Development of a Spectroscopic AI-IoT Database Using Surface-Enhanced Raman Spectroscopy for Tuberculosis Diagnostic Screening Across Thailand and Laos

Full name of Speaker :

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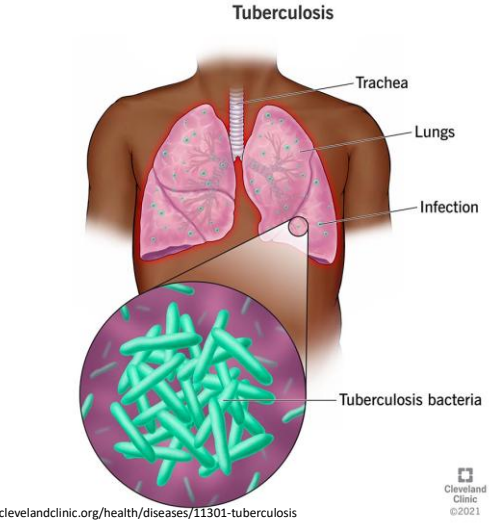
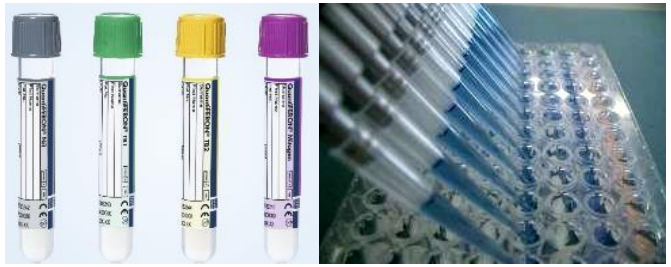
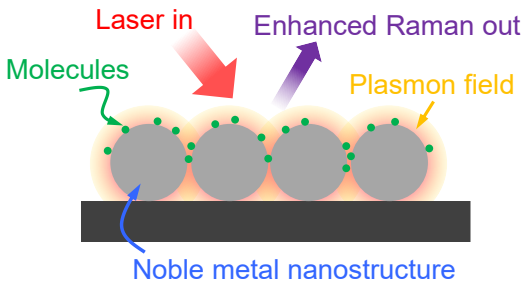
Background :

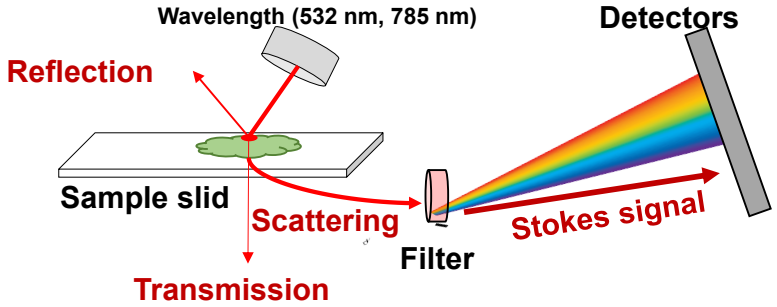
- Tuberculosis (TB): 10 million active cases, 1.5 million deaths annually worldwide.
- 25% of global population infected with latent TB (LTBI).
- High burden region: Thailand (143/100,000) & Laos (138/100,000).
- WHO End-TB target: reduce to 10/100,000 by 2035.
- Existing LTBI tests (IGRA) are **expensive**, **slow**, and **unsuitable** for large-scale community screening.
- Raman spectroscopy (RS) and Surface-Enhanced Raman Spectroscopy (SERS) are emerging POCT technologies in TB diagnostics.
- These methods offer rapid detection of protein molecular patterns and conformational changes in complex biological molecules, with results available within 3 hours.
- Our group has demonstrated that SERS-based tests can distinguish LTBI from healthy controls (HC) with an accuracy of 81–94% in Thai populations (*Biosensors and Bioelectronics 250 (2024): 116063*)
- However, the technology has not yet been validated with samples from other countries



https://my.clevelandclinic.org/health/diseases/11301-tuberculosis







Targets:

- Combines Surface-Enhanced Raman Spectroscopy (SERS) with AI and IoT.
- Uses molecular fingerprints in plasma to classify LTBI and healthy controls from Thailand and Loas.
- Real-time data transmission to cloud-based AI database for diagnostic prediction.

Final Goal: Enable rapid, low-cost, decentralized TB screening based on AI based technology across Thailand and Laos.

https://www.urc-chs.com/news/targeted-mass-screening-in-tb-hotspots/

Proposed Method:

1. Scientific and technological

- Validate the SERS-based IoT-enabled test using 240 plasma samples from the populations in Northeast Thailand and Laos
- Establish a cross-border spectroscopic database integrated into a cloud-based AI platform for LTBI screening

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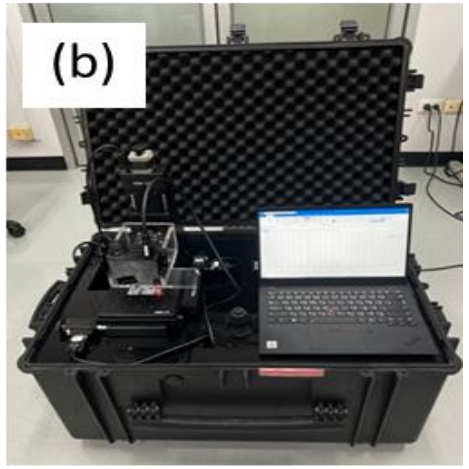


Portable system

SERS substrates

Past Publications

- Eiamchai, Pitak, et al. "Determination of latent tuberculosis infection from plasma samples via label-free SERS sensors and machine learning." Biosensors and Bioelectronics 250 (2024): 116063.
- Kaewseekhao, Benjawan, et al. "Diagnosis of active tuberculosis and latent tuberculosis infection based on Raman spectroscopy and surface-enhanced Raman spectroscopy." Tuberculosis 121 (2020): 101916.
- Kaewseekhao, Benjawan, et al. "Dataset of serum proteomic spectra from tuberculosis patients detected by Raman spectroscopy and surface-enhanced Raman spectroscopy." Data in brief 28 (2020): 104891.

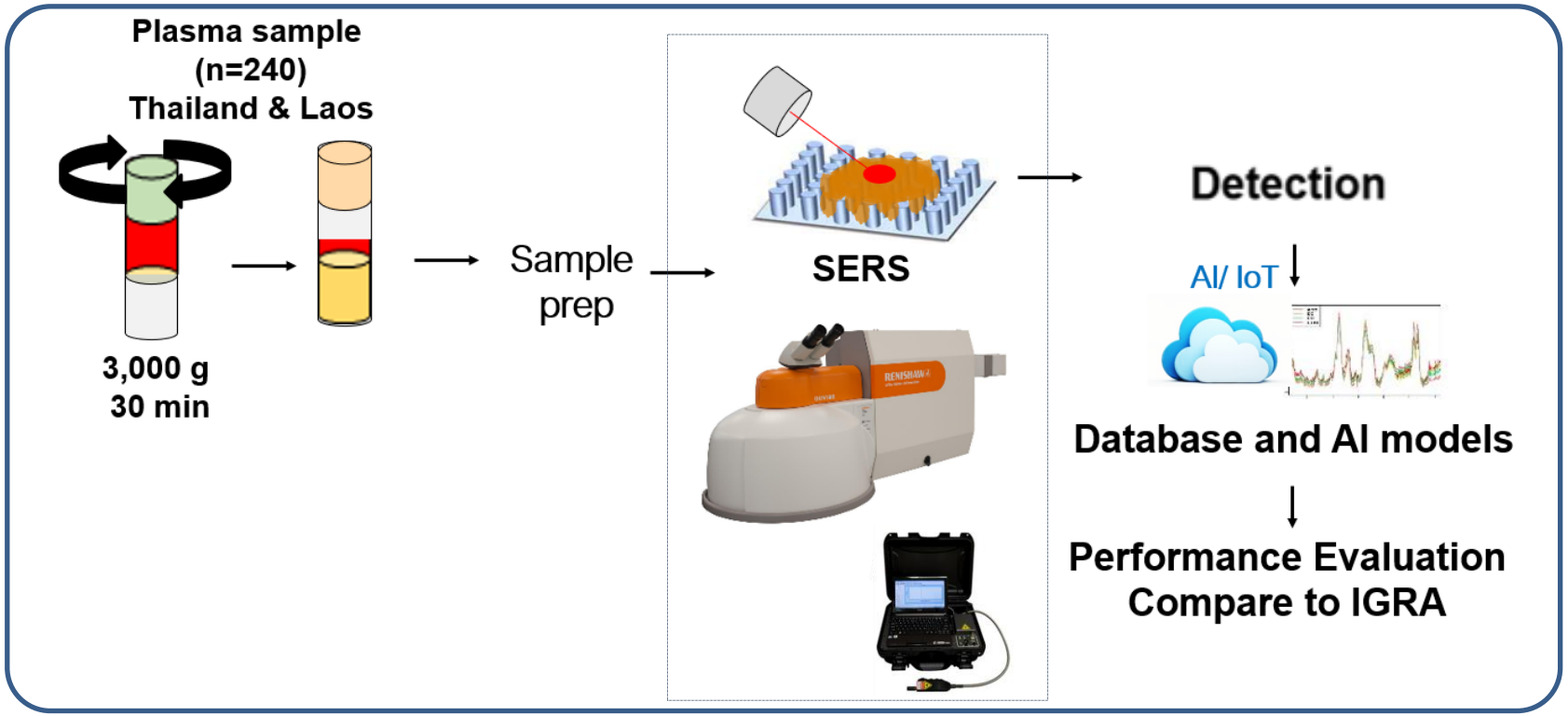
Proposed Method:

2. Implementation

(i) Acquisition of high-quality Raman spectral data from clinical plasma samples,
(ii) Establishment of a cross-border spectrum database
(iii) Development of AI models capable of diagnostic analysis, and
(iv) Preliminary evaluation of diagnostic accuracy and feasibility for community-level screening.

Proposed Method:

3. Experiments including field testing



Cross country
meeting and
Site visit

Output/Outcome

Scientific

-New diagnostic technology for TB screening using Raman Spectroscopy

-New Application of Spectroscopic AI for TB in Laos and Thailand

-Diagnostic performance and feasibility report of SERS-based TB diagnosis using datasets from both countries

-Research publication in a Scopus-indexed Q1 or Q2 journal

Societal

-Cloud-embedded Raman Spectroscopic AI-IoT database for TB diagnosis

-TB screening in risk groups from the two countries

Collaborative

-Collaborative research group among
Medical Microbiologist
Medical Engineering
Data Scientist
Clinical scientists
Public Health sectors

-Trained Research Assistant (M.Sc. or Ph.D.)

Impact:

Scientific and technological Impact

- Broaden the applicability of Raman Spectroscopic AI technology for Medical industry

- Technology transfer to community, clinical laboratory and pharmaceutical companies

Societal Impact

-Reducing TB prevalence in community

-Decreasing the cost for TB management

-Supporting End-TB strategy of WHO between the two countries

Collaborative Impact


-Long-term collaboration between two research group between the two county

-End-TB networking

Conclusion:

1. Targets

-Thailand-Laos collaboration Medical Raman database For tuberculosis diagnosis

-Real-time data transmission and network connectivity of Raman technology to support decentralized diagnostic capabilities.

2. Method (idea)

-Raman data genertaion from 240 plasma samples and AI based analysis

-Development Cross-border spectroscopic database integrated into a cloud-based AI platform for LTBI screening

3. Scientific and societal impact

-New diagnostic technology for TB screening sporting End-TB strategy of WHO