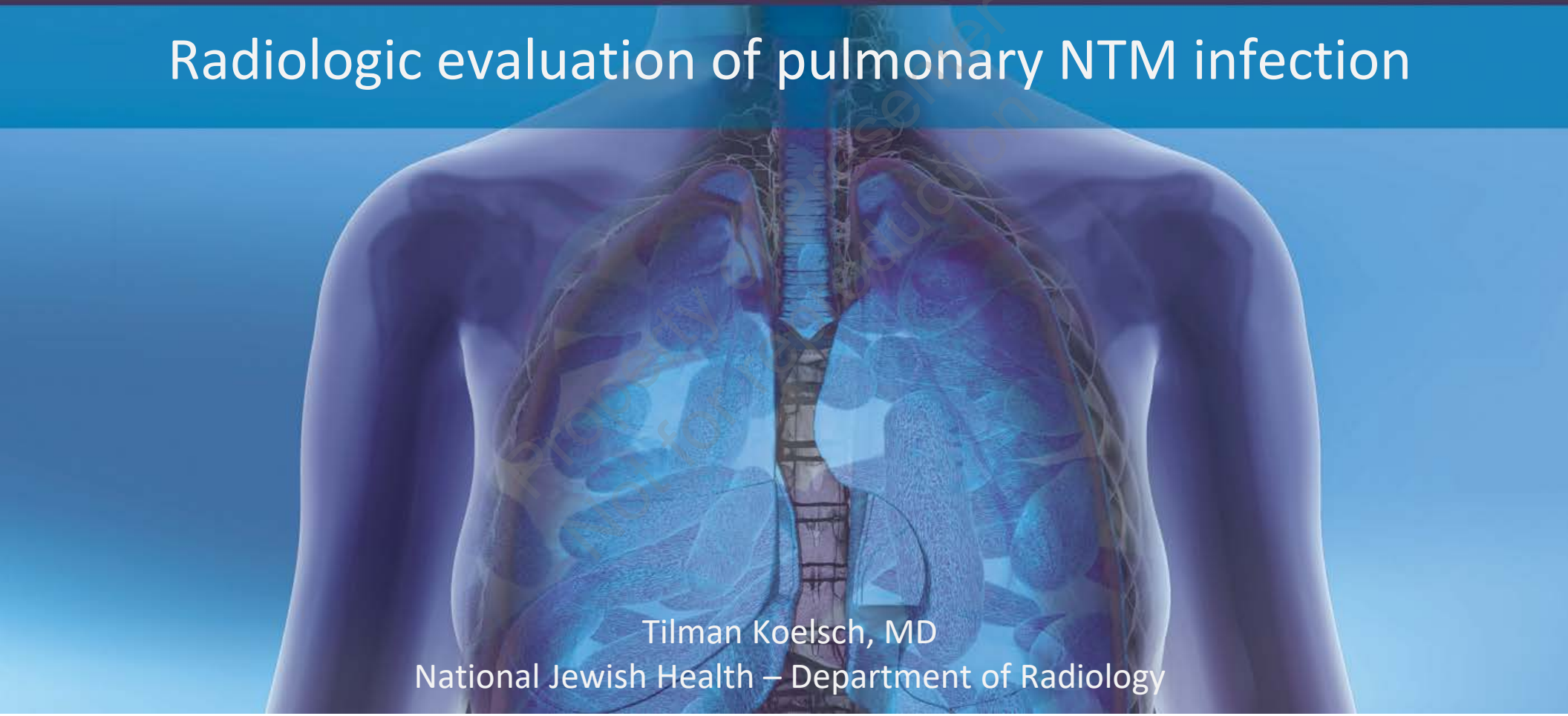
NTM Lecture Series for Providers

Radiologic evaluation of pulmonary NTM infection



Tilman Koelsch, MD
National Jewish Health – Department of Radiology

Disclosures

None

Learning Objectives

- 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

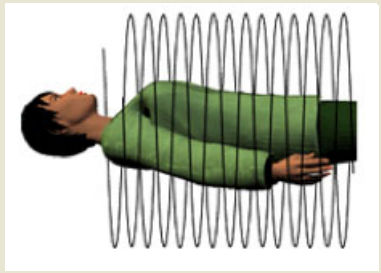
III. Radiological/Clinical Phenotypes

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

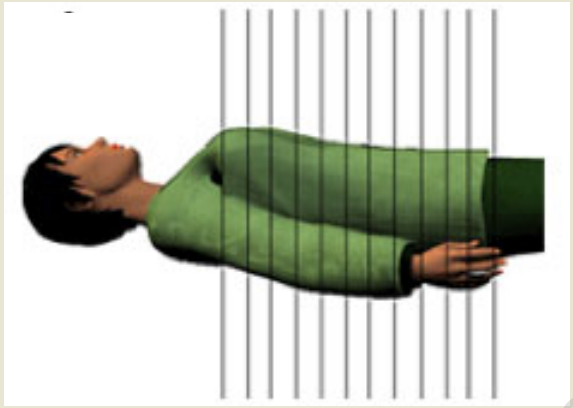
Low Dose – Follow-Up

At NJH we "automatically" use low dose for:

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

CT Technique

- **HRCT (1 mm) THIN**



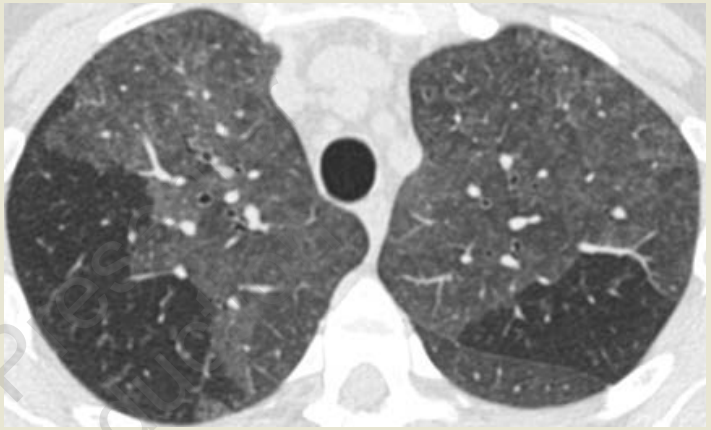
Also:

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

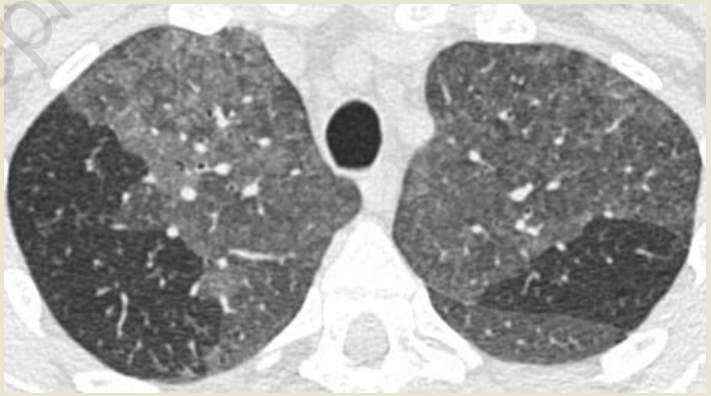
- When to order? (*examples*)
  - **Possible HP / Hot Tub Lung**!
  - Mild interstitial disease / fibrosis

HRCT

Hot Tub Lung



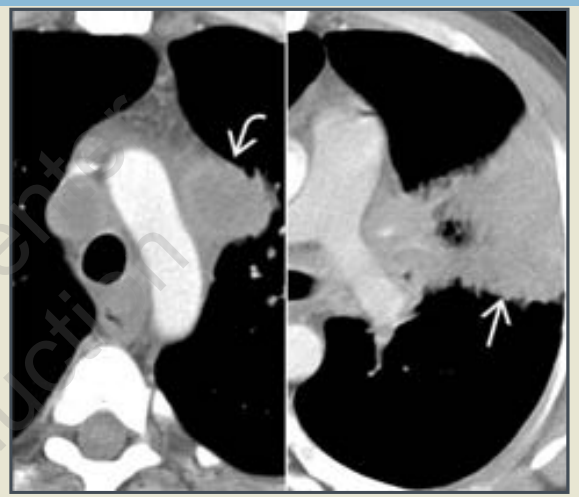
Inspiratory Thin Cut Images



Expiratory – AIR TRAPPING
(areas that stay dark)

CT Technique

- **Contrast?**
  - Usually not needed for LUNG
  - Use for "Soft Tissue"
    - Mediastinum/Hila?
    - Pleura/Chest Wall?



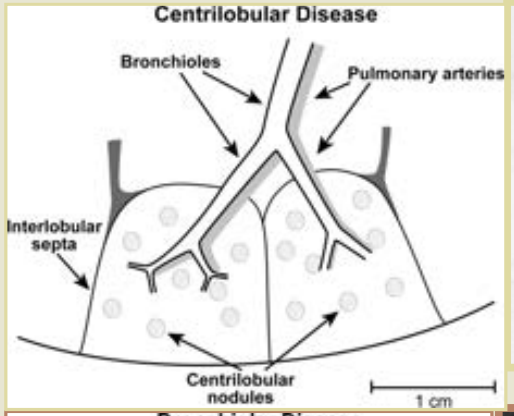
TB – Note Necrotic "Non-enhancing" LN

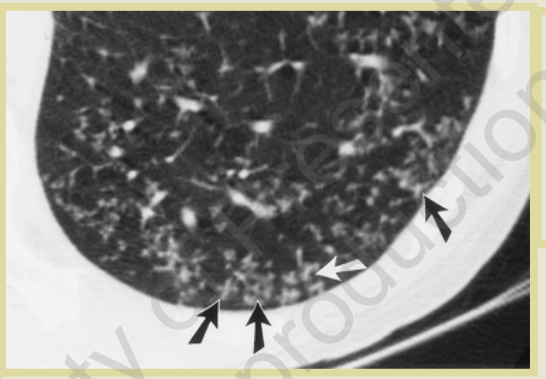
Empyema – Enhancing Plural Rind

NTM Imaging Signs

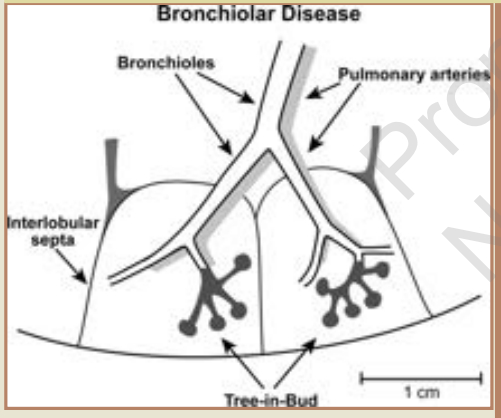
- Tree-In-Bud and Centilobular Nodules
- Bronchiectasis
- Cavities
- Ground-Glass and Consolidation
- Atelectasis

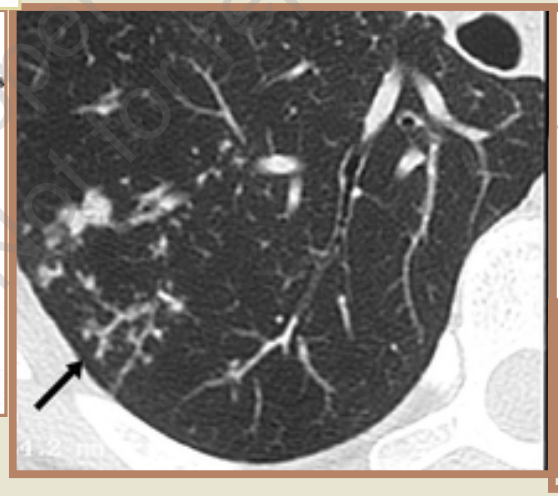
Centrilobular Nodules and Tree-In-Bud



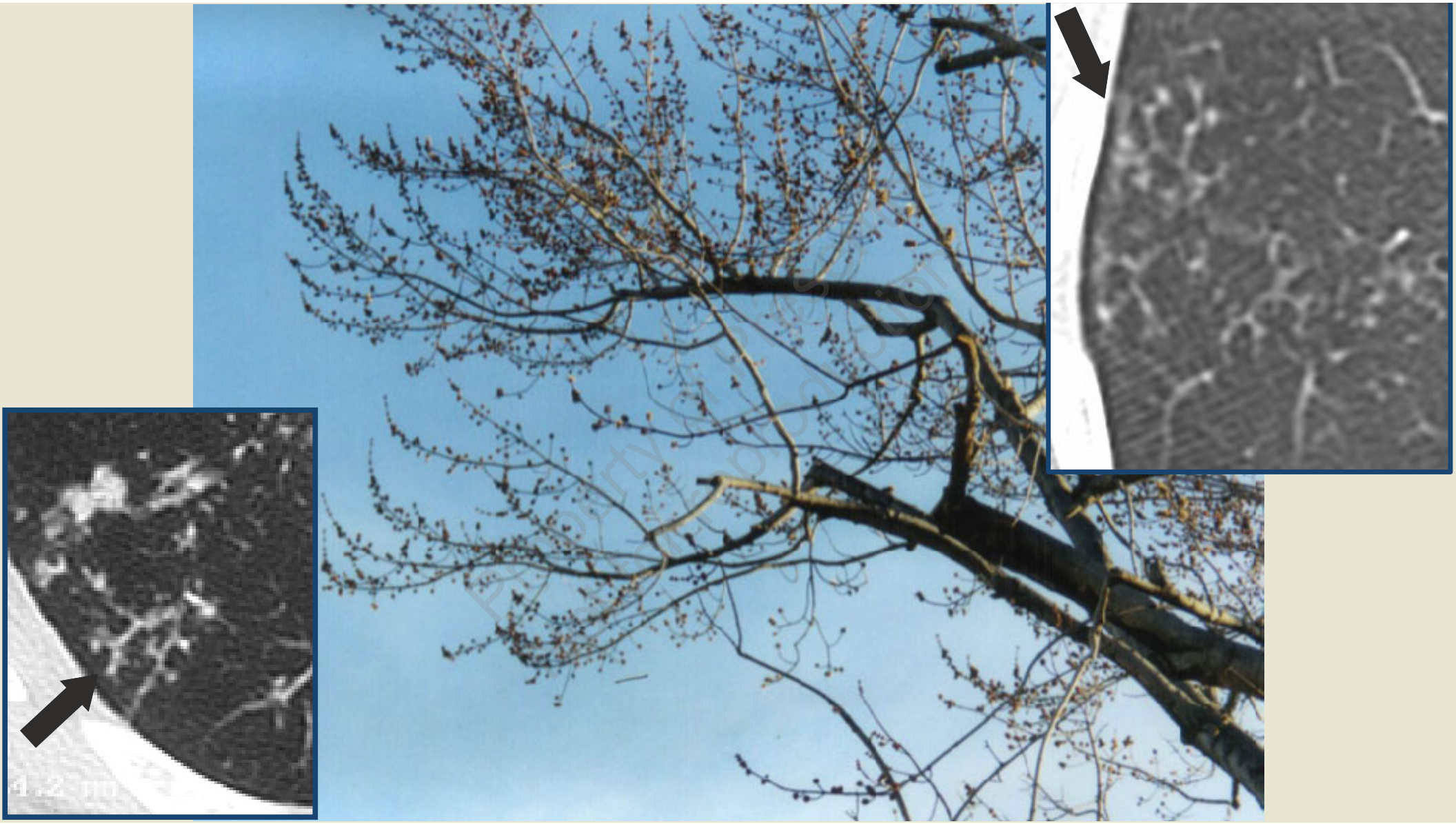


- Typically from Airways
- (i.e. infection, HP, smoking)





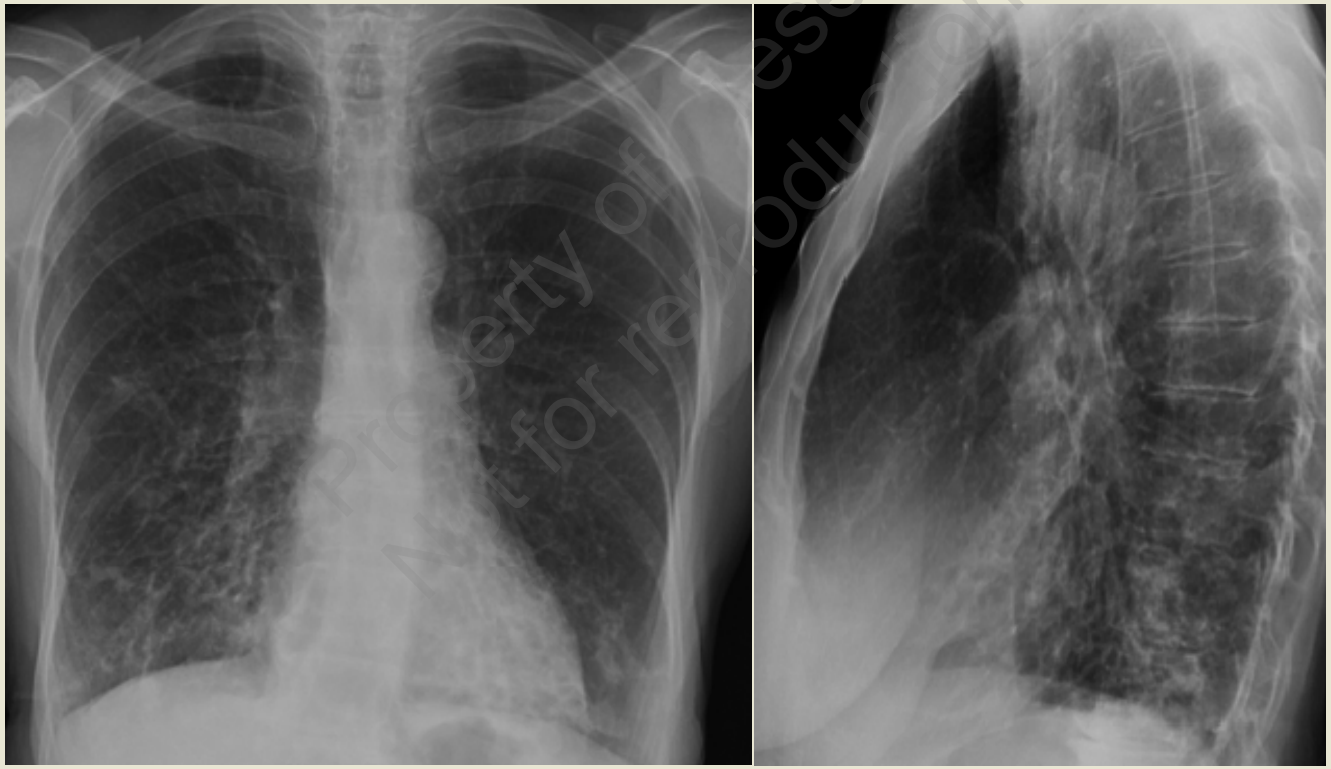
- **Infection, Infection**, Aspiration/Mucus Plugs…



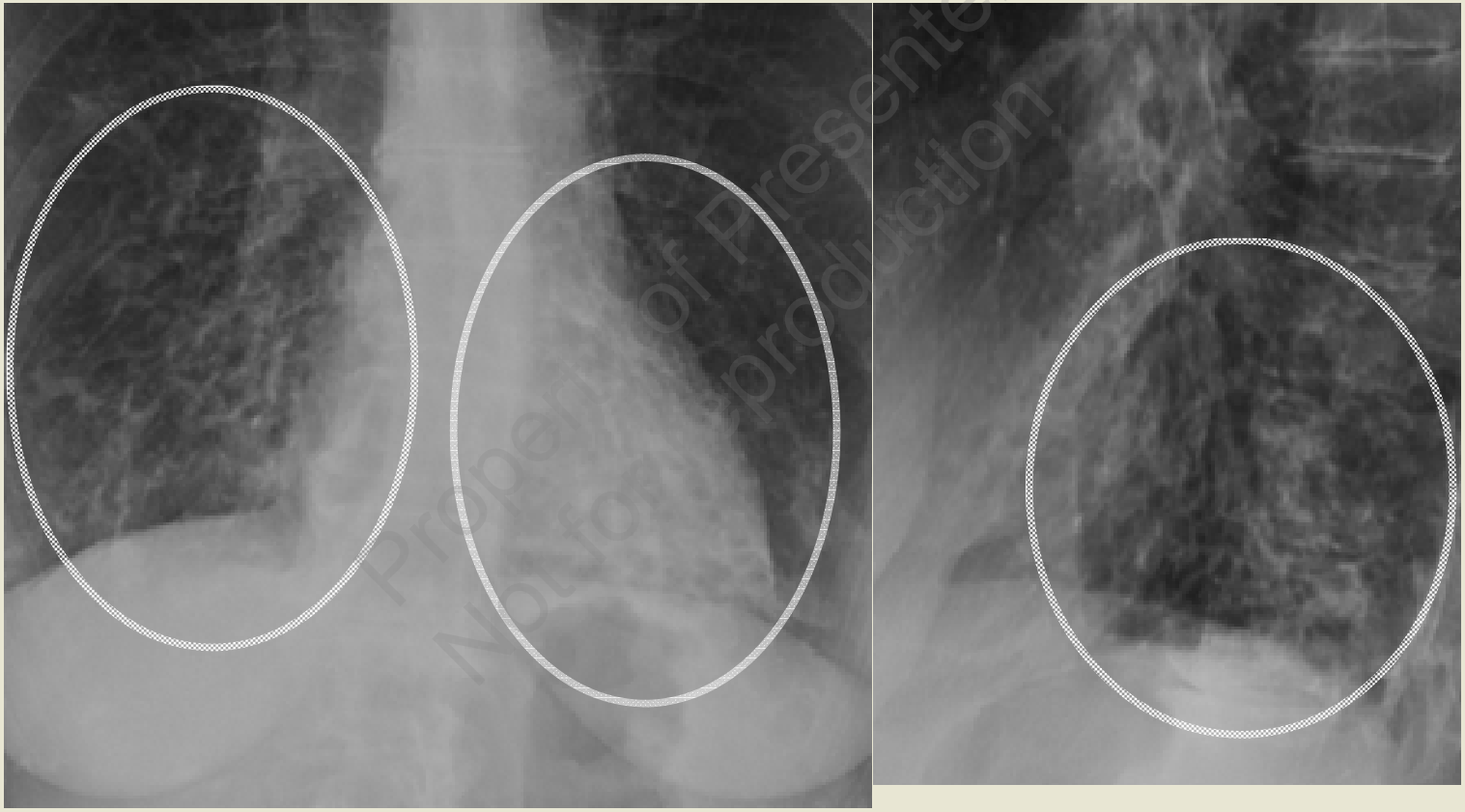
Bronchiectasis

Chest X-ray "Tram-Track" lines and Rings

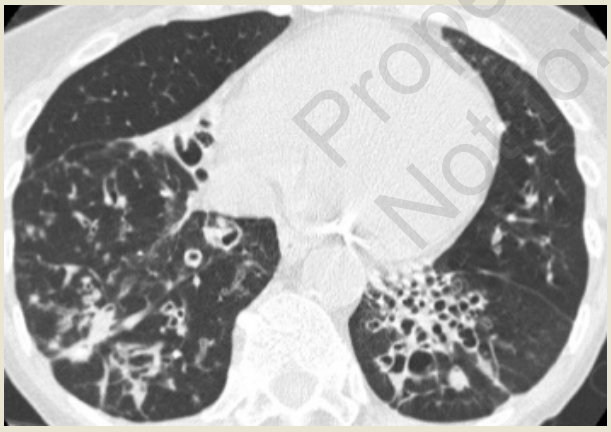
HARD TO SEE ON X-RAY

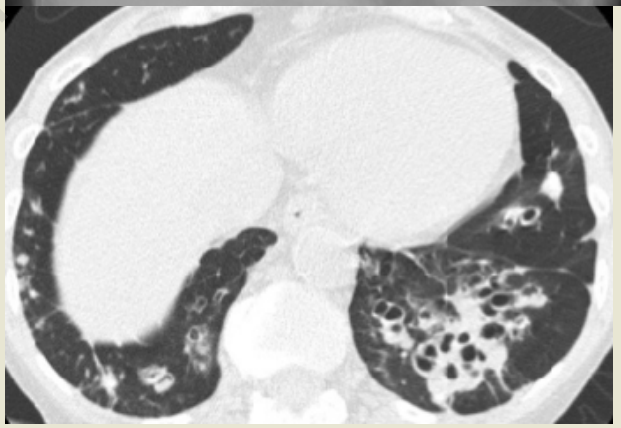


Bronchiectasis

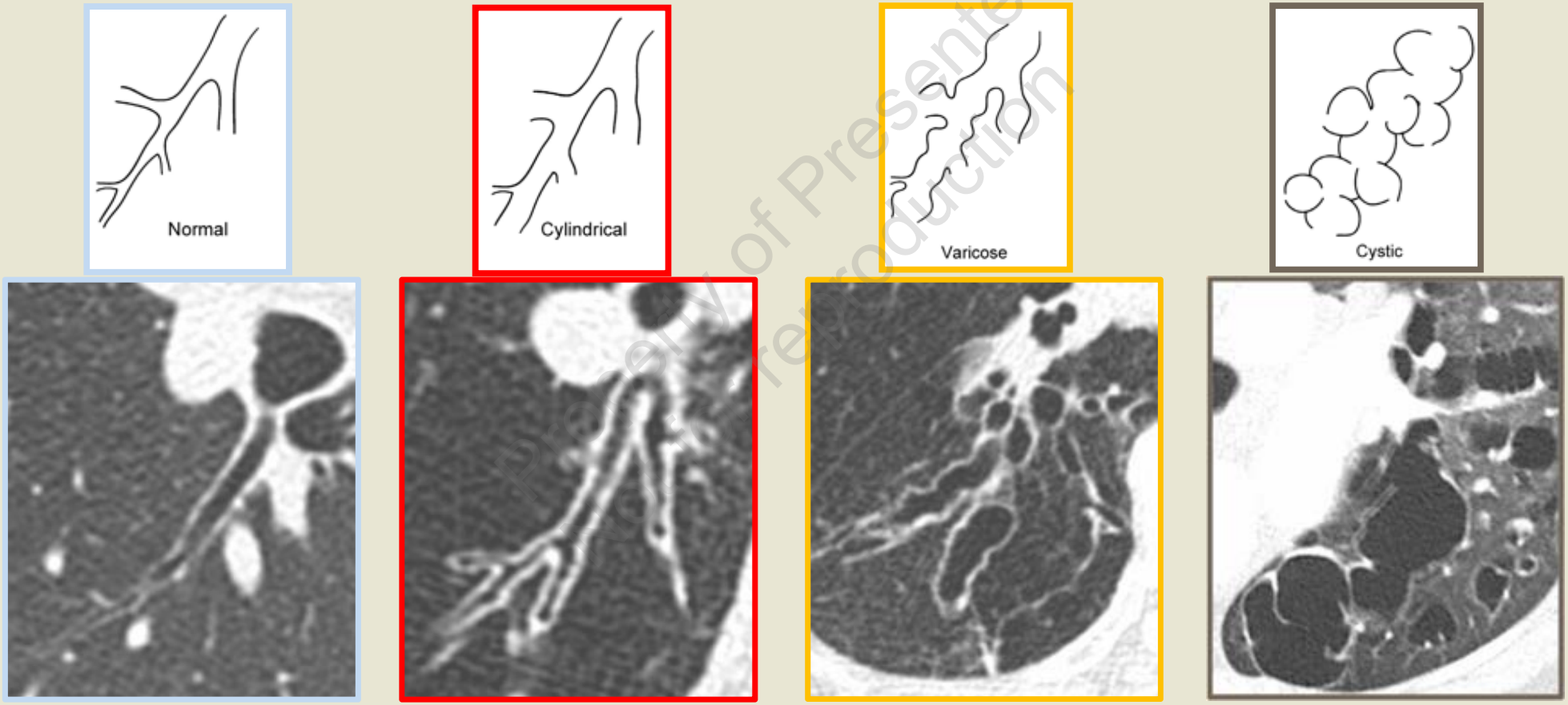


Bronchiectasis



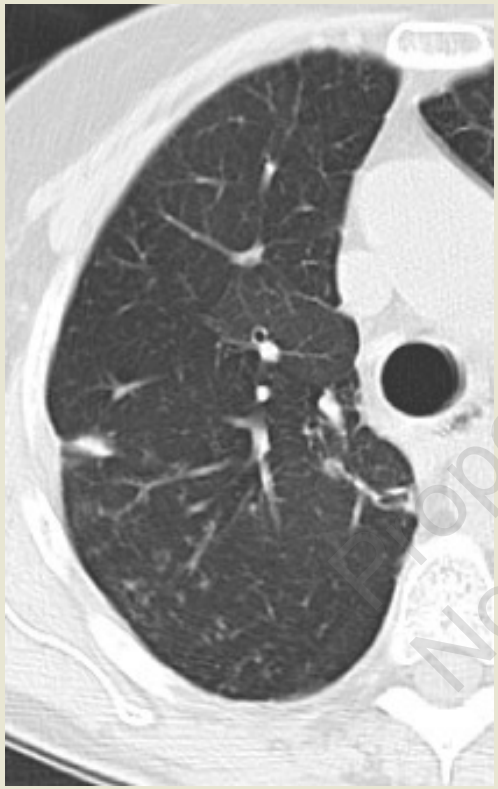


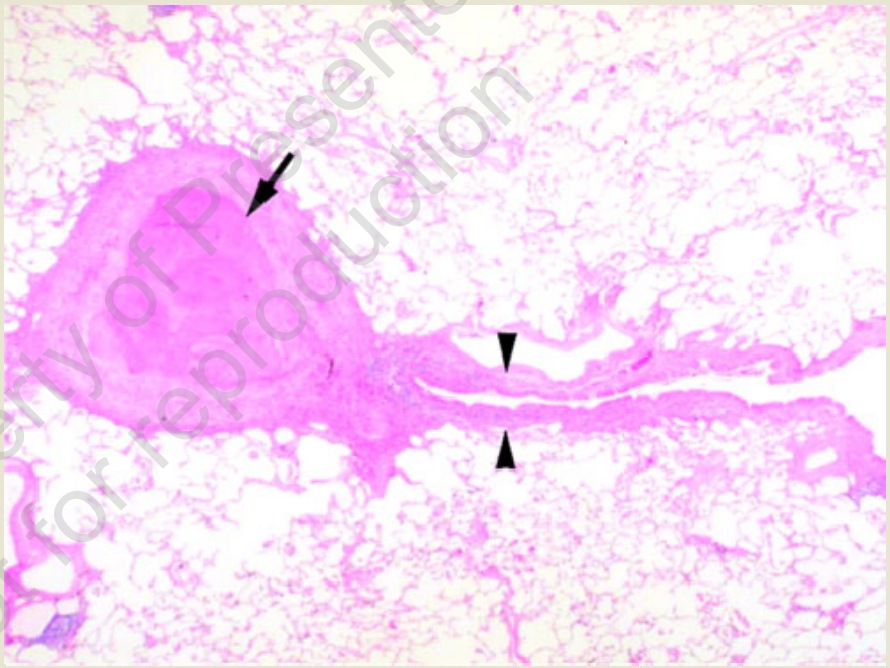
Bronchiectasis



figures from chestmedicine.org

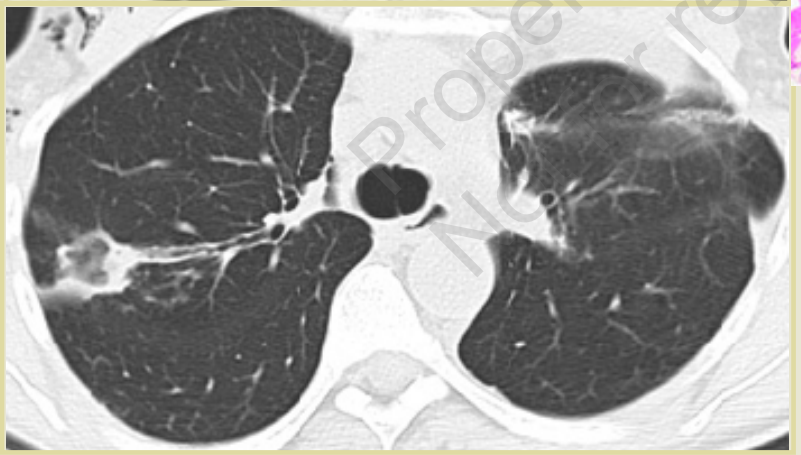
Cavities - and “feeding bronchus” sign

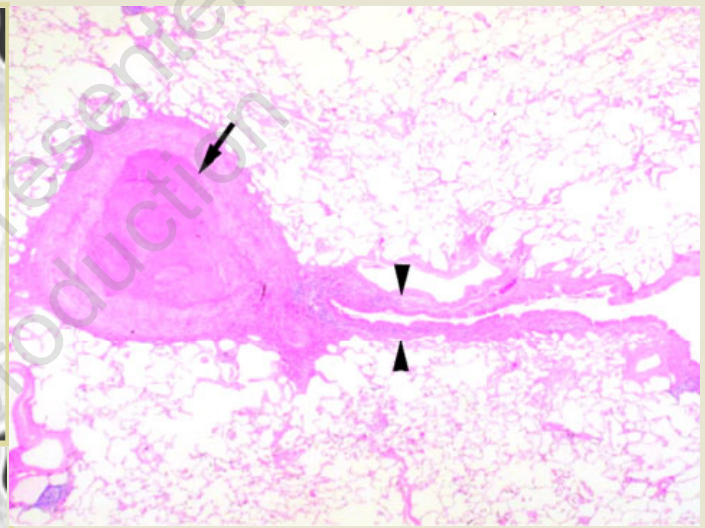




- *Kim et al AJR 2005; 184:1247-1252*

Cavities - and “feeding bronchus” sign



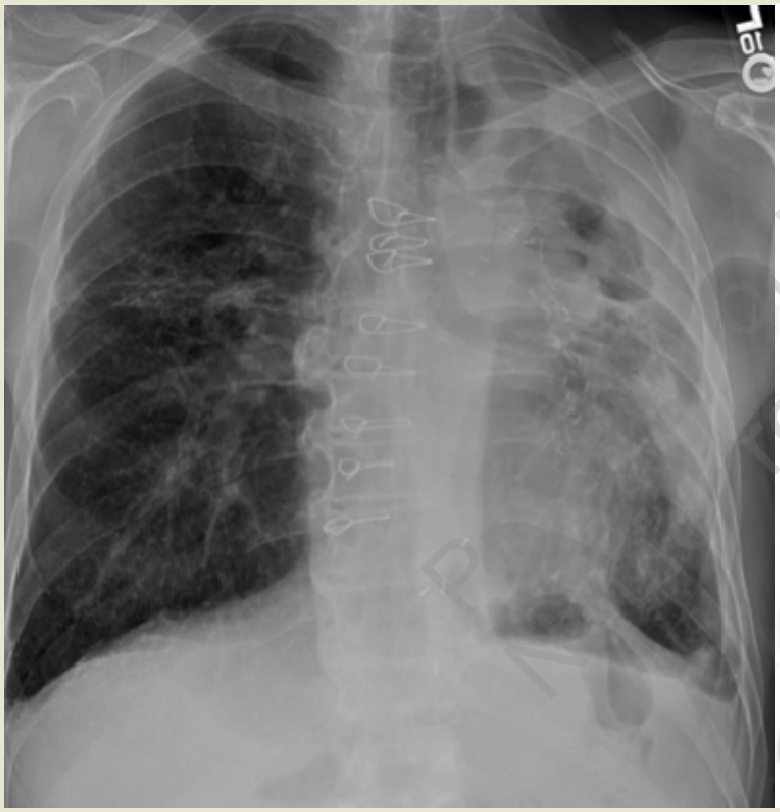


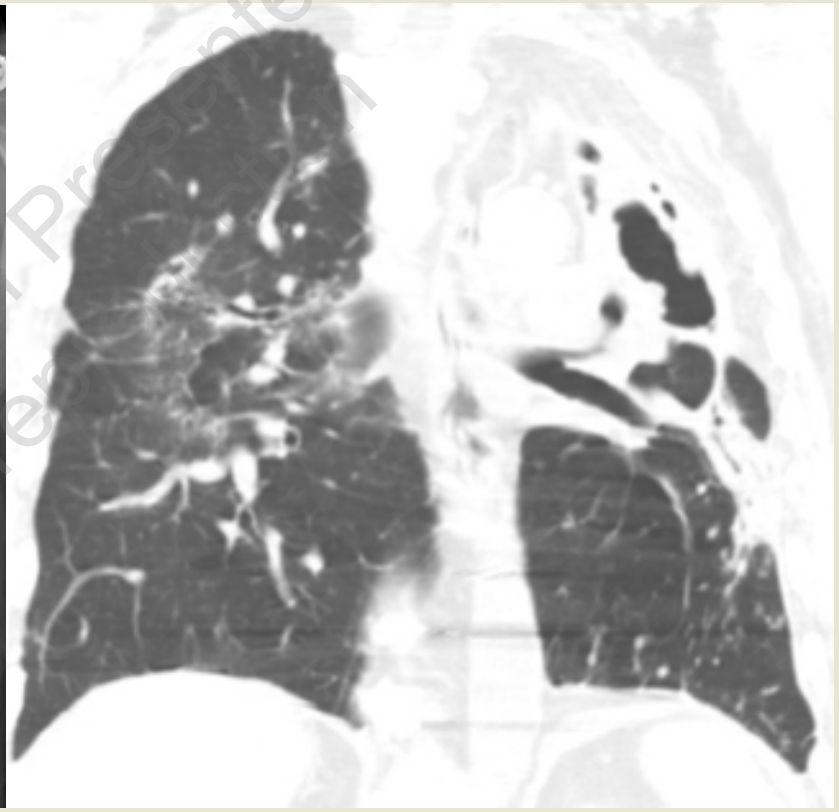
- *Kim et al AJR 2005; 184:1247-1252*

Cavities

CAN BE HARD TO SEE ON X-RAY

Cavities

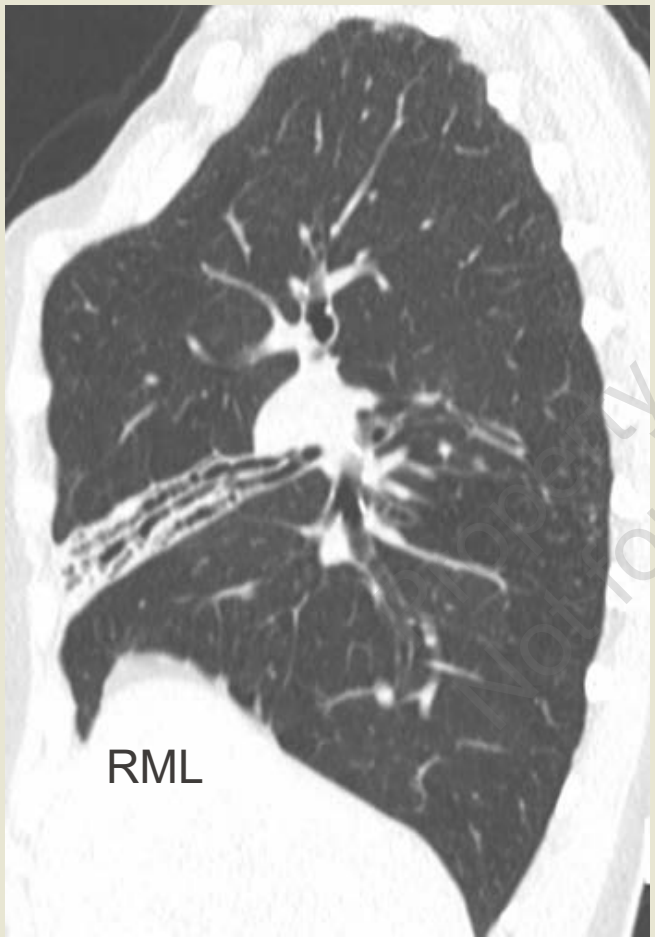




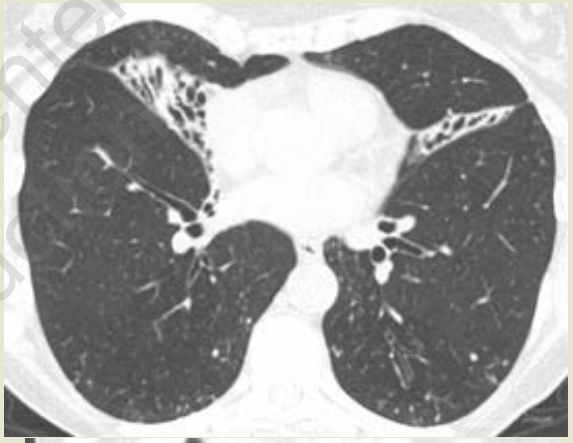
Consolidation and Ground-Glass

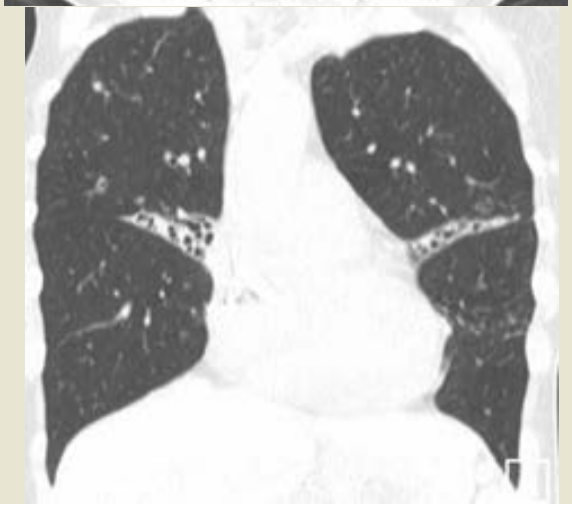
Atelectasis

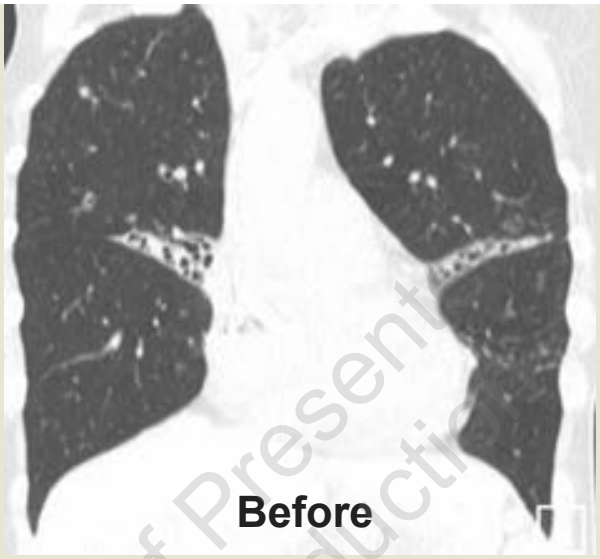
Atelectasis



Atelectasis

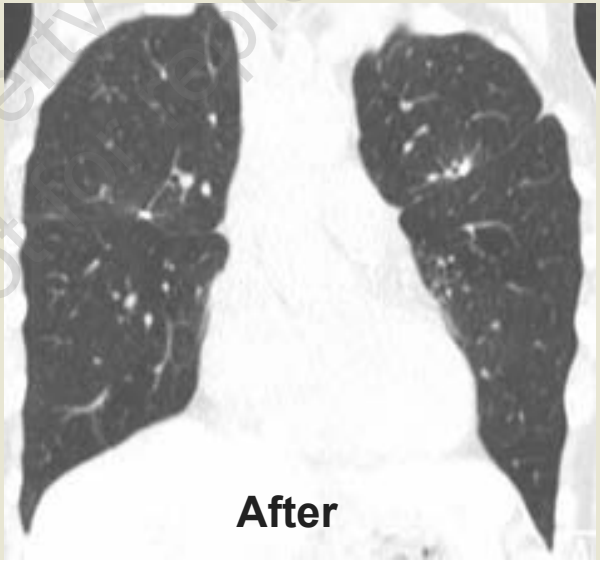






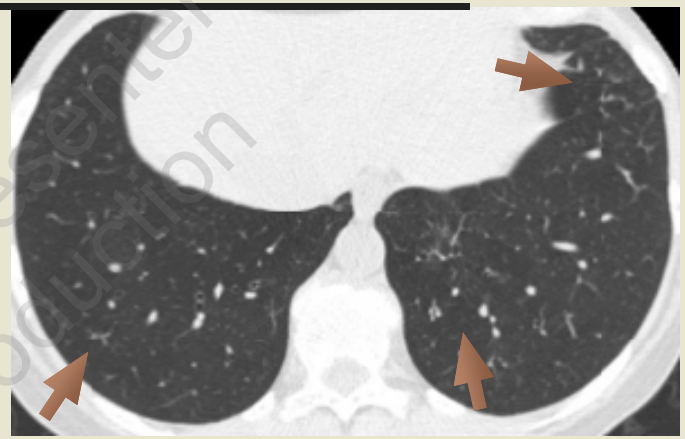
Before

Pt. had surgery to remove RML and Lingula



After

Aside: NTM with *Normal CXR*



Overview

I. CT technique

II. NTM imaging signs

III. Radiological/Clinical Phenotypes

IV. NTM & Underlying Lung Disease

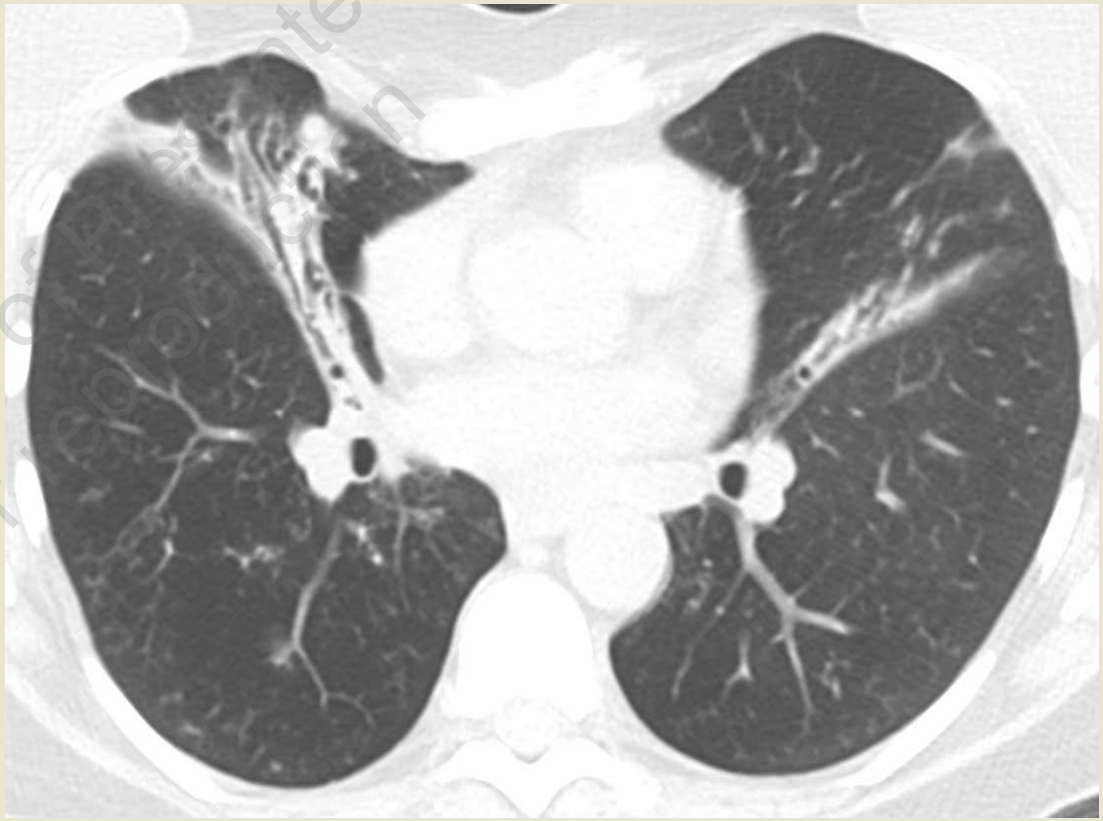
Radiological/Clinical Phenotypes of NTM

I. Nodular Bronchiectatic Type

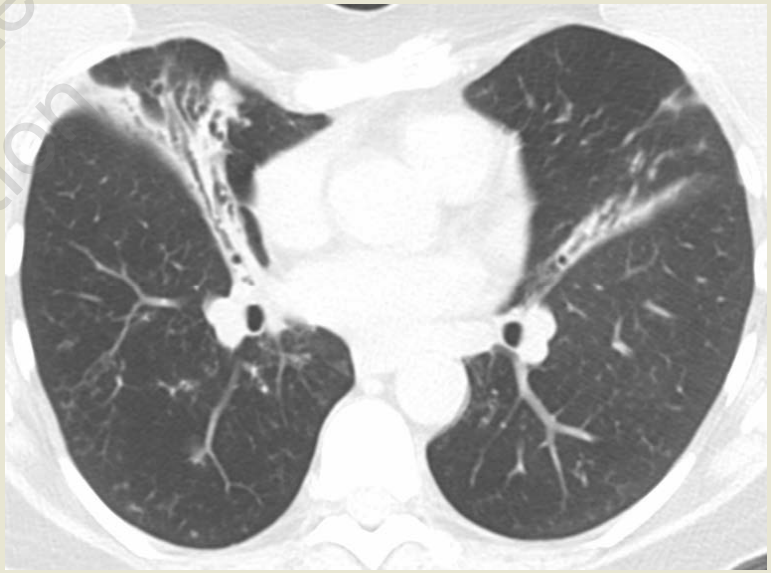
II. Fibrocavitary Type

III. Hot Tub Lung (Hypersensitivity Pneumonitis)

I. Nodular Bronchiectatic Type - CASE 1

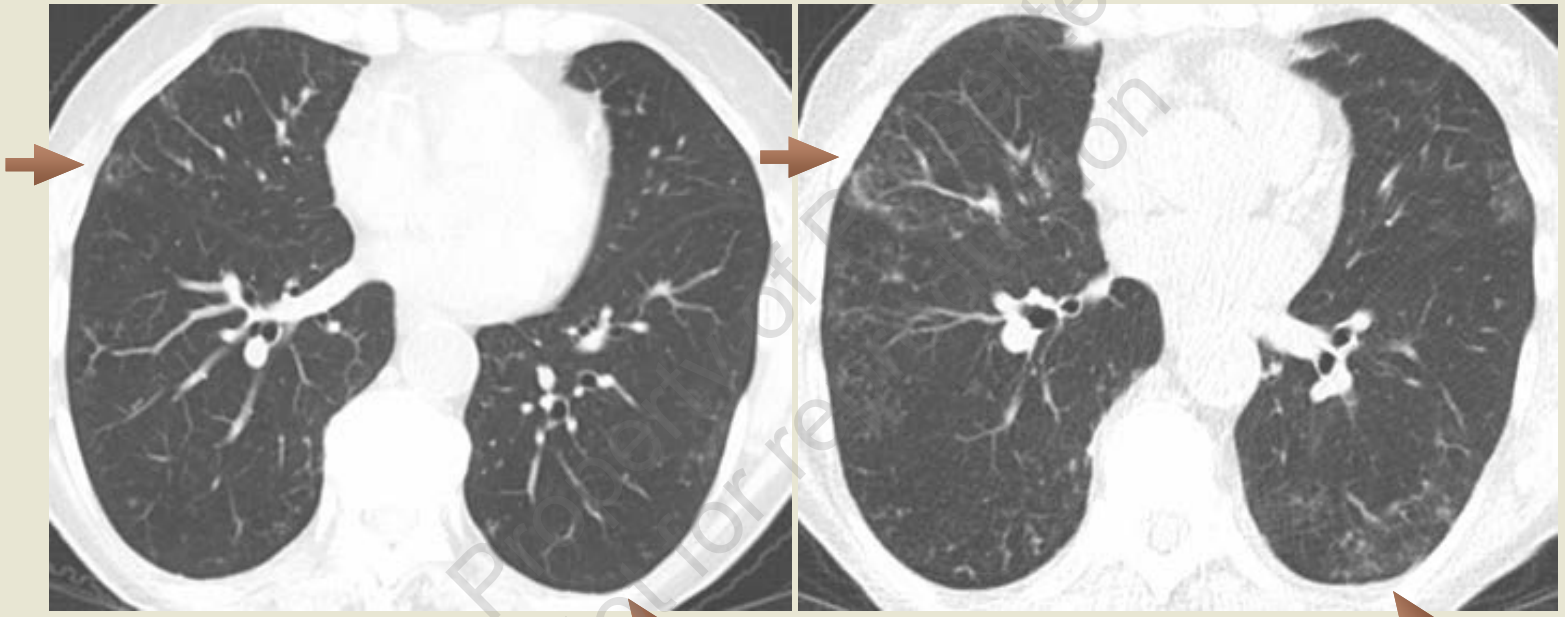


I. Nodular Bronchiectatic Type - CASE 1



Chest X-ray often much more subtle

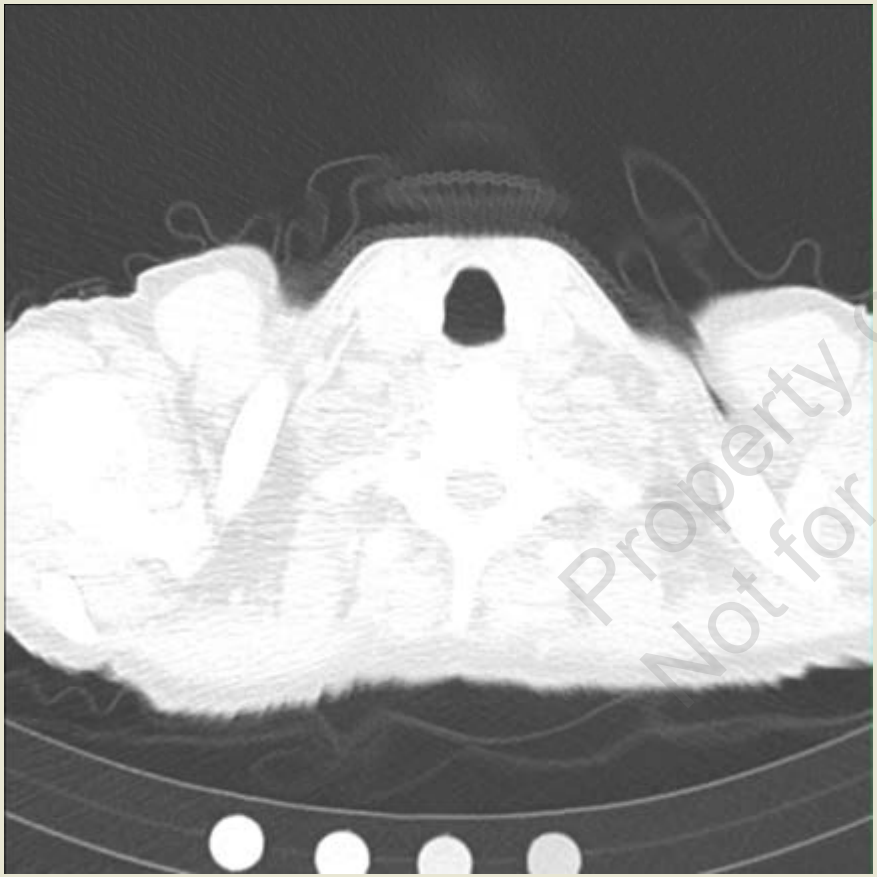
I. Nodular Bronchiectatic Type - CASE 2



2017 2021

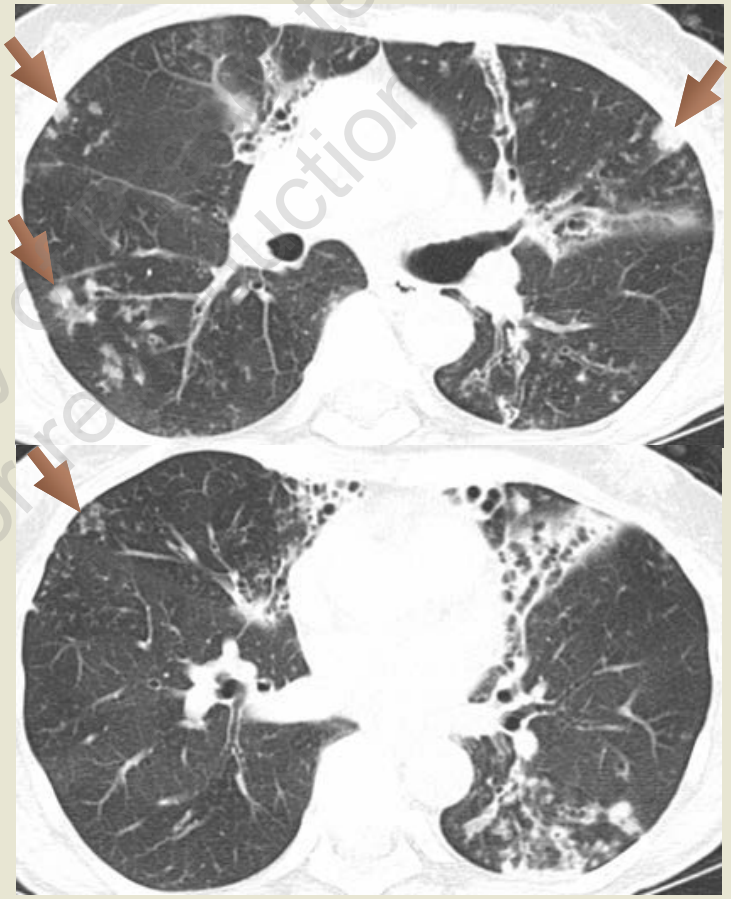
- **<u>Follow-Up</u>** - Look for active disease
  - Tree-in-bud, consolidation
    - look for stability, *(& clinical)*
  - Bronchiectasis, Cavities

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

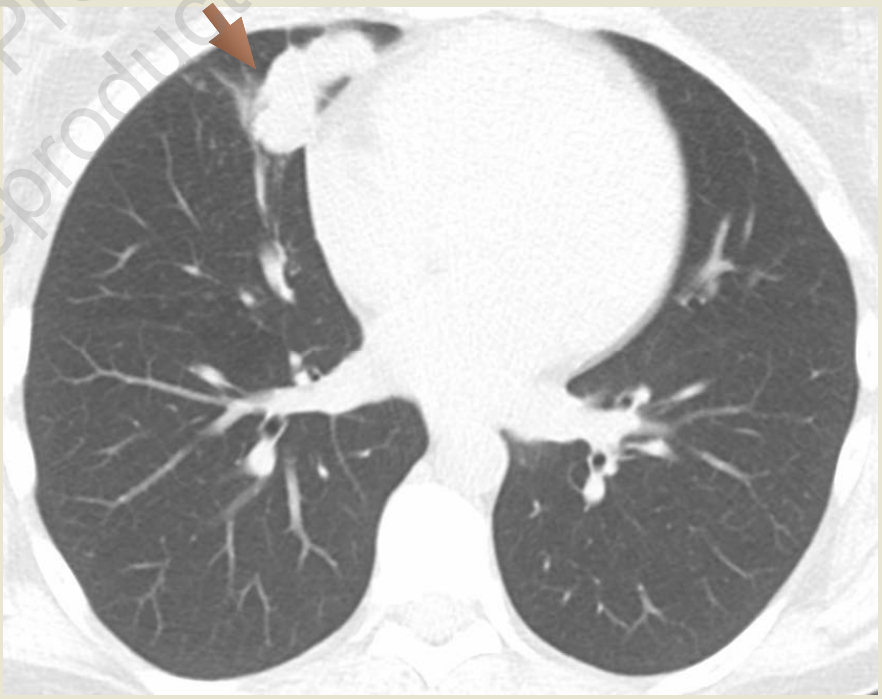
2014

2016

I. Nodular Bronchiectatic Type - CASE 4

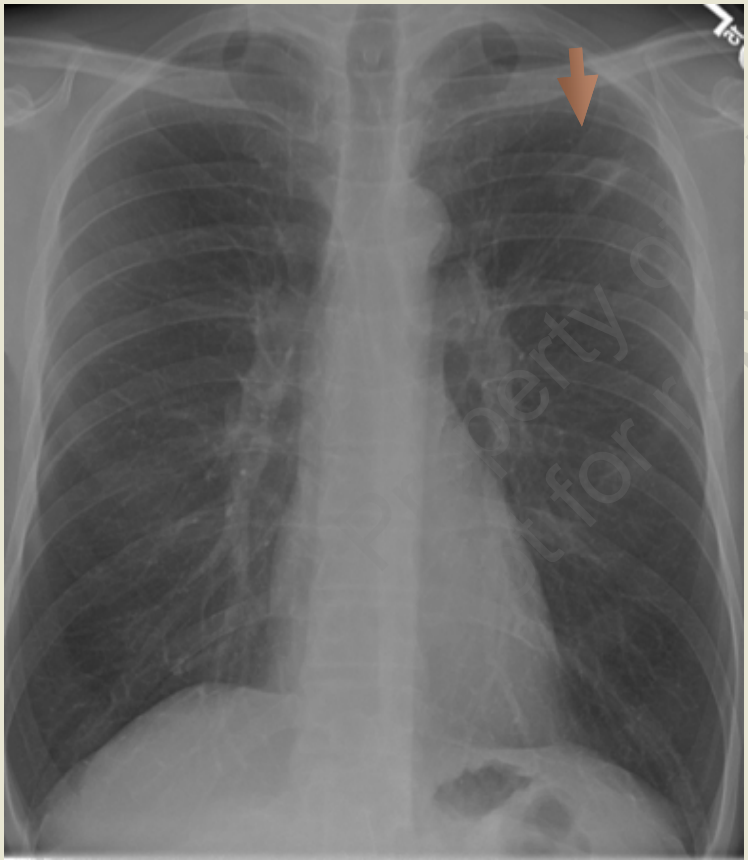
CASE 4 – Focal Solitary Nodule

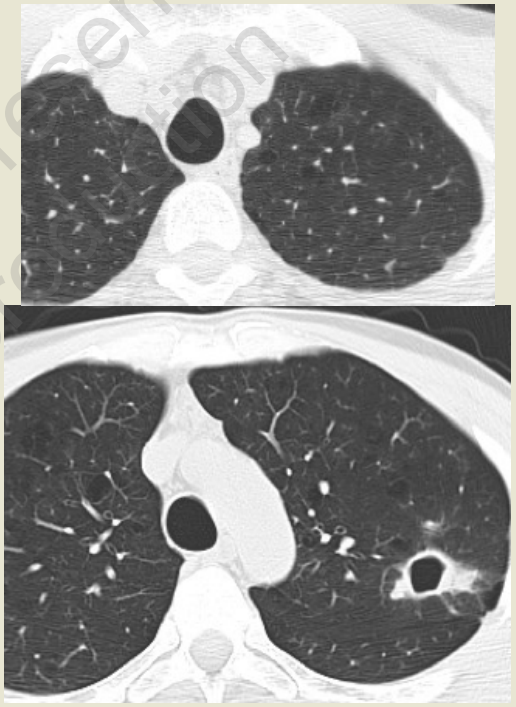
- Uncommon.
- Must still rule out other causes of nodule (*i.e neoplasm)*



I. Nodular Bronchiectatic Type - CASE 5

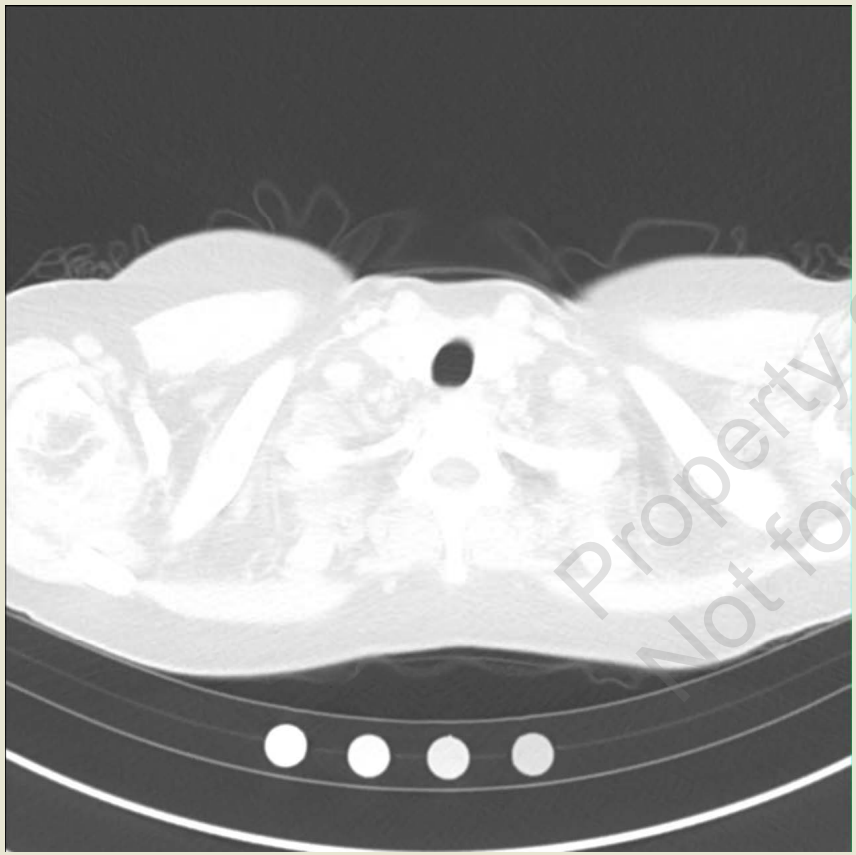
CASE 5 – Focal Solitary "Cavity"

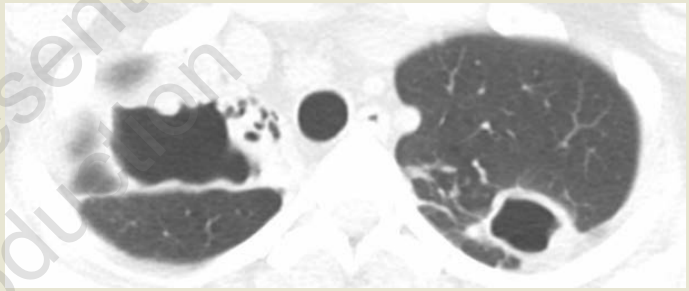


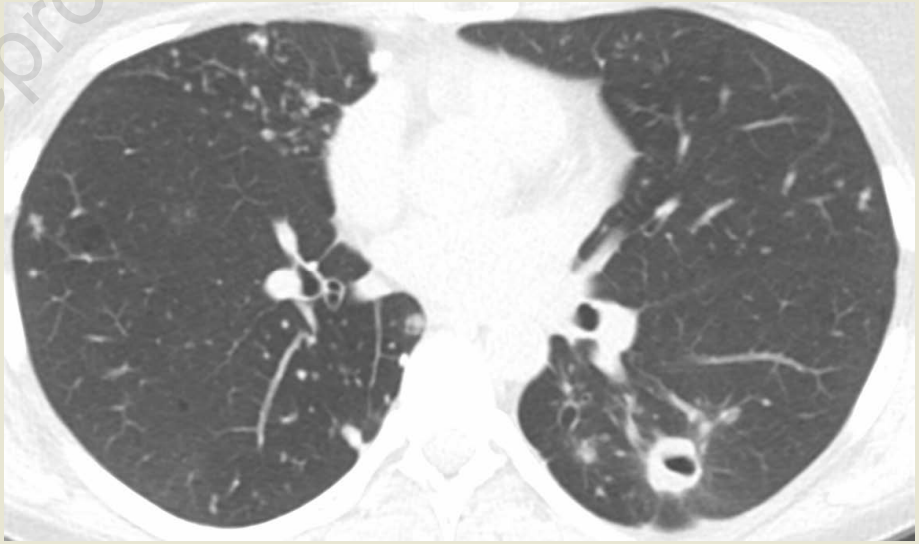


- *Rule out lung cancer*

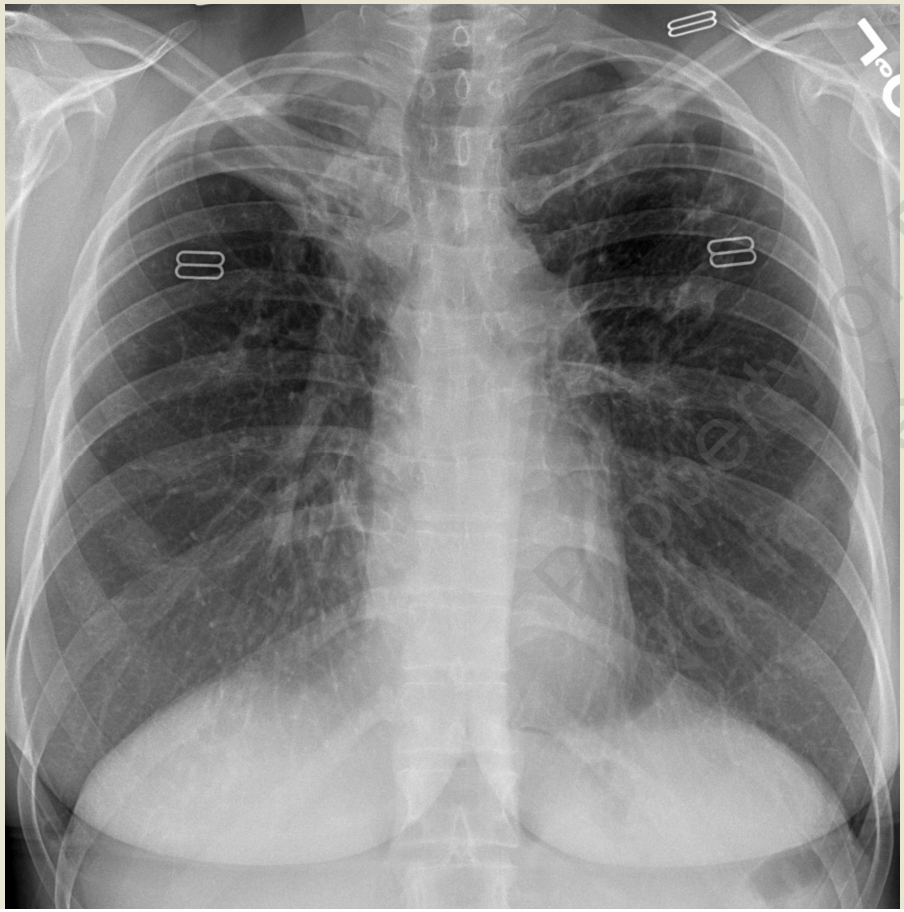
II. Fibrocavitary Type - CASE 1

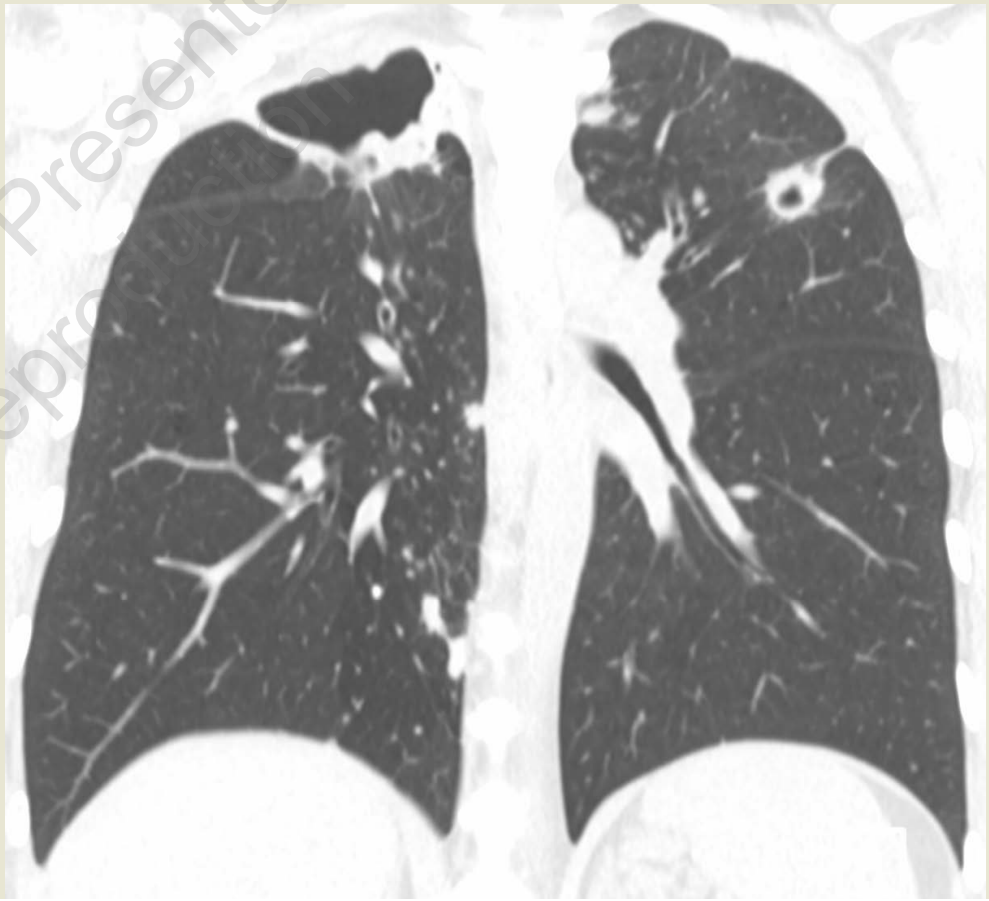






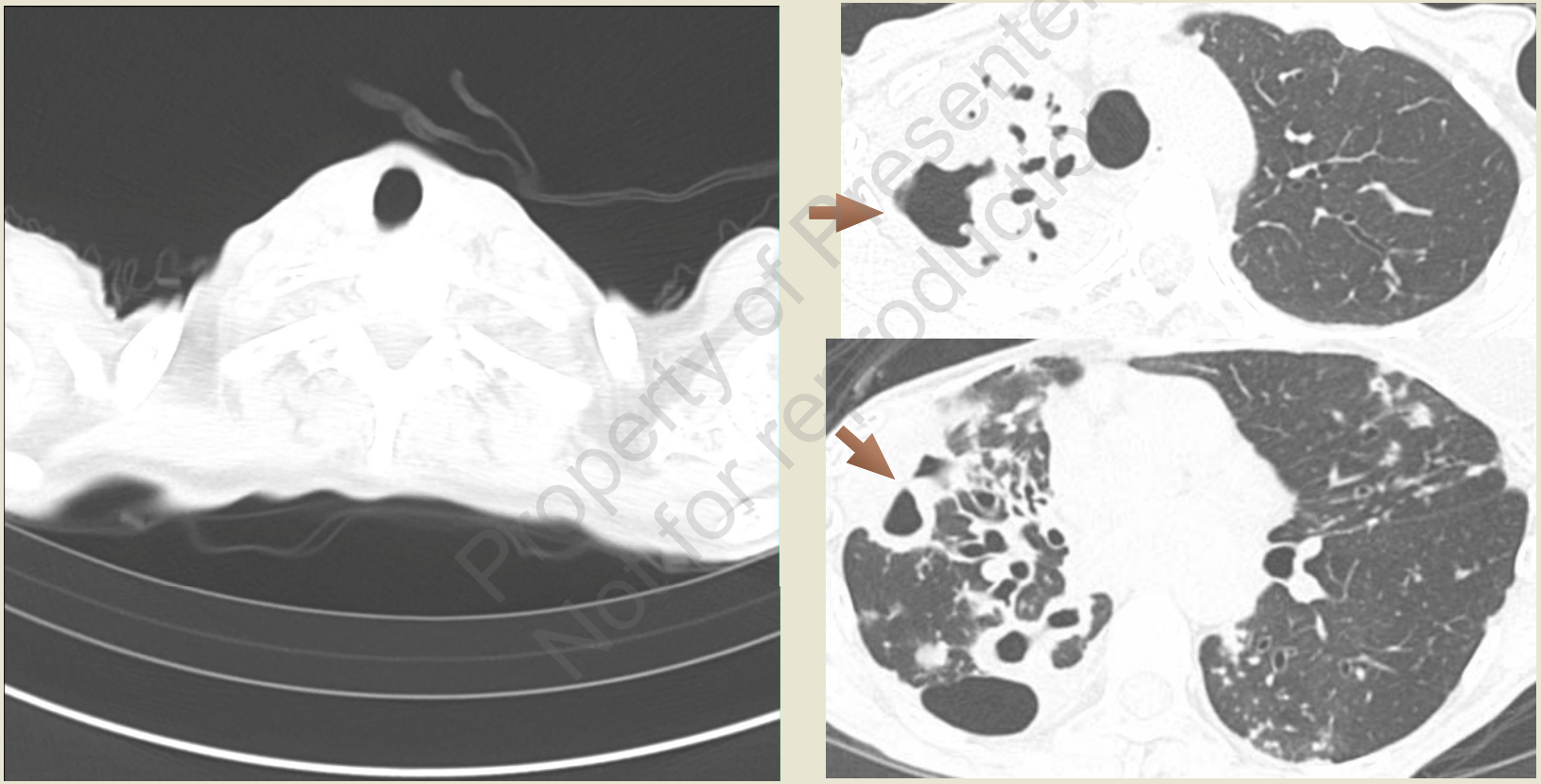
II. Fibrocavitary Type - CASE 1





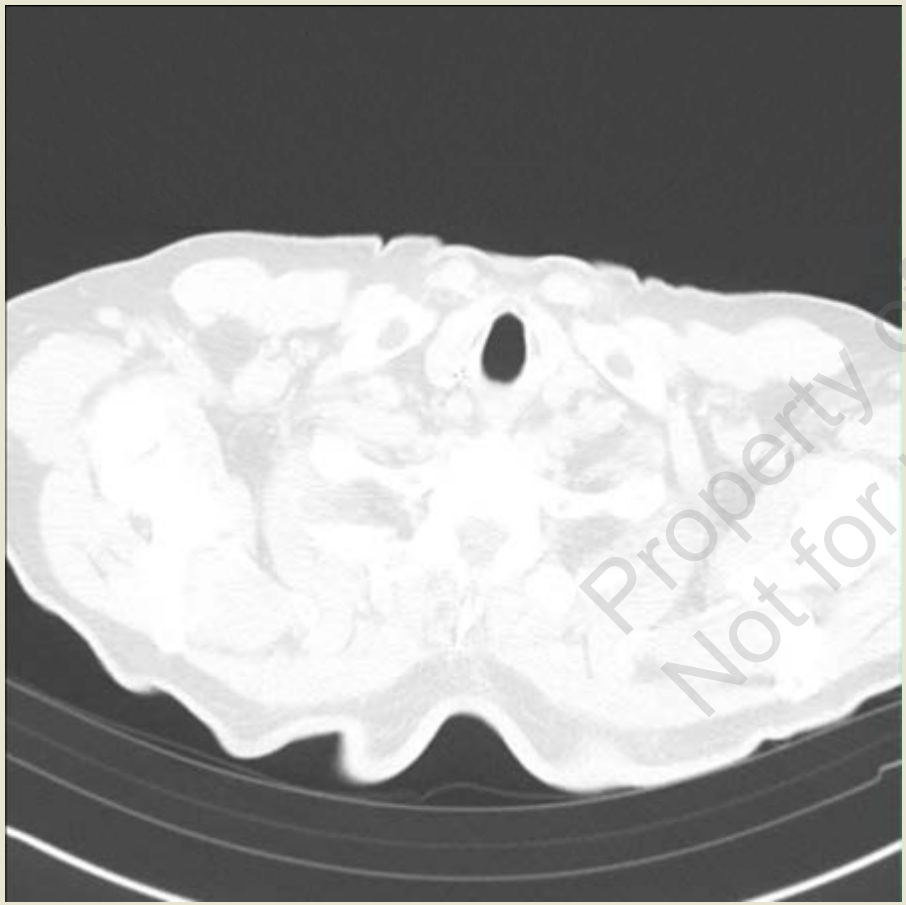
II. Fibrocavitary Type - CASE 2

II. Fibrocavitary Type - CASE 2



CASE 2 - Severe upper lobe cavitary dz.

III. *Hot Tub Lung* ***(Hypersensitivity Pneumonitis)***



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

Overview

I. CT technique

II. NTM imaging signs

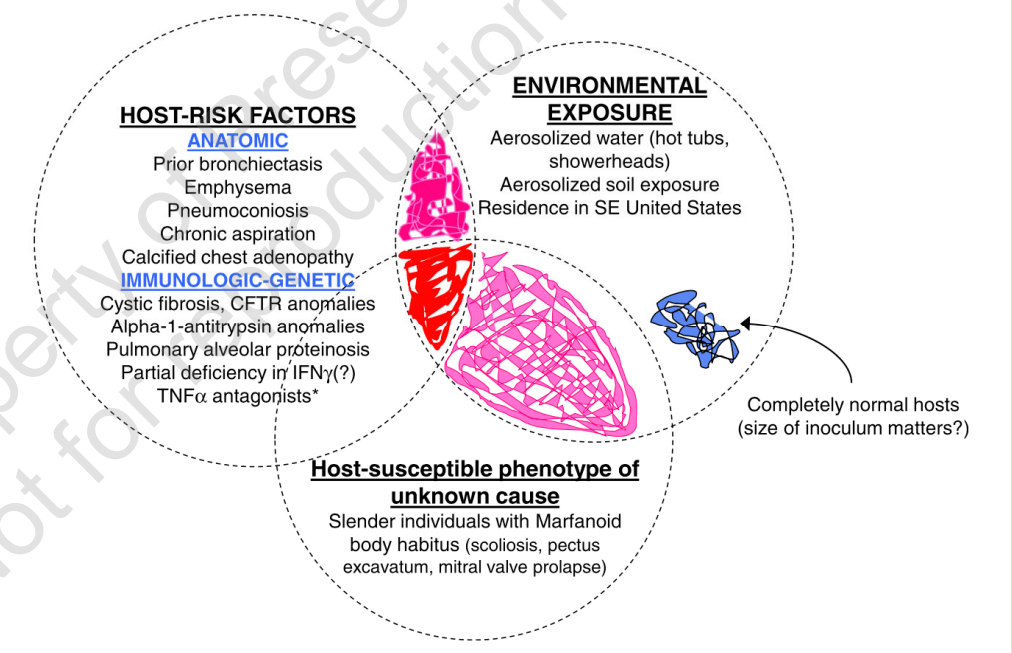
III. Radiological/Clinical Phenotypes

IV. NTM & Underlying Lung Disease

NTM & Underlying Lung Disease

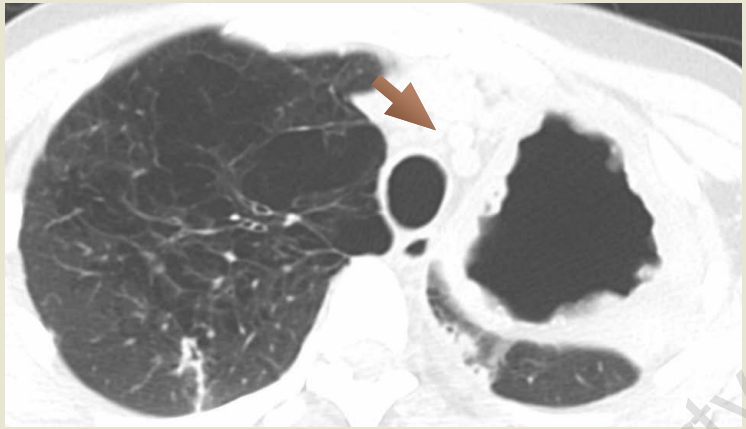
Risk factors for pulmonary NTM

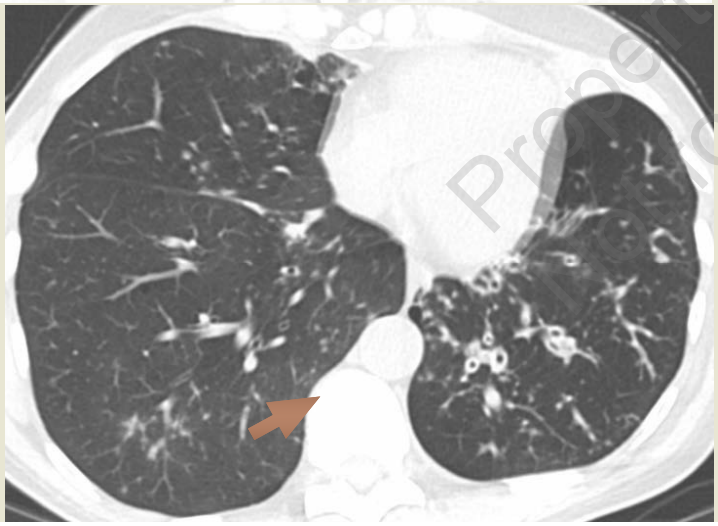
- *Often underlying lung disease*
  - Structural
  - Non-structural
- Radiology also has role also in underlying disease



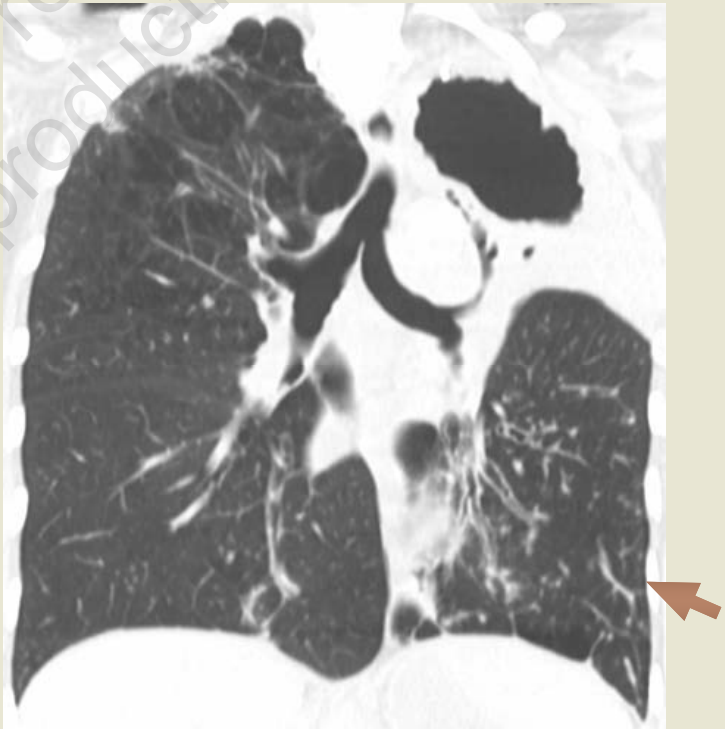
- *Honda et al Clin Chest Med 2015; 36:1-11*

NTM in COPD/Emphysema

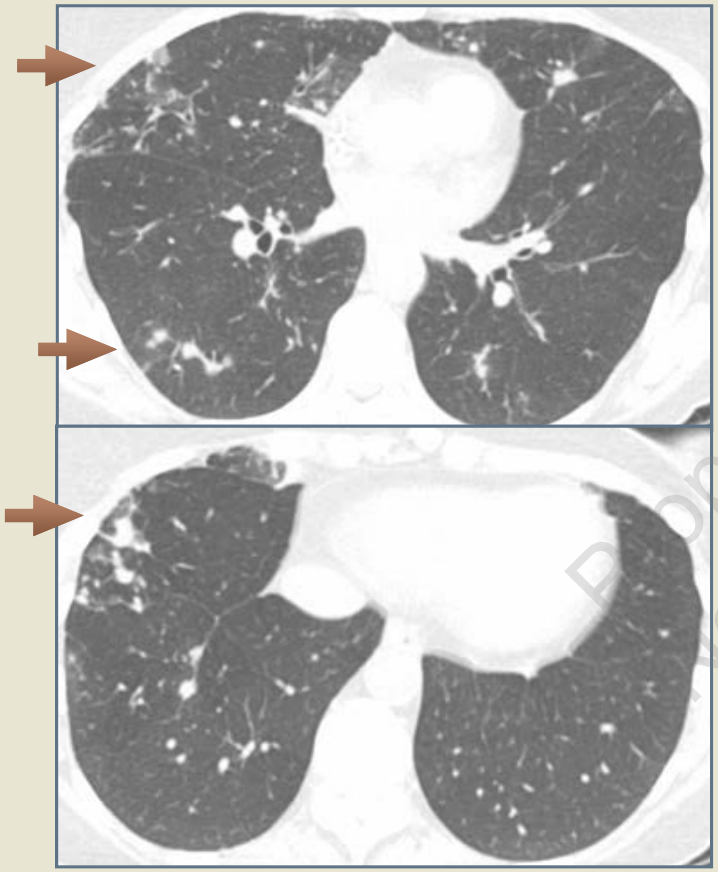




- Cavities can form in emphysema
- Any cavity can “spill” contents leading to worsening disease in lower lung.



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

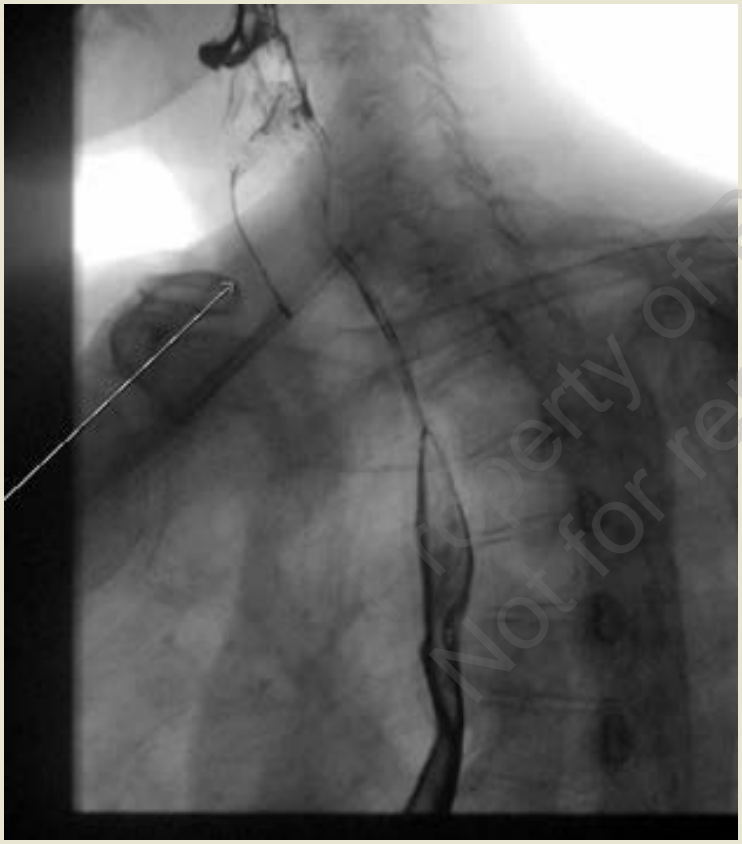
Aspiration Work-up

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

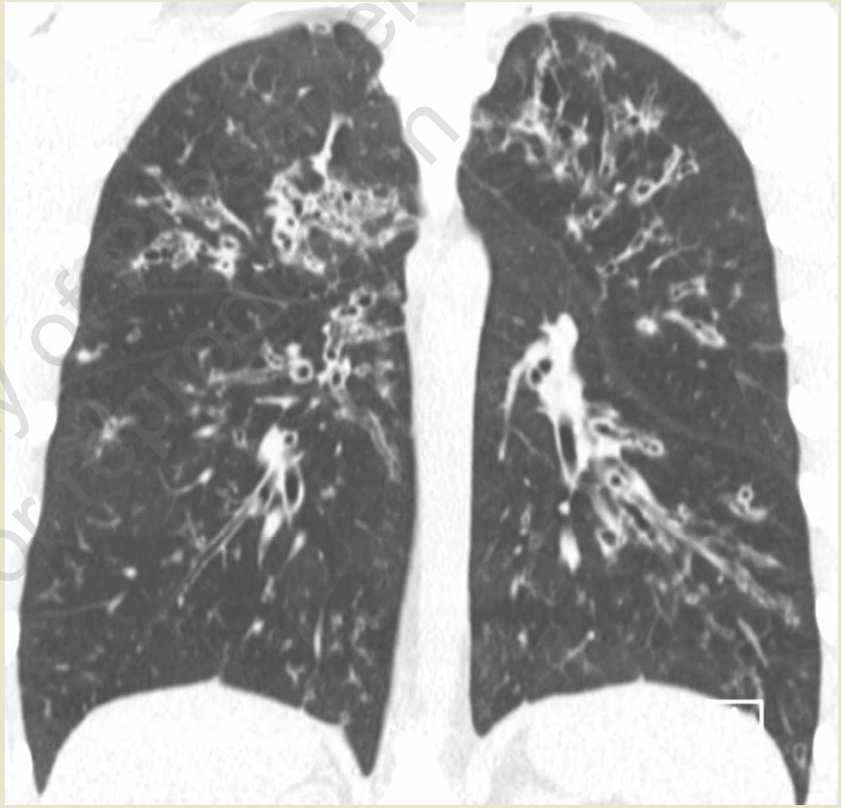
Aspiration Work-up

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

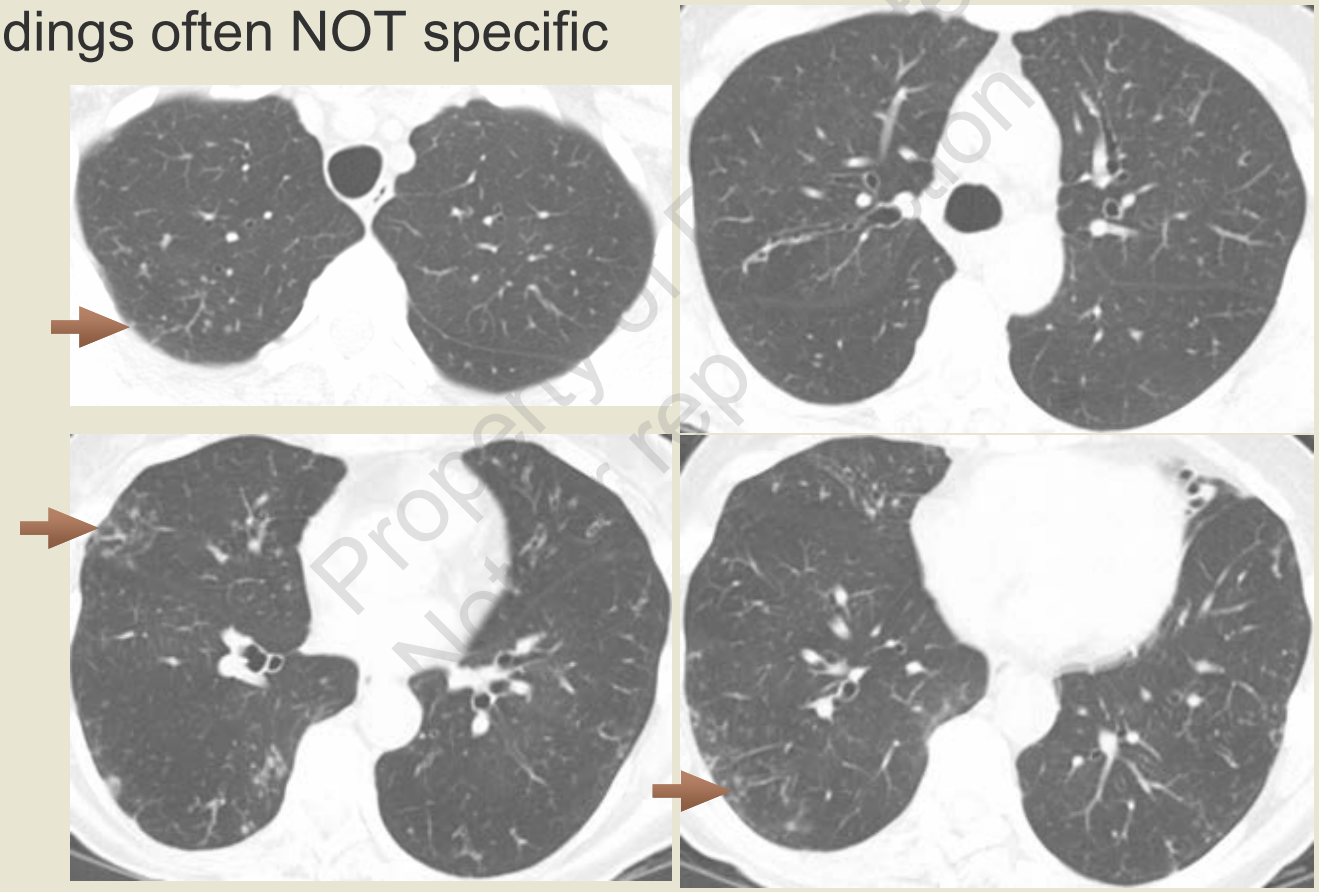
NTM in Adult CF – Case 1



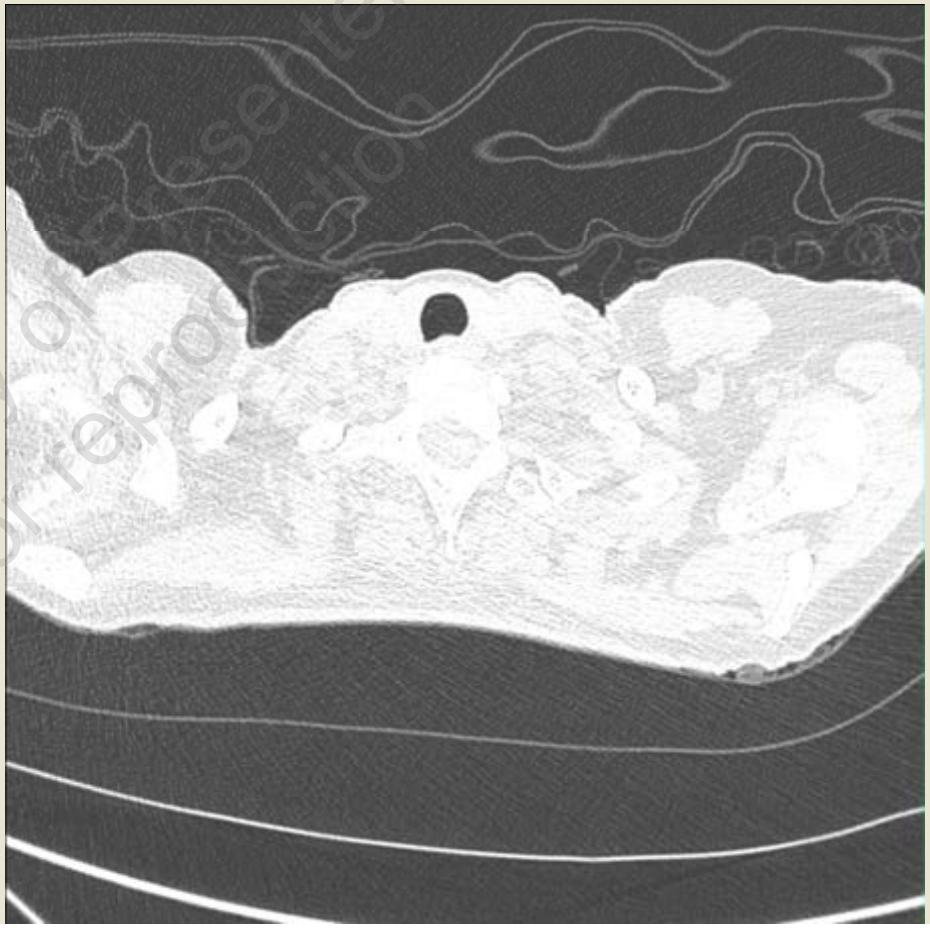
- more “classic” upper lung adult CF

NTM in Adult CF – Case 2

Findings often NOT specific



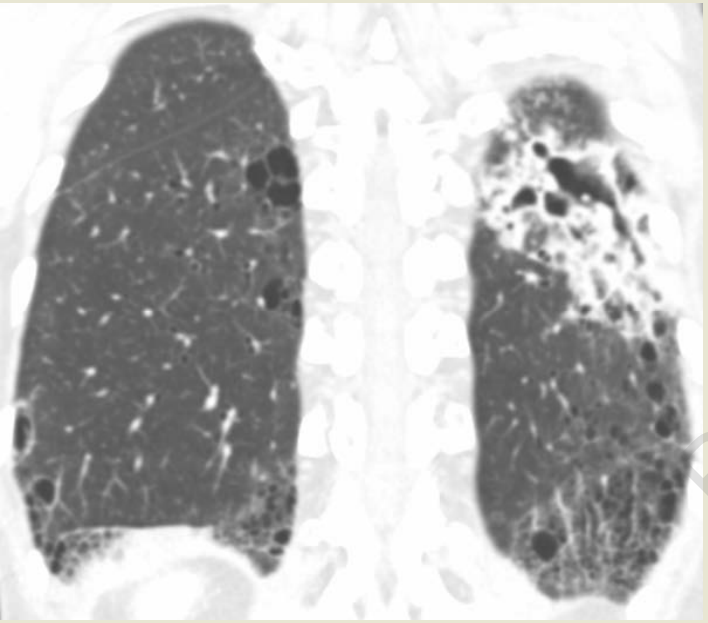
NTM in Alpha 1 Antitrypsin



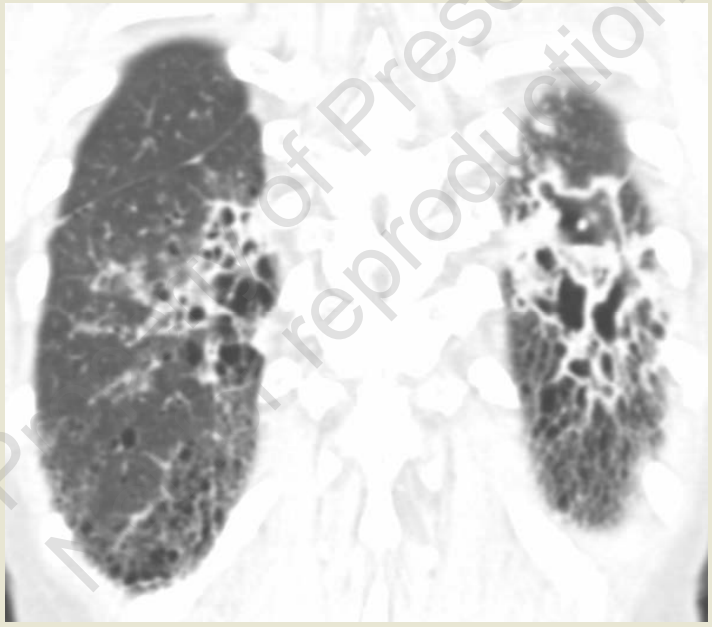
NTM in Pulmonary Fibrosis (Scleroderma ILD)

Presentation | **1 Year Later** | **3 Years Later**

NTM in Pulmonary Fibrosis (Scleroderma ILD)



Presentation

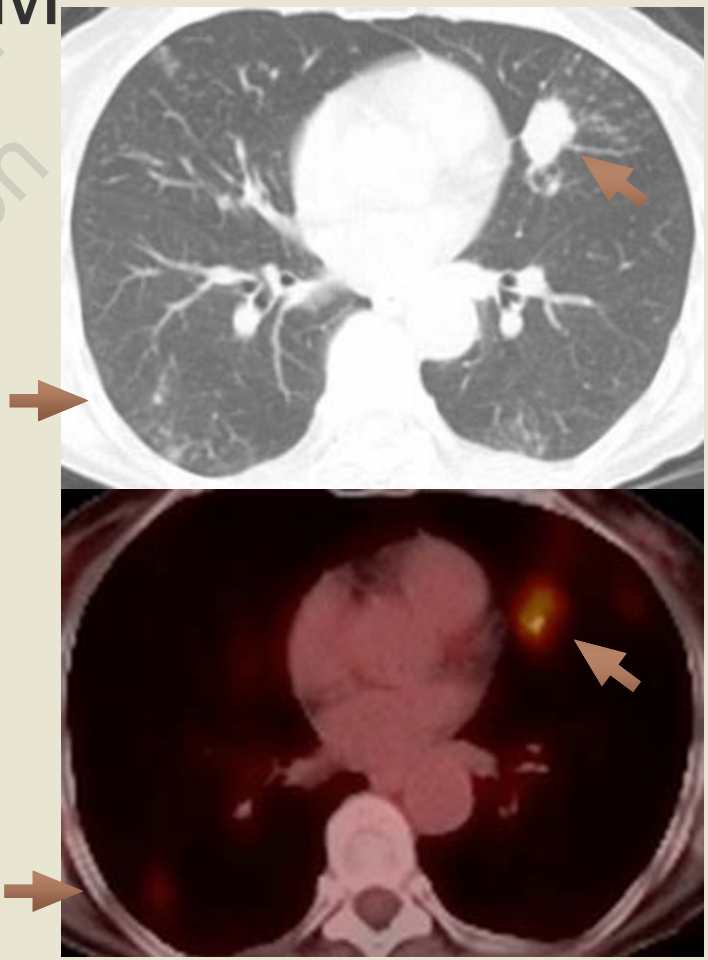


1 Year Later

3 Years Later

PET/CT and NTM

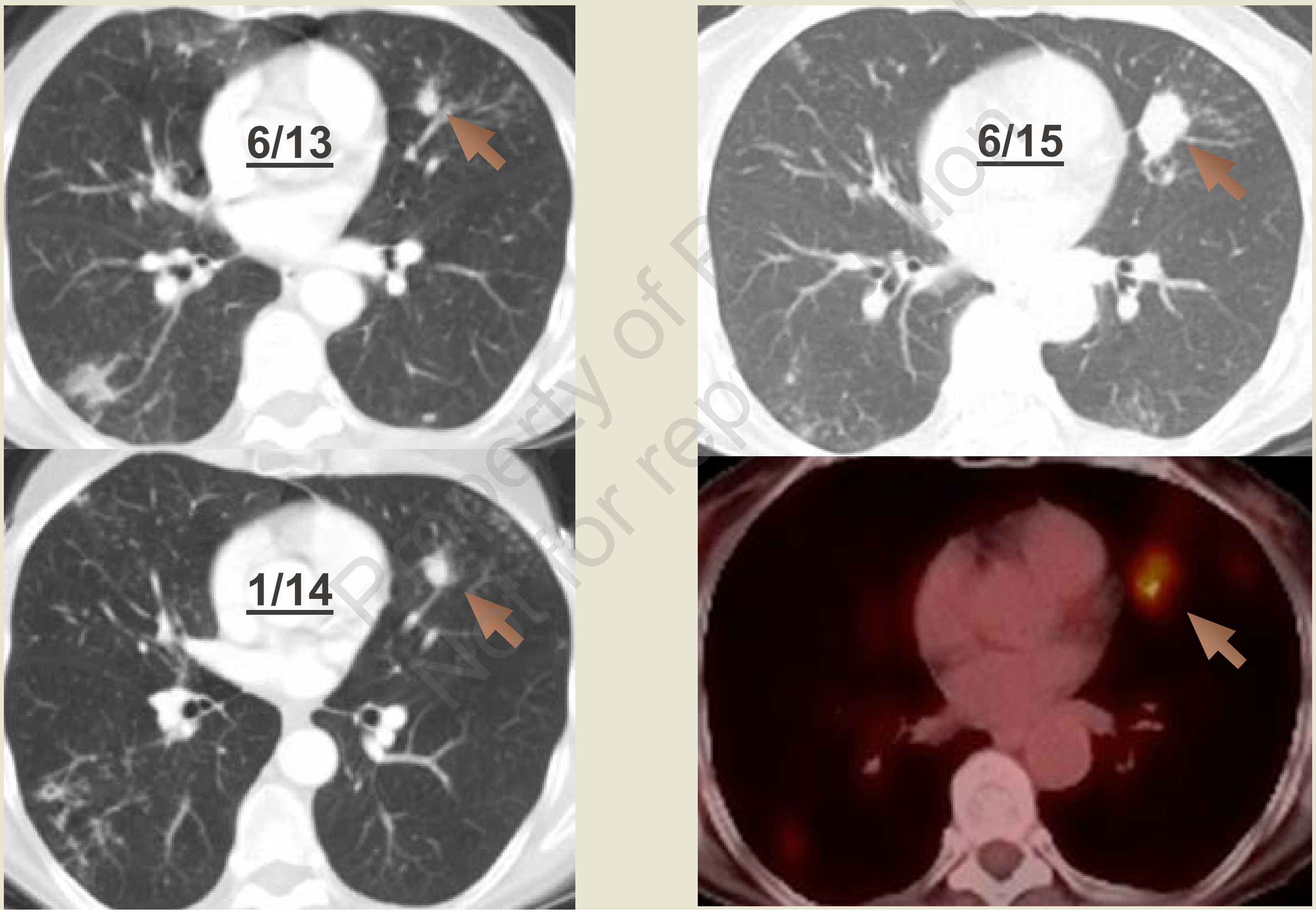
- NTM will cause increased uptake (like most infections)
- SUV typically about 8.5 (4.4-9.7)
- So ***caution*** in evaluating for cancer with NTM



- *Hahm 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 Cavitary 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