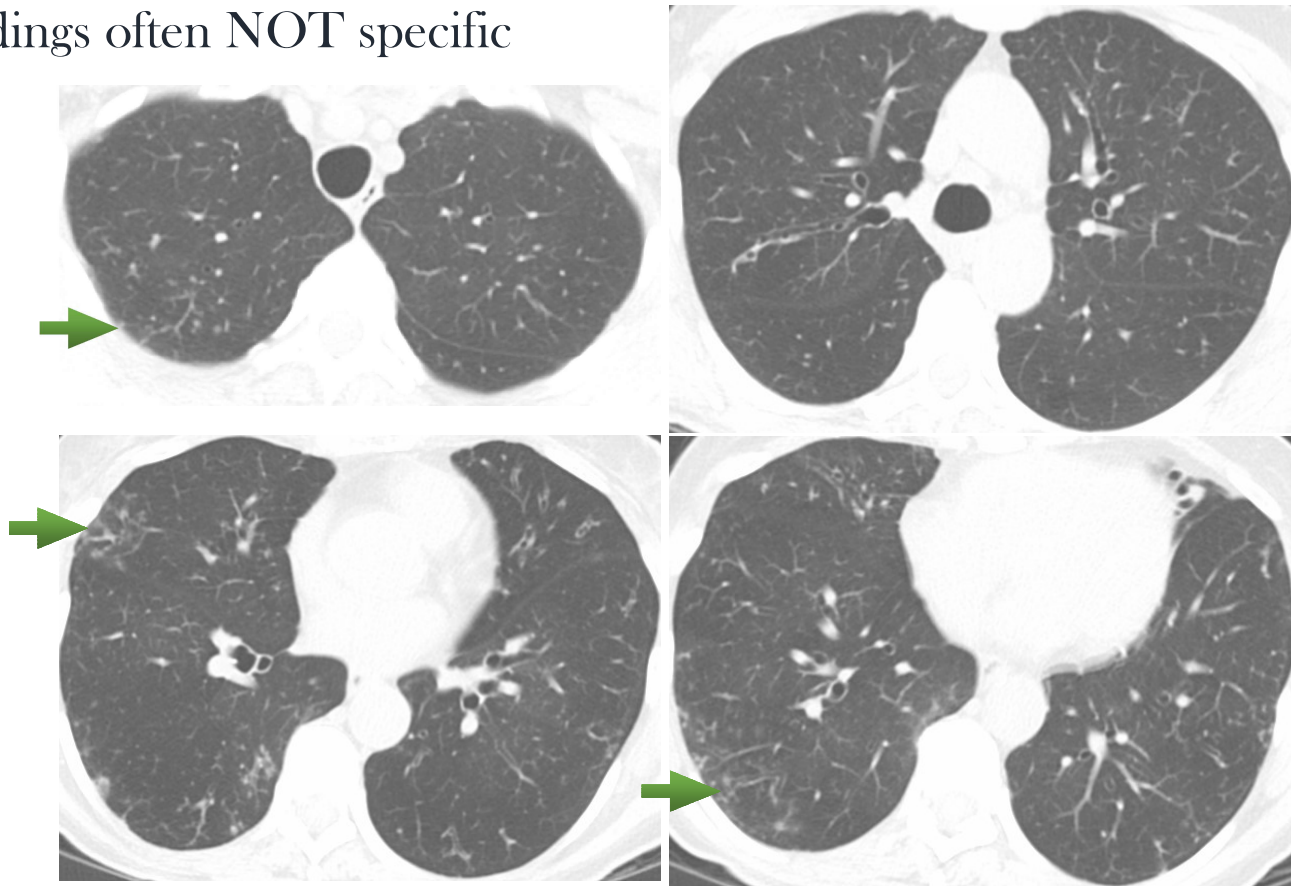
NTM in Adult CF – Case 1



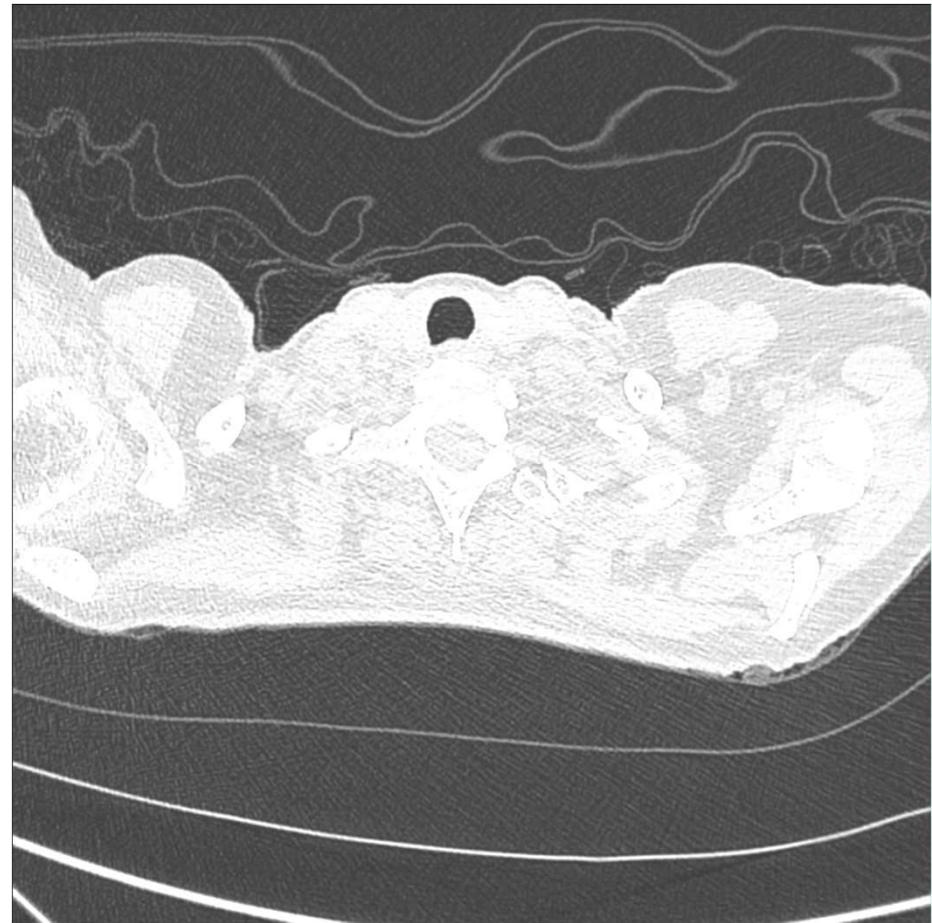
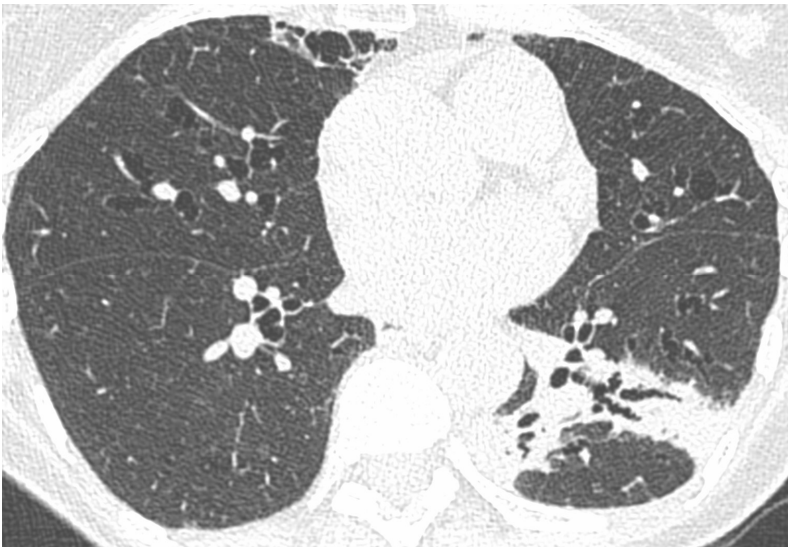
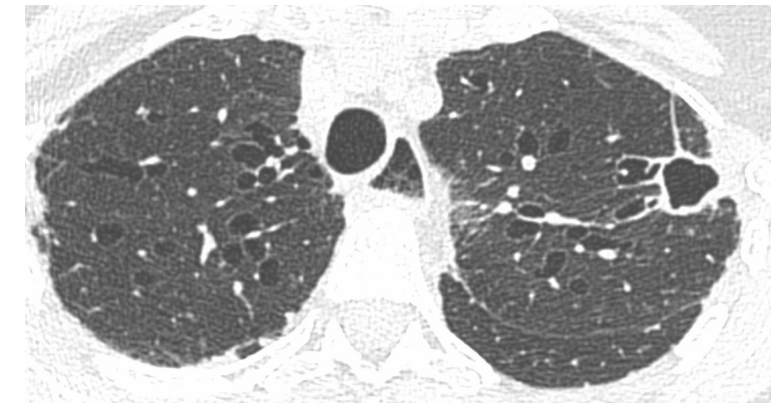
- more “classic” upper lung adult CF

NTM in Adult CF – Case 2

Findings often NOT specific



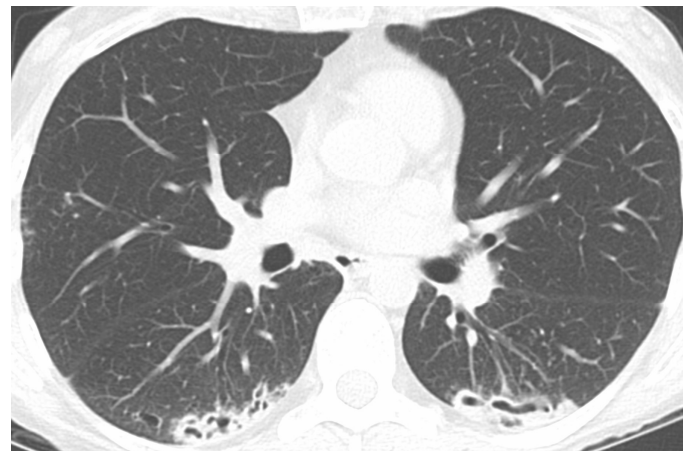
NTM in Alpha 1 Antitrypsin



NTM in Pulmonary Fibrosis (Scleroderma ILD)



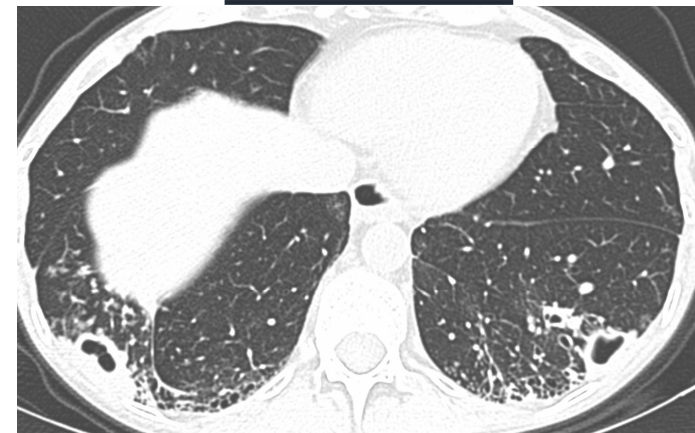
Presentation



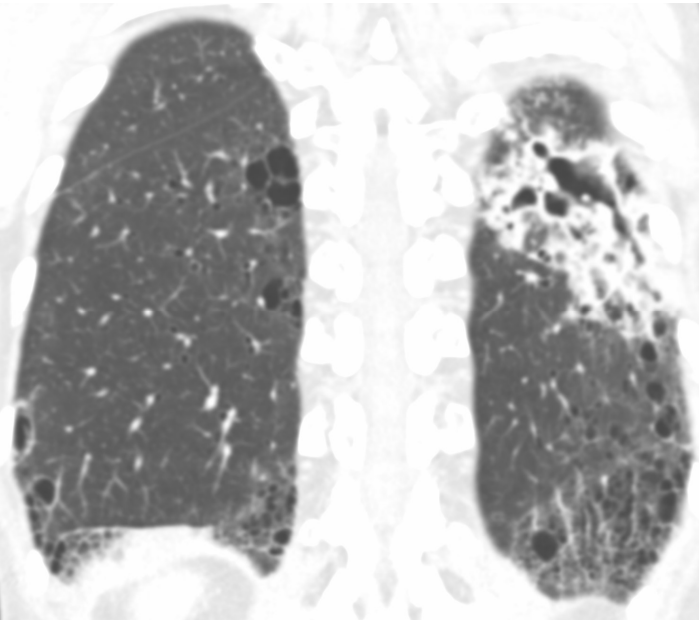
1 Year Later



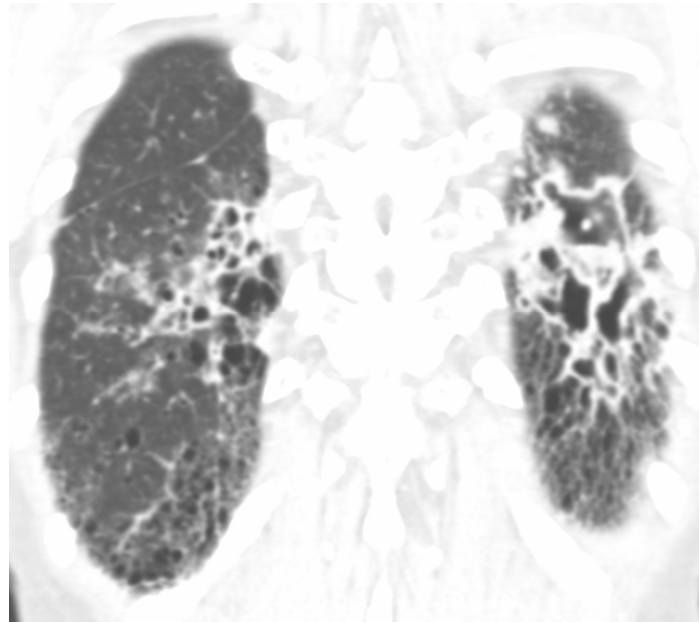
3 Years Later



NTM in Pulmonary Fibrosis (Scleroderma ILD)



Presentation



1 Year Later

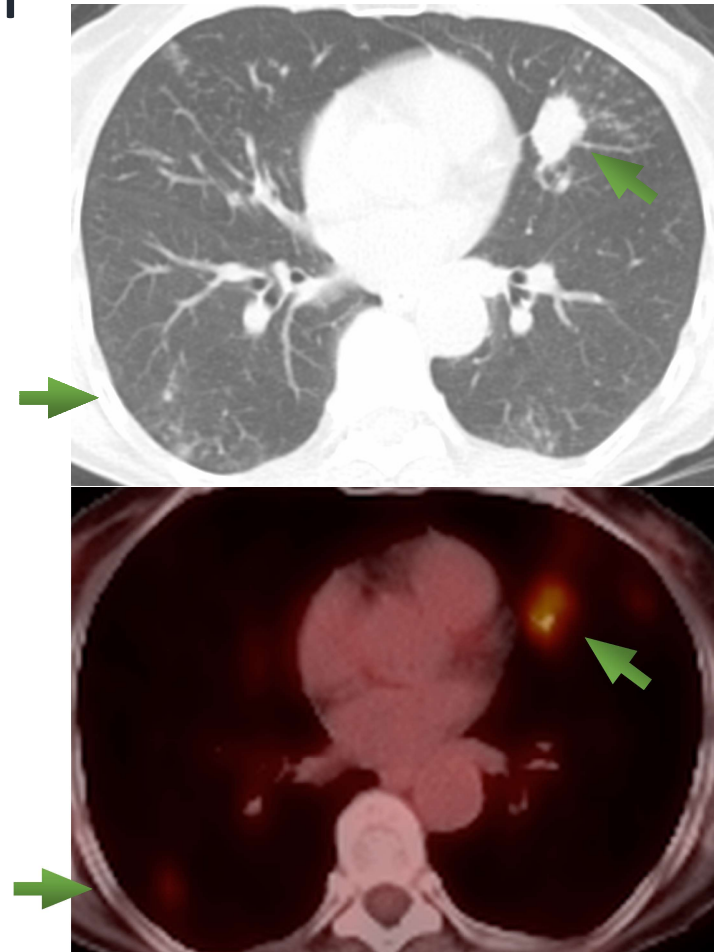


3 Years Later

PET/CT and NTM

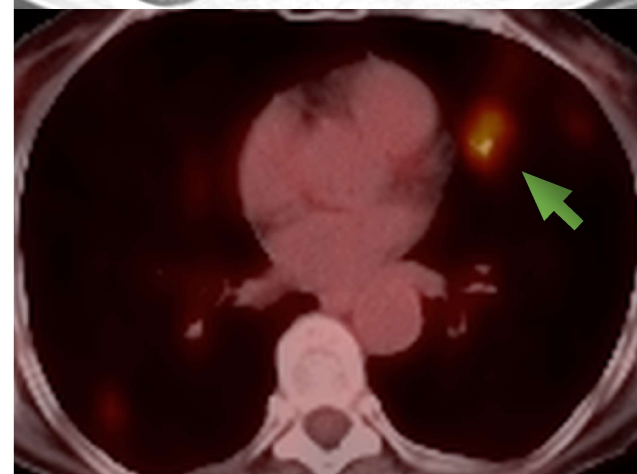
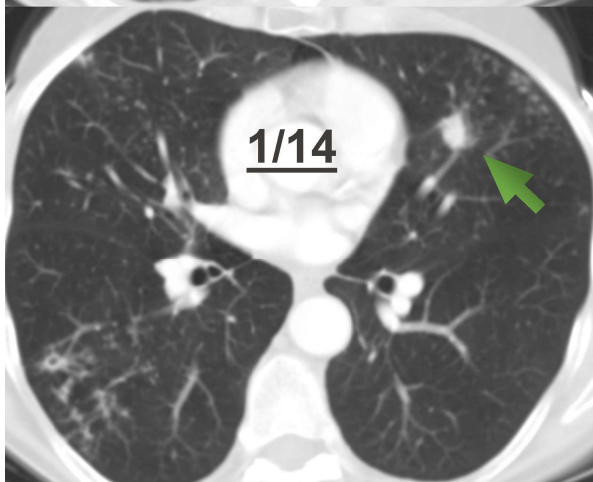
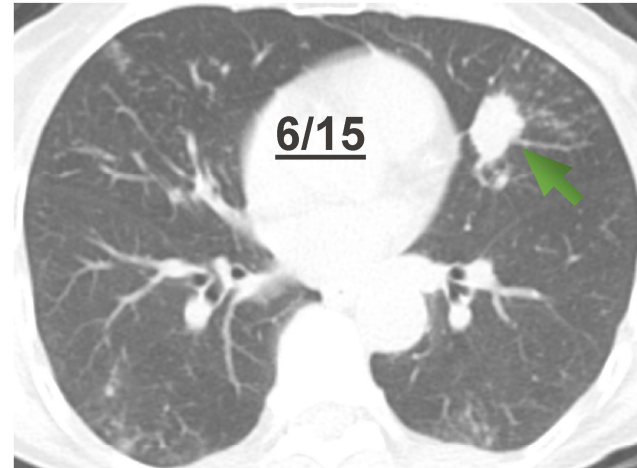
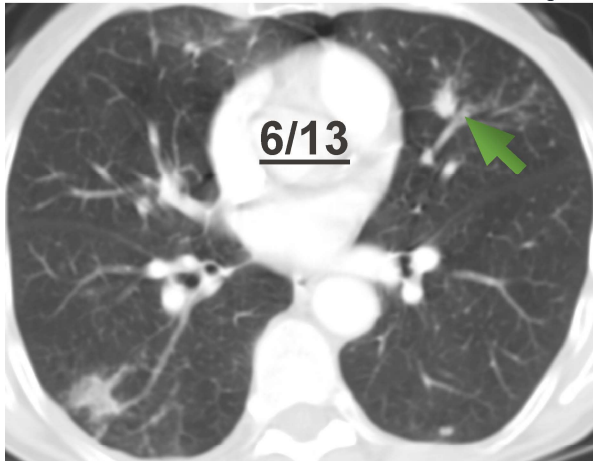
- NTM will cause increased uptake (like most infections)
- SUV typically about 8.5 (4.4-9.7)
- So caution in evaluating for cancer with NTM

- *Hahn et al. Lung. 2010 Jan-Feb;188(1):25-31*
- *Treglia et al. J Comput Assist Tomogr. 2011;35(3):387-93.*



PET/CT and NTM

- Lung Cancer with NTM



References

- Ketai L, Currie B, Holt M, Chan E. Radiology of Chronic Cavitory Infections. *JTI*. 2018; 33(5):334-343.
- Martinez S, McAdams HP, Batchu CS. The many faces of pulmonary nontuberculous mycobacterial infection. *AJR Am J Roentgenol*. 2007;189(1):177-186.
- Ellis SM. The spectrum of tuberculosis and non-tuberculous mycobacterial infection. *Eur Radiol*. 2004;14 Suppl 3(3):E34-E42.
- Ellis SM, Hansell DM. Imaging of Non-tuberculous (Atypical) Mycobacterial Pulmonary Infection. *Clin Radiol*. 2002;57(8):661-669.
- Jeong YJ, Lee KS, Koh W-J, Han J, Kim TS, Kwon OJ. Nontuberculous mycobacterial pulmonary infection in immunocompetent patients: comparison of thin-section CT and histopathologic findings. *Radiology*. 2004;231(3):880-886.
- Wittram C, Weisbrod GL. Mycobacterium avium complex lung disease in immunocompetent patients: radiography-CT correlation. *BJR*. 2002;75(892):340-344.
- Erasmus JJ, McAdams HP, Farrell MA, Patz EF. Pulmonary nontuberculous mycobacterial infection: radiologic manifestations. *RadioGraphics*. 1999;19(6):1487-1505.
- Musaddaq B, Cleverley JR. Diagnosis of non-tuberculous mycobacterial pulmonary disease (NTM-PD): modern challenges. *BJR*. 2020; 93: 20190768