According to the WHO, tuberculosis is one of the top ten causes of death worldwide. Approximately one fourth of the world’s population is infected with *Mycobacterium tuberculosis*. Most have asymptomatic or latent disease that is well controlled by the immune system, but around 10% of people will progress to active disease during their lifetime, with immunocompromised people at highest risk (HIV infection, diabetes mellitus, malnutrition, malignancy, etc.). In 2017, 10 million people developed active tuberculosis infection and 1.6 million died.

Multi drug-resistant tuberculosis (MDR-TB), which is resistant to at least isoniazid and rifampin, and extensively drug-resistant tuberculosis (XDR-TB) which is additionally resistant to several second line agents, pose a grave public health threat.

The high global burden of disease and worsening drug resistance, highlight the importance of optimizing treatment and monitoring strategies for patients infected with tuberculosis.

### Chest X-Ray Scoring

- Chest x-rays are an invaluable tool for the diagnosis of active pulmonary tuberculosis, especially in low resource settings. While reactivation tuberculosis typically presents as upper lobe cavitary disease, there is great variability in the chest x-ray findings of pulmonary tuberculosis.
- There have been many attempts at developing scoring systems for chest x-rays for tuberculosis patients. For example, the Wilcox scoring system found a correlation between severity of chest x-ray findings and subsequent development of chronic obstructive airways disease. This system was more qualitative than quantitative and only graded chest x-ray severity Grades 1-3.
- In 2016, the Timika X-ray score was developed which assigned a numerical value based on chest x-ray severity which correlated with a positive tuberculosis smear after 2 months of treatment.
- Chest X-rays collected from a cohort of approximately 250 adult patients receiving treatment for pulmonary tuberculosis at Sasson General Hospital in Pune, India were reviewed and scored using the Timika X-ray Score. These data were collected as part of the Cohort for Tuberculosis Research by the Indo-US Medical Partnership (CTRUMPH) which aims to better understand local epidemiology and strengthen research capacity.

### Pitfalls

- The Timika X-ray Score involves calculating the total area of lung involvement from 0% involvement to 100% involvement. The right lung represents 60% of the lungs and the left lung represents 40%. After calculating the percentage area involved, you add 40 points for the presence of a cavity, giving you a maximal score of 140.
- Chest x-rays were obtained from patients at diagnosis, after 2 months of treatment, after 6 months of treatment, and at treatment relapse as needed.
- Two readers independently scored all chest x-rays and any significant discrepancy in scoring was resolved by a third chest x-ray reader.
- This chest x-ray shows extensive involvement of pulmonary tuberculosis.
- Starting with the right lung, A the top third has minimal involvement but the lower two thirds are fully involved. Since the right lung is 60% of the total lung area, the right lung shows 40% total lung involvement.
- On the left side, the middle one third is showing patchy involvement. Since the left lung represents 40% of total lung area, the left lung shows 12% lung involvement.
- The is evidence of cavitary disease in the middle third of the right lung, likely representing central necrosis among the extensive infiltrate. That gives an additional 40 points.
- There is no way to differentiate in the scoring between patchy lung involvement and dense consolidation.
- It is unclear how lung collapse and pleural effusion should impact scoring.
- Differences in chest x-ray quality and penetration could impact perception of lung involvement.
- An experienced chest x-ray reader is necessary to prevent including normal structures such as the hilum and vascular markings in the chest x-ray scores.
- The radiologic definition of a cavity is vague. Since cavitary disease counts for 40 points, this can lead to great inter-reader variability.

### Opportunities for Improvement

- Resolving the previously stated challenges will be difficult, given that chest x-ray scoring should be simple for use in the field.
- It is critical to have an experienced chest x-ray reader who can account for differences in the quality and penetration of an x-ray film which may impact perceived lung involvement.
- There should be a stricter definition of a cavity. Including size criteria would help include only clinically significant cavitory disease.

### Conclusion

Tuberculosis continues to be an important cause of morbidity and mortality worldwide and ongoing research is necessary to limit its impact.

- Chest x-ray scoring is an important, validated tool both for researchers and clinicians to estimate severity of disease and make predictions about response to treatment.
- Experience scoring chest x-rays for a cohort of patients in Pune, India, shows that there remain several pitfalls which, if addressed, could expand the use of chest x-ray scoring in tuberculosis research and patient management.

### Sources