Applying Multi-modality Artificial Intelligence for Screening of Tuberculosis in a TB High-burden Large Rural Region in China

Lure, Fleming; Jaeger, Stefan; Cheng, Gungxun; Li, Hongjun; Lu, Pu-xuan; Yu, Weiye; Kung, Justin; Guan, Yubao

1 Shenzhen Zhying Medical Imaging Shenzhen China; 2 National Library of Medicine, National Institute of Health Bethesda, USA; 3 Peking University Shenzhen Hospital Shenzhen China; 4 Beijing Youan Hospital, Capital Medical University Beijing China; 5 Shenzhen Center for Chronic Disease Control Shenzhen USA; 6 Shenzhen Center for Chronic Disease Control Shenzhen China; 7 Beth Israel Deaconess Medical Center, Harvard Medical School Boston USA; 8 The First Affiliated Hospital of Guangzhou Medical University, Guangzhou Institute of Respiratory Disease Guangzhou China

Background and Challenge

- In rural areas, although radiological equipment including DR and CT are widely available, it lacks of skilled radiologists to interpret radiographs for active and MDR-TB.
- Similarly, microscopy systems are also available but shortage of pathologists is even more serious.
- Use of multiple modalities can improve the diagnosis accuracy but is challenging in rural area.
- Quick assessment using images can determine the effectiveness and resistance of drug treatment, which can help to adjust the drug.
- Artificial intelligence can play very important role for fast and early screening and diagnosis of TB.

Motivation Objectives

- We deployed Multi-modality AI (ERASE-TB) is a high burden large rural province affected by TB, Qinhai, to assist physicians in detecting TB in radiological and pathological images.
- Our study investigates the efficacy of ERASE-TB to assist physicians in detecting TB at multiple hospitals located in Qinhai.

Technologies & Solutions


- TB Detection on DR/CR
- Multi-hospital Automatic AFB Detection System
- Automatic Temporal Subtraction
- Full-Field Fluorescence Microscopy

Installation Steps of AI

- Worklist connected to PACS environment
- Automatically refresh the list
- Doctors use this list to perform diagnosis and generate reports
- AI automatically generates marks in image indicating different abnormalities
- Diagnostic report (text) are also generated automatically based on AI performance
- Diagnostic report will be changed if doctor changes the marks on the image

Deployment

Deployment Activities
Field Engineers travels mountain and river over thousands of miles to install

Installation of Image Collector Over 70 rural hospitals

Routine Usage

Over 8% adults have been processed by ERASE-TB

Clinical Results from Routine Large-Scale Usage

Within 8 months
- 70 rural hospitals and 1 central TB hospital connected with ERASE-TB networks
- Over 8k adults have been processed by ERASE-TB
- Analyze 20,000 ~ 30,000 each month to increase screening rate
- Increase detection rate by 20% compared to historical rate
- Alleviate the pain for the shortage of doctors
- Early detection of TB resulting in the detection of more MDR-TB
- In 10 sec, AI automatically screen 22 different abnormalities: TB, nodules, TB, infection, multiclonal, and emaciation
- AI automatically generate text
- 30-40 min for doctor to generate reports for patients

Summary & Conclusions

- Large-scale routine usage of AI in China for TB screening
- AI can improve the performance to screen TB especially in the rural area where doctors are not enough
- Installation of multi-modalities will further improve the performance to identify more TB

Results of Usages

Conclusions

- Over 500 hospitals and over 100,000 adults diagnosed with TB by AI
- AI automatically generates marks in image indicating different abnormalities
- Diagnostic reports (text) are also generated automatically based on AI performance
- Diagnostic reports will be changed if doctor changes the marks on the image

Collaboration Organization