Leveraging Neural Networks and Imaging Experts-in-the-Loop for Automated Tuberculosis Screening Using Chest Radiographs in Population Screening Programs to Ensure Efficient Workflows

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Background

Deep learning (DL) model to automatically screen chest X-rays (CXRs) for the presence of tuberculosis (TB) and customized it specifically for a population screening program with our "Artificial Intelligence (AI) and Expert-in-the-Loop Model" to provide a "final signed report".

Methods

For an TB screening program being run by a government body in collaboration with a public health foundation, we reviewed a CXR dataset of 44,623 images taken in mobile diagnostic vans. We used anonymized HIPAA compliant images annotated by a qualified radiologist.

Results

All images were evaluated by an expert radiologist. The model's predictions were compared to radiologist readings. The model demonstrated an AUROC of 0.97, 95% CI [0.94,0.99], and a sensitivity of 0.90, 95% CI [0.81,0.98], at a specificity of 0.95, 95% CI [0.93,0.96].

Discussion

In the future, we plan to deploy the model on edge devices.

Recognizing early diagnosis is the key to eradicating TB, organizations around the world have started active case-finding through population screening programs. Deploying AI based workflows, DL based pre-screening for CXR analysis and imaging experts in loop working collectively provides instant validation, quantified, structured radiology reports. This has the potential to be an affordable, scalable last-mile approach for population screening to eliminate TB.
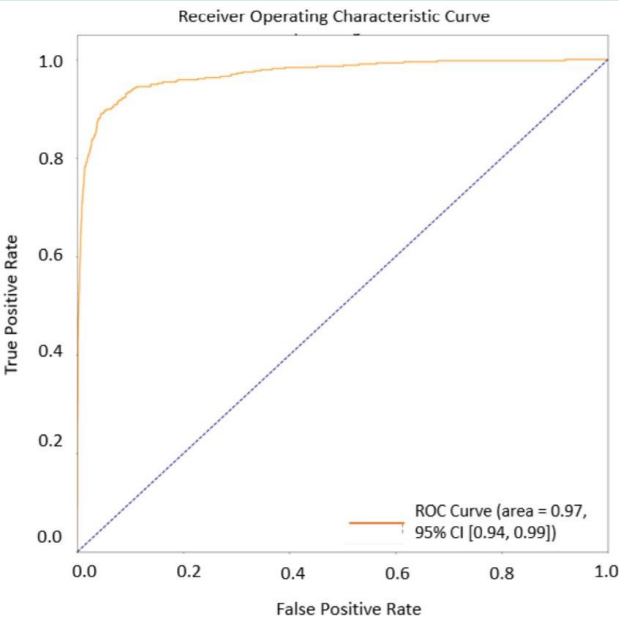
Extra Tables & Figures

Figure: ROC curve at different classification thresholds

Accuracy	0.94, 95% CI [0.93, 0.96]
Sensitivity	0.90, 95% CI [0.81, 0.98]
Specificity	0.95, 95% CI [0.93, 0.96]
AUROC	0.97, 95% CI [0.94, 0.99]

Table: Performance measures for the model

Performance metrics of the AI-based model for TB screening in population screening setting