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

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Background and Challenge

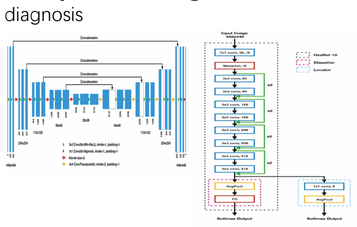
- In rural area, although radiological equipment including DR and CT are widely available, it lacks of skilled radiologists to interpret radiographs for active and MDR TB.
- Similarly, microscopy systems are also available but shortage of pathologists is even more serious.
- Use of multiple modality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

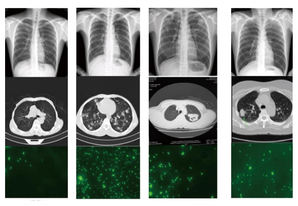
Motivation Objectives

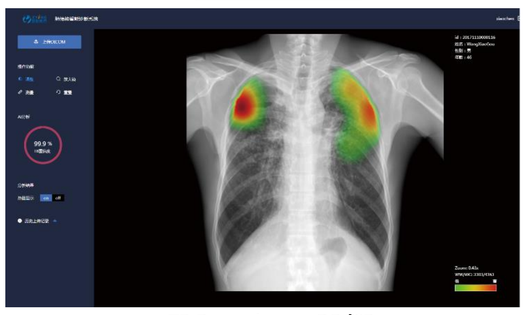
- We deployed Multi-modality AI (ERASE TB) in a high-burden large rural province affected by TB, Qinhai, to assist physicians in detecting TB in radiological and pathological images.
- Our study investigates the efficacy of ERASE TB to assist physicians in detecting TB at multiple hospitals located in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

Technologies & Solutions

Deep Learning AI: Use of Unet and ResNet to generate optimal performance of the system in multi-modality diagnosis



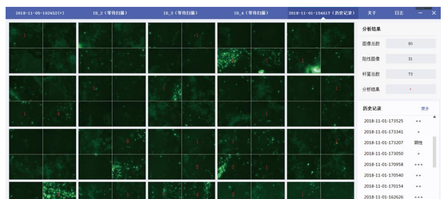




TB Detection on DR/CR

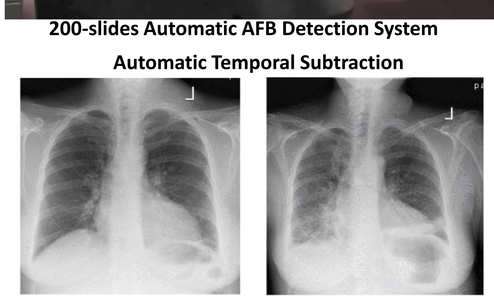
4-slides Automatic AFB Detection System

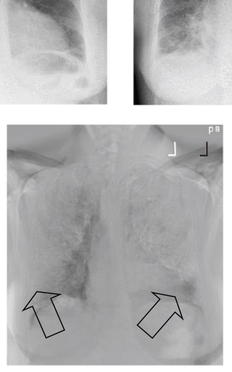
200-slides Automatic AFB Detection System



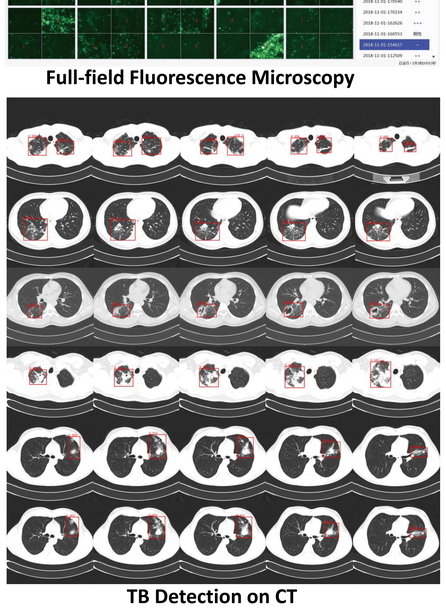
Full-field Fluorescence Microscopy

Automatic Temporal Subtraction



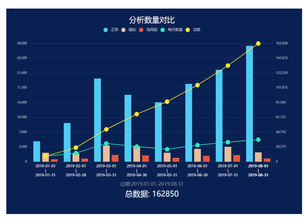


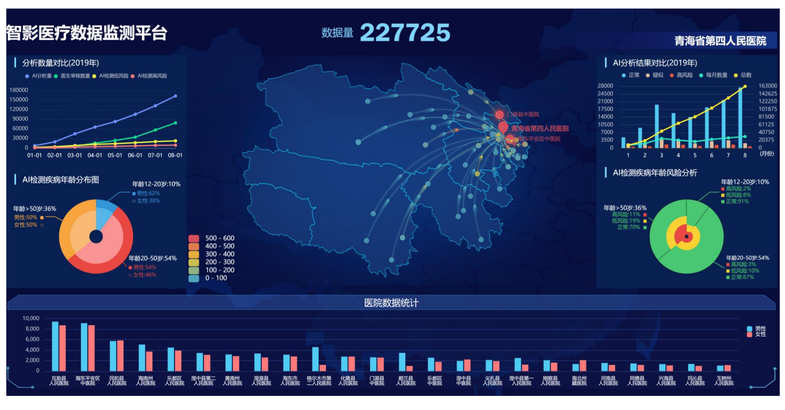
Highlight of Changes for Folow-up and Treatment Assessment

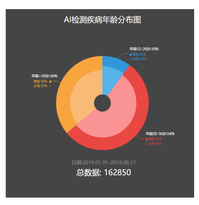


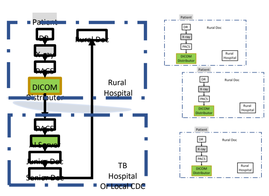
TB Detection on CT

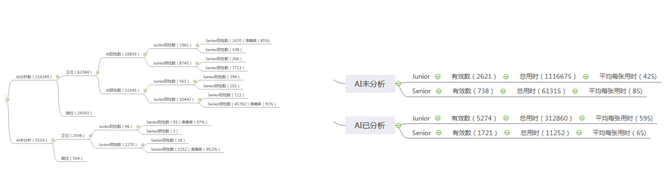
Results of Usages







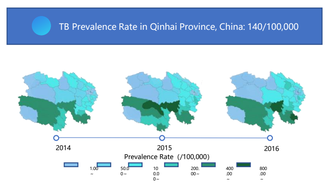




Deployment

Deployment Activities

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



Installation Steps of AI

部署 (Deployment)

第一步：中心服务器部署
Step 1: Set up AI server in the central TB hospital

第二步：县级医院和中心对接
Step 2: Install Image collection router in rural hospitals

第三步：人工智能网络全覆盖
Step 3: Activate AI coverage for the entire province

Over 70 rural hospitals

Installation of Image Collector Over 70 rural hospitals

Training

Routine Usage

TB AI installed in central TB Hospital

- Work list connected in 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 reports (text) are also generated automatically based on AI performance
- Diagnostic reports will be changed if doctor changes the marks on the image

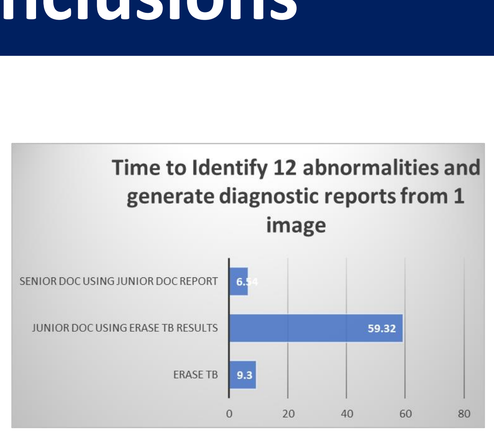
Summary & Conclusions

Clinical Results from Routine Large-Scale Usage

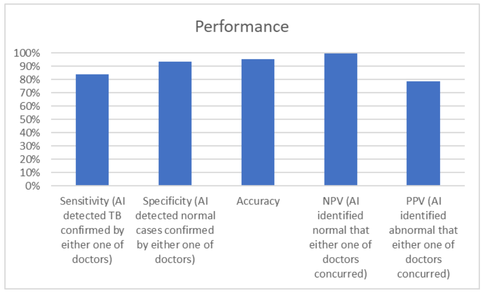
Within 8 months

- 70 rural hospitals and 1 central TB hospital connected with ERASE TB networks
- Over 8% adults have been processed by ERASE TB

- Analyze 20,000 – 30,000 each month to increase
- Screening rate
- Increase detection rate by 23%, 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 12 different abnormalities: TB, nodule, TB, infectious, cardiomegaly
- AI automatically generate text
- 30-60 min for doctor to generate reports for patients



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

Collaboration Organization