

Tuberculosis: Interpretation of chest radiographs

Bob Dickson
July 17, 2019

Tri-State TB Intensive



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**No conflicts, no
disclosures.**



2

Tuberculosis: interpretation of chest radiographs

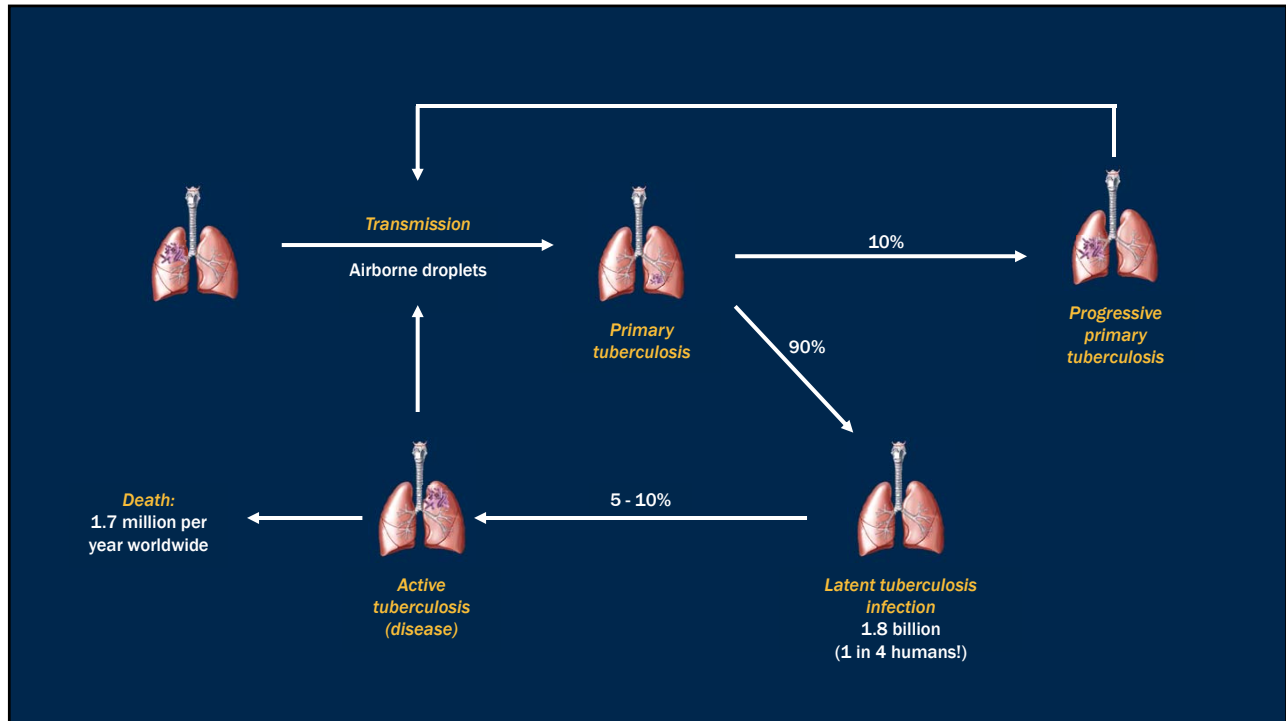
- When do we need chest imaging?
- Modalities of imaging
- Some concepts in chest x-ray interpretation
- The common manifestations of tuberculosis on chest x-rays

3

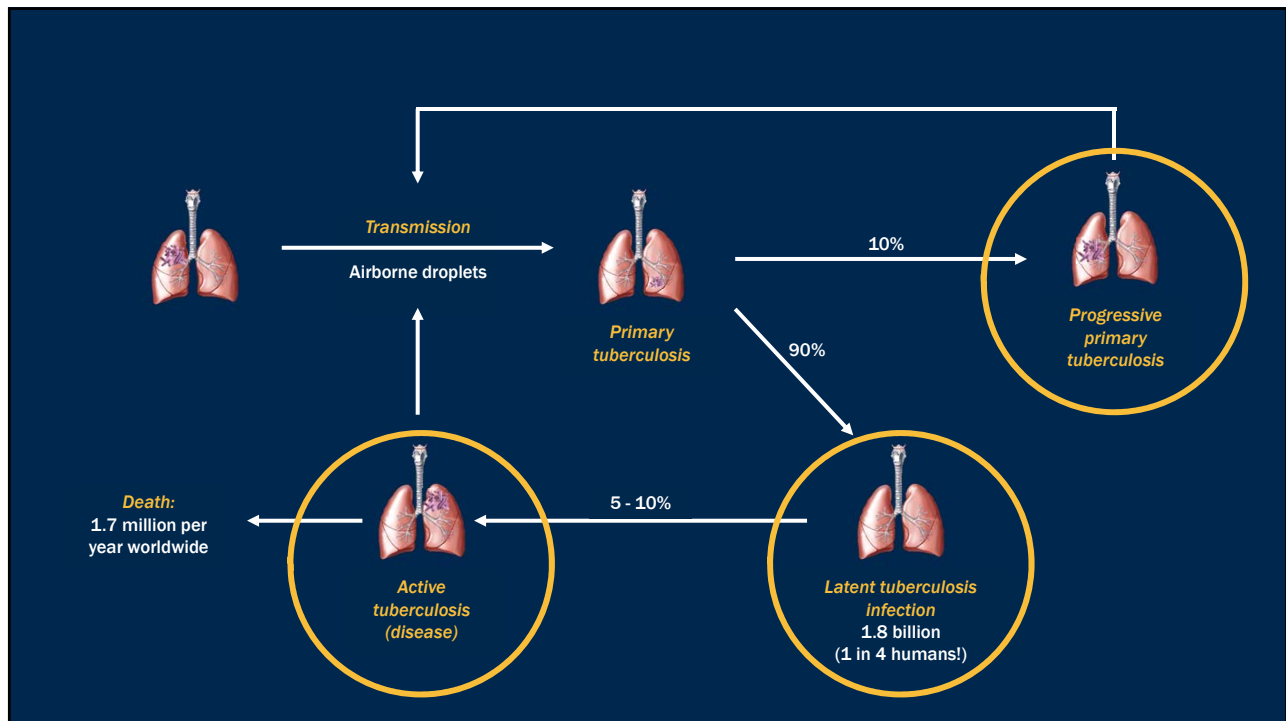
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Latent tuberculosis cannot be diagnosed in a patient with TB-compatible **symptoms** or **imaging**.

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Chest x-ray

Chest CT

Extrapulmonary
imaging

10

Chest x-ray

Chest CT

**Extrapulmonary
imaging**

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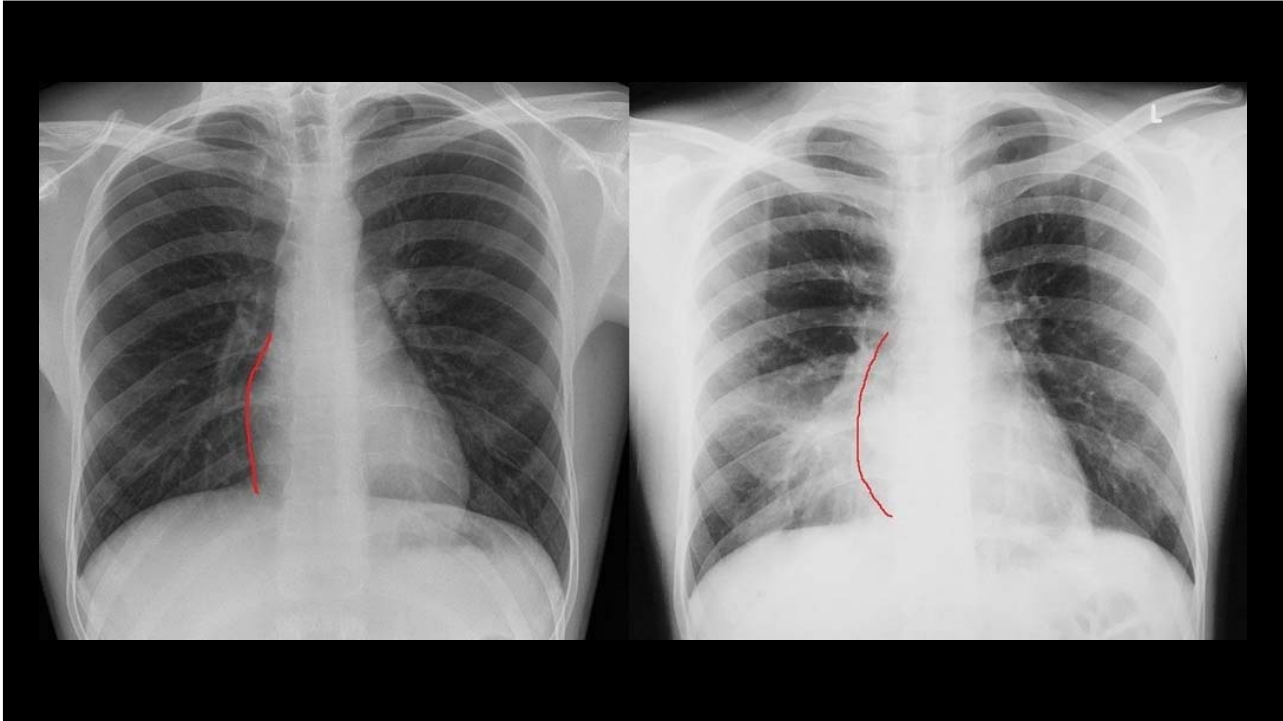
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- “Unsupervised” vs “supervised” interpretation
- “Atomistic” vs “holistic” interpretation
- “Book smarts” vs “street smarts”
- “Set yourself up for success”
- The importance of the interface
- “One view is no view”

Key concepts in chest x-ray interpretation

14



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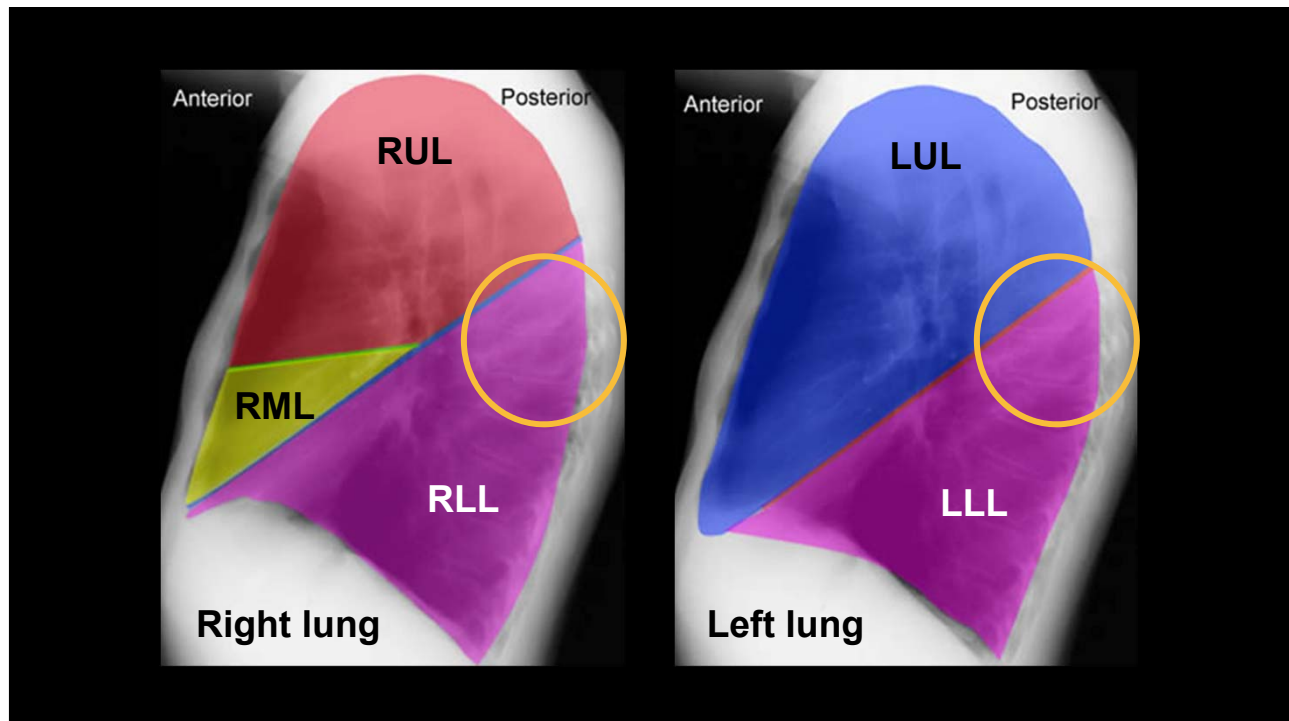


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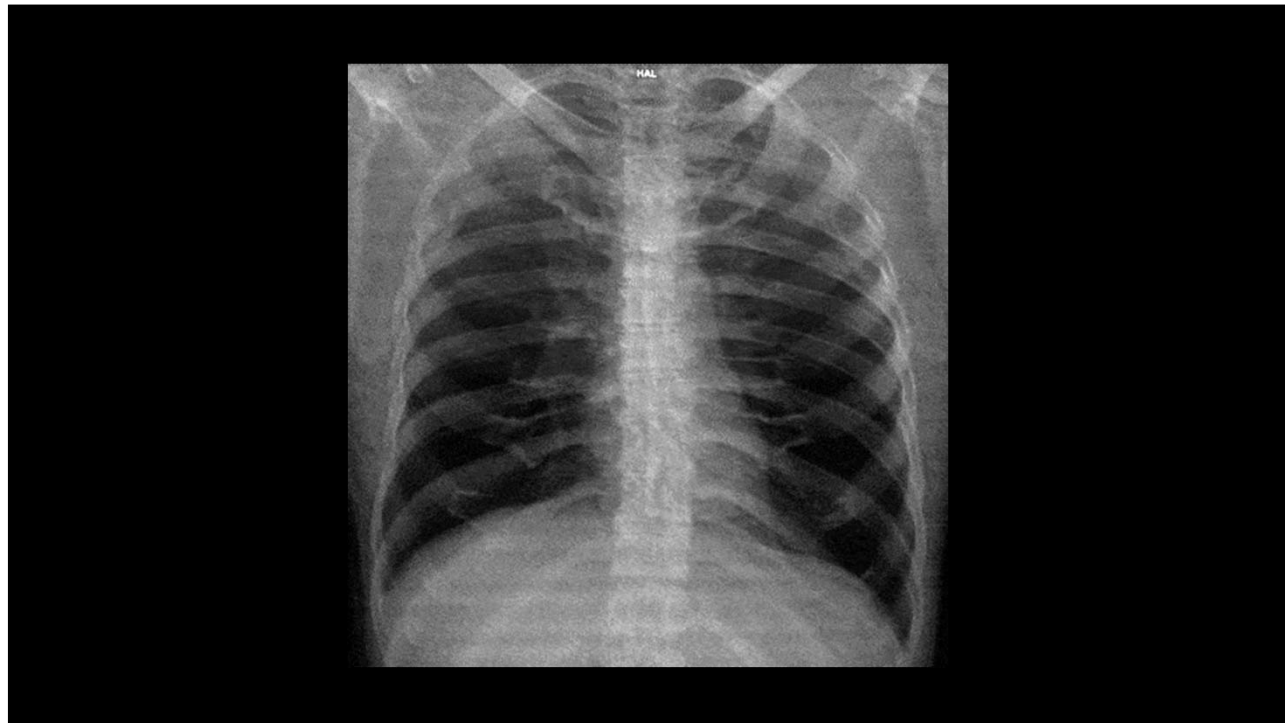
“One view is no view”



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Utility of the Lateral Chest Radiograph in the Evaluation of Patients With a Positive Tuberculin Skin Test Result*

Marianne Meyer, MD, Peter Clarke, MD, and Anthony W. O'Regan, MD

Study objectives: In the United States, chest radiographs are performed on patients with positive tuberculin skin test (TST) results. It is not known whether, in addition to a single posteroanterior radiograph, a lateral chest radiograph is clinically indicated or cost-effective. We sought to determine the utility of the lateral chest radiograph in evaluating TST-positive adults.

Design: Cross-sectional study.

Setting: Tertiary-care hospital.

Patients: Adults with positive TST results.

Measurements: Findings on posteroanterior radiographs alone were compared to posteroanterior and lateral chest radiographs.

Results: In 2 of 533 cases (0.4%), lateral chest radiographs revealed a calcified granuloma not visible on posteroanterior radiographs. This finding did not alter patient management. In all other cases, lateral radiographs only confirmed findings seen on posteroanterior chest radiographs.

Conclusion: Treatment altering findings were always visible on posteroanterior radiographs alone. These results suggest that lateral chest radiographs are not useful in evaluating adults with positive TST results.

Key words: chest radiograph, screening, tuberculosis.

Abbreviations: ATS = American Thoracic Society; CDC = Centers for Disease Control and Prevention; CI = confidence interval; LTR = lateral tuberculin infection; nts = subcutaneous TST = tuberculin skin test.

Tuberculosis screening is central to the control of Mycobacterium tuberculosis transmission in the United States. The recommended practice for evaluating tuberculin skin test (TST)-positive patients includes routine screening by chest radiography to rule out clinically active tuberculosis or to detect the presence of fibrotic lesions suggestive of old tuberculosis.¹ In a recent joint statement, the American Thoracic Society (ATS) and Centers for Disease Control and Prevention (CDC) recommended the use of a single posteroanterior radiograph for all TST-positive adults and children ≥ 5 years of age.² In fact, no study has compared the sensitivity of posteroanterior and lateral chest radiographs to posteroanterior chest radiographs alone in the evaluation of patients with a positive TST result. Therefore it is unclear if a posteroanterior and lateral chest radiograph or a single posteroanterior chest radiograph is required for screening purposes. In the setting of limited health-care resources and budgetary constraints in tuberculosis control programs, elimination of the lateral chest radiograph in routine screening of TST-positive patients could have a substantial economic impact and could lead to a significant reduction in radiologic exposure. The present study was designed to evaluate the additional benefit of routine screening lateral chest radiographs in an urban population of high-risk, TST-positive subjects.

MATERIALS AND METHODS

Patients

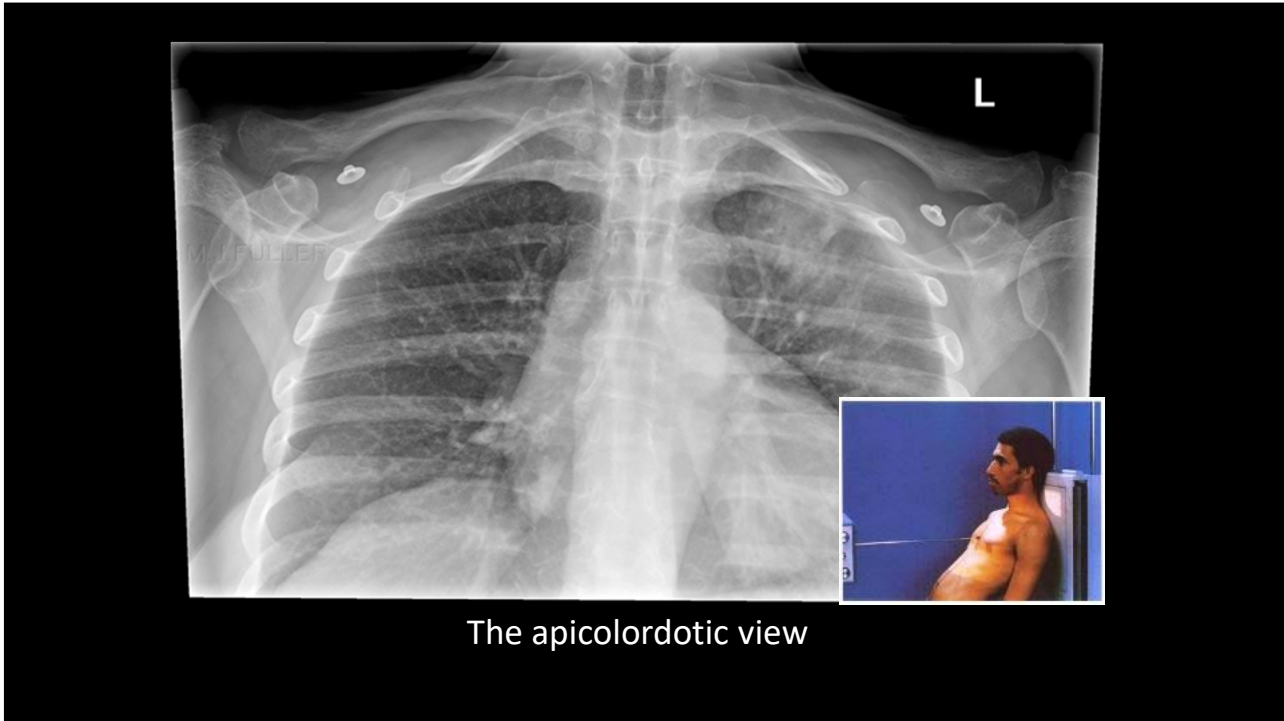
All adult patients who were seen at the Boston Tuberculosis Control Program Clinic at Boston Medical Center for a positive TST result between January 2000 and March 2000 were included in the study. The Boston Tuberculosis Control Program Clinic serves an inner-city population with a high case load of recent immigrants who are targeted for TST based on ATSCDC guidelines. Patients undergoing screening at this clinic routinely undergo posteroanterior and lateral chest radiographs as part of

Table 2—Abnormal Findings on Chest Radiographs

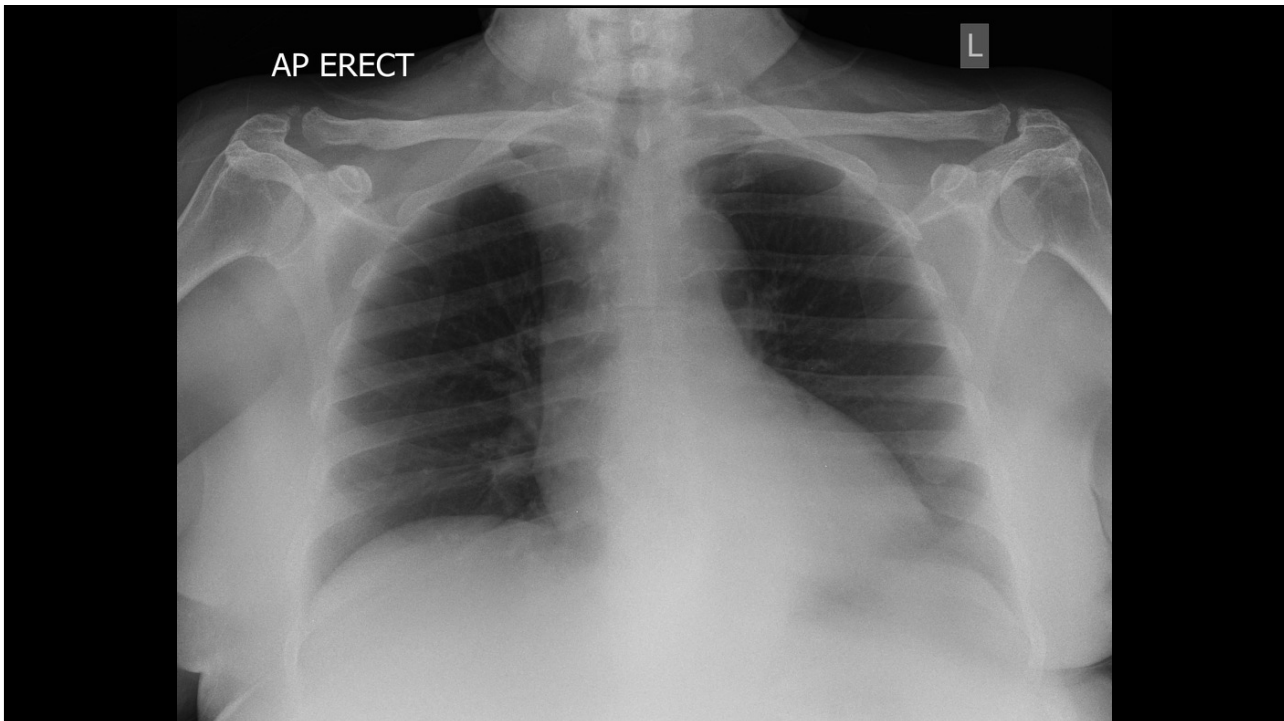
Findings	Abnormal Posteroanterior Radiograph, No.	Normal Posteroanterior/Abnormal Lateral Radiograph, No.
Fibrosis	59	0
Granuloma	11	2
Consolidation	4	0
Cavitation	2	0
Calcified lymph nodes	3	0
Pleural disease*	2	0
Total	81	2

*Without evidence of fibrosis.

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What CXR features do you look for?

Apical infiltrates (70 - 90%)

Cavities (20 - 40%)

Hilar adenopathy (<20%)

Mid/lower lung infiltrates (<15%)

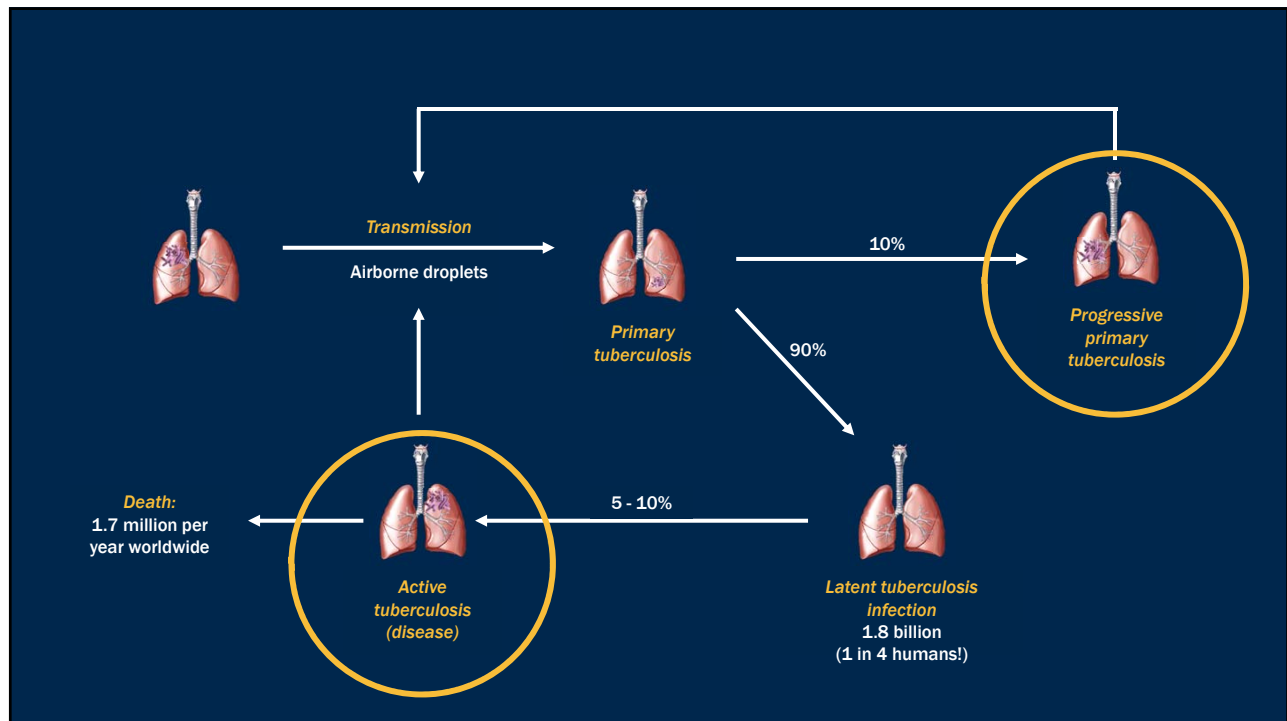
“Healed” scars (<5%)

Normal (10 - 20%)

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A normal CXR **does not exclude** active TB!

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Primary TB

- Mid- and lower-lung predominant
- Cavitation uncommon
- Lymphadenopathy is prominent

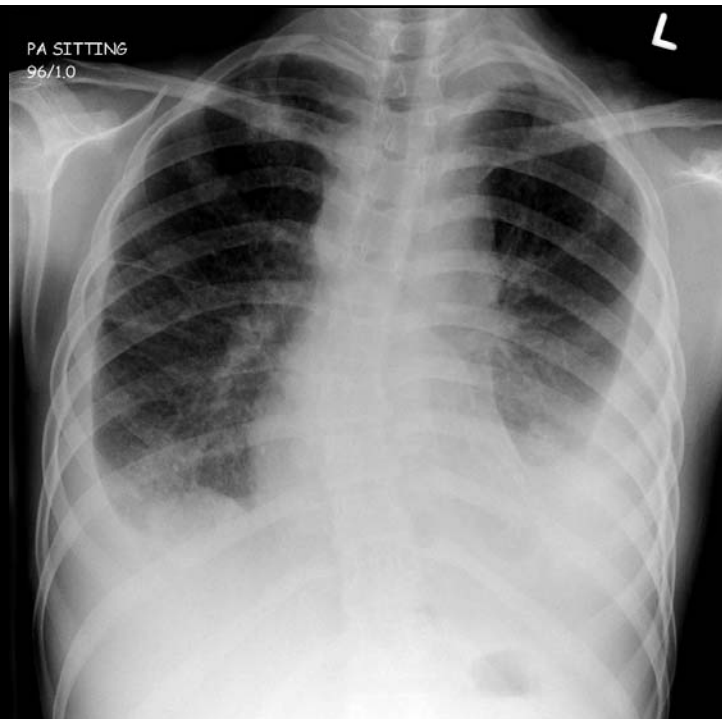
Reactivation (post-primary) TB

- Upper-lobe predominant
- Cavitation common
- Lack of lymphadenopathy

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- Mid- and lower-lung predominant
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Frank Gaillard, Radiopaedia.org, rID: 8741

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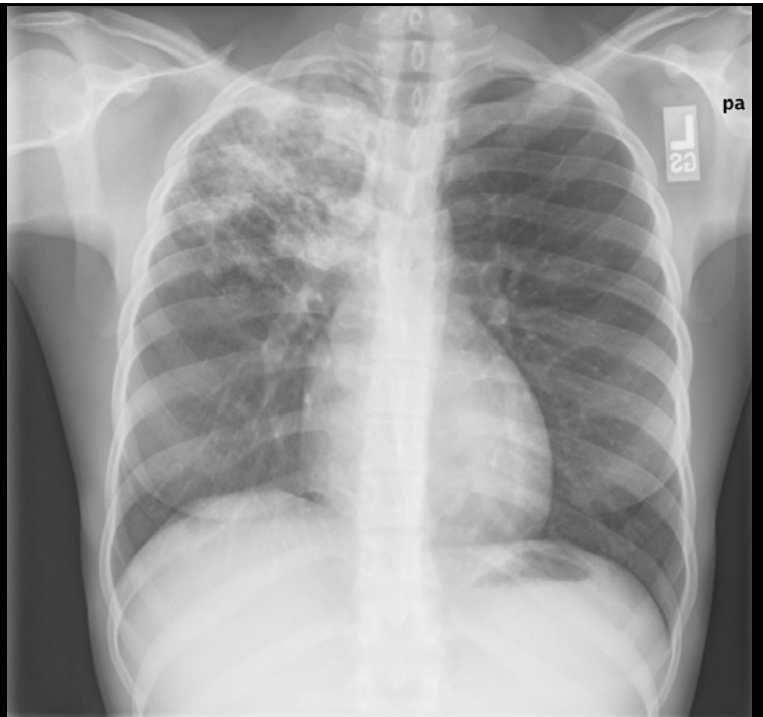


Frank Gaillard, Radiopaedia.org, rID: 12569

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Reactivation (post-primary) TB

- Upper-lobe predominant
- Cavitation common
- Lack of lymphadenopathy



Frank Gaillard, Radiopaedia.org, rID: 8632

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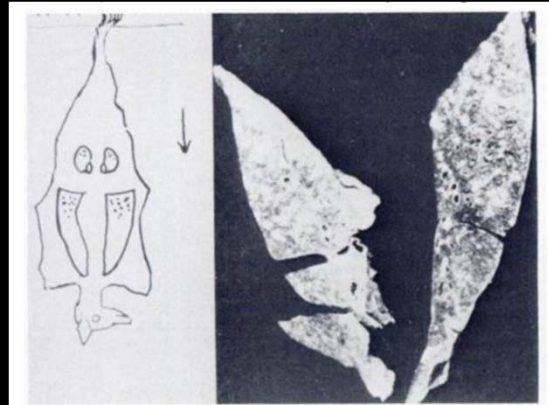
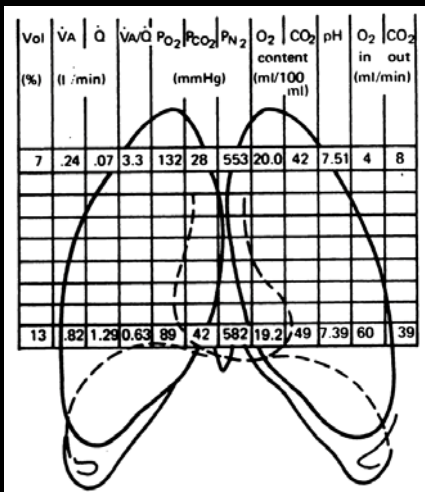


FIGURE 11. Localization of pulmonary tuberculosis at bases of lung in bat, which spends much of its time upside down (from Rothlin and Undritz¹⁷).

West, JB. "Regional differences in the lung." *Chest* 74.4 (1978): 426-437.

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Miliary TB

- Diffuse micronodules
- Represents disseminated infection



Lee-Anne Slater, Radiopaedia.org, rID: 14542

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ORIGINAL CONTRIBUTION

Clinical and Radiographic Correlates of Primary and Reactivation Tuberculosis: A Molecular Epidemiology Study

Elvin Gong, MD, MPH
Barry Kreiswirth, PhD
Joe Buzarski, MD, MPH
Neil W. Schluger, MD

CONTEXT The traditional teaching that pulmonary tuberculosis characterized by lymphadenopathy, effusions, and lower or mid lung zone infiltrates on chest radiography represents "primary" disease from recently acquired infection, whereas upper lobe infiltrates and cavities represent secondary or reactivation disease acquired in the more distant past, is not based on well-established clinical evidence. Furthermore, it is not known whether the atypical radiograph common in human immunodeficiency virus (HIV)-associated tuberculosis is due to a preponderance of primary progressive disease or altered immunity.

OBJECTIVE To analyze the relationship between recently acquired and remotely acquired pulmonary tuberculosis, clinical and demographic variables, and radiographic features by using molecular fingerprinting and conventional epidemiology.

DESIGN, SETTING, AND POPULATION A retrospective, hospital-based series of 456 patients treated at a New York City medical center between 1990 and 1999. Eligible patients had to have had at least 1 positive respiratory culture for *Mycobacterium tuberculosis* and available radiographic data.

MAIN RESULTS Radiographic appearance as measured by the presence or absence of 6 features: upper lobe infiltrate, cavity lesion, adenopathy, effusions, lower or mid lung zone infiltrate, and milary pattern. Radiographs were considered typical if they had an upper lobe infiltrate or cavity whether or not other features were present. Atypical radiographs were those that had adenopathy, effusion, or mid lower lung zone infiltrates or had none of the above features.

RESULTS Human immunodeficiency virus infection was most commonly associated with an atypical radiographic appearance on chest radiograph with an odds ratio of 0.20 (95% confidence interval, 0.13-0.31). Although a clustered fingerprint, representing recently acquired disease, was associated with typical radiograph in univariate analysis (odds ratio, 0.68; 95% confidence interval, 0.47-0.99), the association was lost when adjusted for HIV status.

CONCLUSIONS Time from acquisition of infection to development of clinical disease does not reliably predict the radiographic appearance of tuberculosis. Human immunodeficiency virus status, a probable surrogate for the integrity of the host immune response, is the only independent predictor of radiographic appearance. The altered radiographic appearance of pulmonary tuberculosis in HIV is due to altered immunity rather than recent acquisition of infection and progression to active disease.

JAMA. 2005;293:2740-2745. www.jama.com

Author Affiliations are listed at the end of this article.
Corresponding Author: Neil W. Schluger, MD, Division of Pulmonary, Allergy, and Critical Care Medicine, Columbia University Medical Center, 620 W 168th St, Box 1048, New York, NY 10032 (nws11@columbia.edu).

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Table 2. Radiographic Characteristics in Patients With Pulmonary Tuberculosis

	No. (%) of Total Patients	
	Present	Absent
Cavitary lesion	131 (28.7)	325 (71.3)
Upper lobe infiltrate	266 (58.3)	190 (41.7)
Lymphadenopathy	103 (22.6)	353 (77.4)
Effusion	90 (19.7)	366 (80.2)
Effusion only	26 (5.7)	430 (94.3)
Middle or lower lobe infiltrate	187 (41.0)	269 (59.0)
Milary	24 (5.3)	432 (94.7)
Typical	276 (60.5)	180 (39.5)

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Table 4. Univariate Analysis of Association Between Typical Radiographic Features and Social, Demographic, and Clinical Predictors

	No. (%)		OR (95% CI)	P Value
	Typical Radiograph (n = 266)	Atypical Radiograph (n = 190)		
Any drug resistance	28 (10.5)	10 (5.26)	2.11 (1.00-4.47)	.05
Age >60 y	51 (19.2)	24 (12.6)	1.64 (0.97-2.78)	.06
Clustered RFLP	127 (47.7)	109 (57.4)	0.68 (0.47-0.99)	.04
IV drug use*	26 (22.2)	22 (30.56)	0.64 (0.33-1.26)	.20
Non-US born	104 (39.1)	59 (31.1)	1.42 (0.96-2.11)	.08
HIV-infected†	77 (38.7)	114 (74.5)	0.21 (0.13-0.34)	<.001
Homelessness‡	37 (14.5)	27 (14.6)	1.00 (0.58-1.70)	.98
Isoniazid resistance	26 (9.8)	10 (5.3)	1.95 (0.92-4.15)	.08
Multidrug resistant	11 (4.14)	7 (3.68)	1.13 (0.43-2.96)	.80
Race or ethnicity				
Asian	10 (3.8)	5 (2.6)	1.44 (0.49-4.30)	.50
Hispanic	124 (46.6)	81 (42.6)	1.18 (0.81-1.71)	.40
Black	116 (43.6)	86 (45.3)	0.94 (0.64-1.36)	.73
White	16 (6.02)	18 (9.5)	0.61 (0.30-1.23)	.17
Men	79 (29.7)	60 (31.6)	0.91 (0.61-1.37)	.67
Year of diagnosis before 1995	103 (38.7)	65 (34.2)	1.20 (0.82-1.79)	.32

Abbreviations: CI, confidence interval; HIV, human immunodeficiency virus; IV, intravenous; OR, odds ratio; RFLP, restriction fragment length polymorphism.
*Status unknown for 267 participants, for a denominator of 117 among those with a typical radiograph and 72 for those with an atypical radiograph.
†Status unknown for 104 participants, for a denominator of 199 for those with a typical radiograph and 153 for those with an atypical radiograph.
‡Status unknown for 16 participants, for a denominator of 255 for those with a typical radiograph and 185 for those with an atypical radiograph.

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What are some **CT** features of **active TB**?

Cavities, consolidation, lymphadenopathy, ground glass infiltrate, tree-in-bud opacities, semisolid nodule, multiple nodules, pleural effusion...

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If a radiologist says a finding is “consistent with **atypical** mycobacterial disease”...

...it is also consistent with **typical** mycobacterial disease!

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