An Inclusive AI-Powered Screening Platform for Automated Urinary Stone Detection on KUB X-ray Films:

Scaling Healthcare Accessibility across the ASEAN Region

Presenter:

Sutat SAE-TANG (sutat.sae-tang@nectec.or.th), Artificial Intelligence Research Group, National Electronics and Computer Technology Center (NECTEC), Thailand

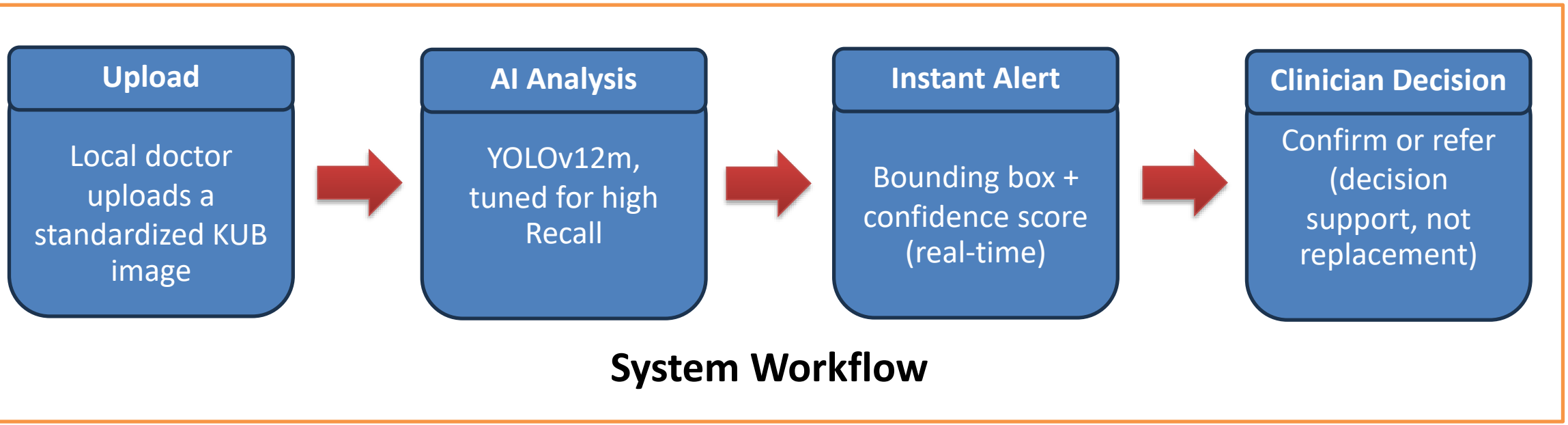
Co-authors:

- Wattanachai UNGJAROENWATHANA (Urologist, Sunpasitthiprasong Hospital, Thailand)
- Payathsone SINGKHAMCHANH (Urologist, Mahosot Hospital, Lao PDR)

Overview

Purpose:

- Deploy a scalable, accessible, high-accuracy AI screening tool for automatic urinary stone detection on KUB X-ray films across ASEAN.
- Targets low-resource settings and community clinics, works as a clinical decision support system.
- Uses decentralized machine learning for cross-border model updates without compromising local data privacy.



System Workflow

Background

- Urinary tract stone disease is a high-prevalence healthcare burden across Southeast Asia[1]. If undetected, it can lead to acute renal failure and systemic infections.
- KUB X-ray is the most affordable and widely available initial screening method in rural ASEAN facilities.
- Bottleneck: a severe shortage of radiologists, so general practitioners (GPs) often miss small or low-opacity stones because of anatomical overlap.

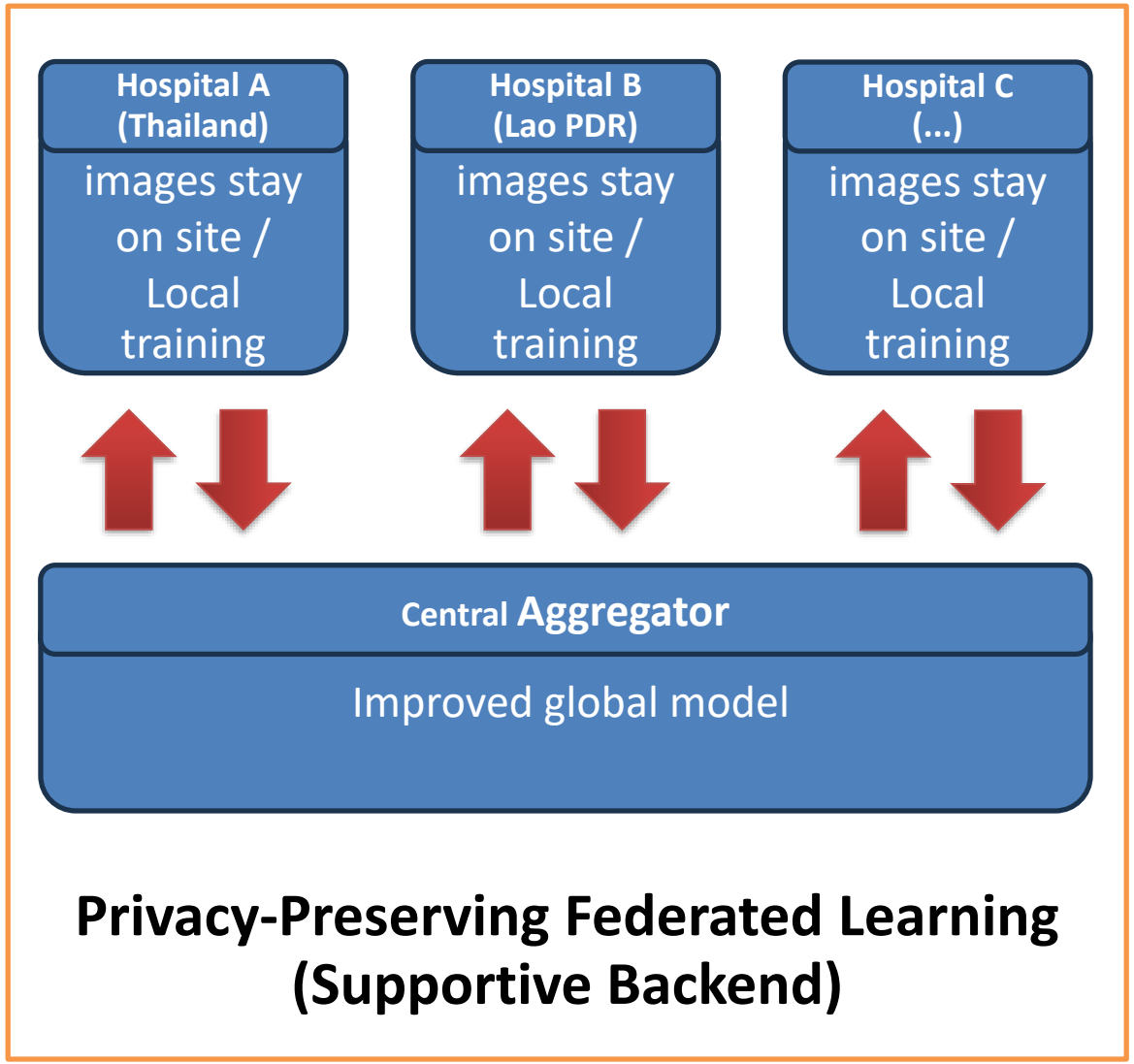
1. Liu, Y., Chen, Y., et al. (2018). Epidemiology of urolithiasis in Asia. Asian Journal of Urology, 5(4), 205-214.

Targets

- Establish an ASEAN-wide AI screening platform that helps GPs detect and localize urinary stones with automated bounding boxes.
- Bridge the healthcare gap in remote and underserved communities with a lightweight, web-accessible service.
- Use Federated Learning as a supportive backend to handle diverse X-ray image qualities from multiple hospitals.
- Foster multi-center clinical validation and cooperation among ASEAN member institutes to enhance the global model's sensitivity (Recall)

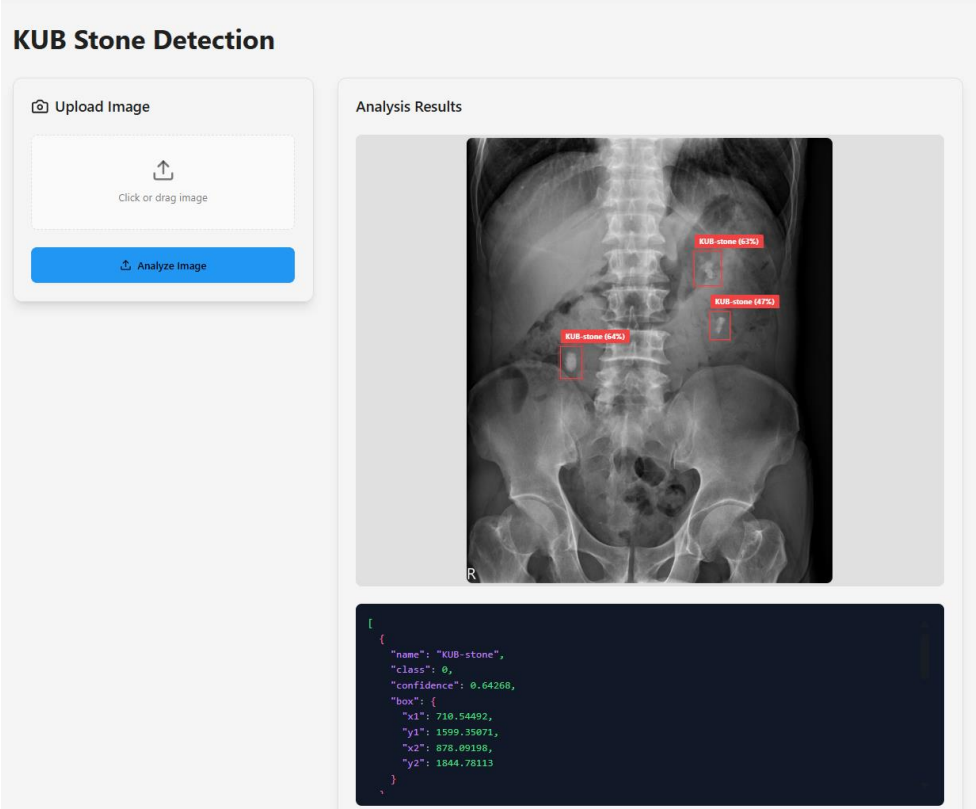
Proposed Method: Scientific and technological

- **Dataset:** 16,763 expert-annotated clinical images.
- **Model:** YOLOv12m, F1-score 76.18%, Precision 78.82%, Recall 73.71%.
- **Optimization:** Higher Recall (screening sensitivity) to minimize false negatives in rural triage.
- **Supportive backend:** Using Federated Learning, Hospitals act as local training nodes and share only anonymous model parameters with a central aggregator.



Proposed Method: Implementation

- **Screening interface:** A validated web-app prototype (https://ipulab.com/service/kub-det-web/). Local doctors upload standardized KUB images, and the AI returns real-time visual alerts with confidence scores to prevent diagnostic oversights.
- **Output:** Automated bounding boxes that localize stones.
- **Role:** Decision support for the clinician, not a replacement.
- **Future (Cloud-to-Edge):** Compress YOLOv12m for offline use on low-cost medical tablets in areas with unstable internet.



A screenshot of the web-app prototype for KUB stone detection

Proposed Method: Experiments & Field Testing

- **Benchmarked Performance**: YOLOv12m, F1-score 76.18%, Precision 78.82%, Recall 73.71% on 16,763 images.
- **Field testing plan:** Mahosot Hospital, Lao PDR, and other ASEAN country.
- **Validation:** Multi-center clinical validation to enhance the global model's Recall.

Impact: Scientific & Technological

- A high-Recall model suits initial screening and reduces false negatives in rural areas.
- Learning from images of varying quality across hospitals makes the global model more robust.
- Federated Learning allows cross-border model refinement without moving patient data, which reduces legal and data-governance barriers.

Impact: Societal & Collaborative

Societal:

- Fewer missed stones, and fewer severe complications such as acute renal failure and systemic infection.
- Better detection of small or low-opacity stones by GPs in areas lacking radiologists.
- High-tier diagnostics for low-resource settings, community clinics, B40 and underserved groups.

Collaborative:

- Multi-center clinical validation among member institutes.
- Existing Thailand–Lao PDR partnership (NECTEC, Sunpasitthiprasong Hospital, Mahosot Hospital).
- Cross-border collaboration that stays within local data privacy rules, since only model parameters are shared.
- ASEAN IVO consortium to pilot in member countries.

Output/Outcome: Scientific & Technological

Already available:

- Working web-app prototype (https://ipulab.com/service/kub-det-web/).
- YOLOv12m model trained on 16,763 images, F1-score 76.18%, Precision 78.82%, Recall 73.71%.

Expected outputs:

- A global model with higher Recall through multi-center validation.
- A compressed YOLOv12 model for offline use on low-cost tablets (Cloud-to-Edge.
- A cross-hospital, cross-border Federated Learning system.

Output/Outcome: Societal & Collaborative

Societal:

- ASEAN Rural Triage Network: a screening network in community hospitals of member countries.
- Standardized ASEAN Medical AI Blueprint: the network's success documented as a framework to guide other screening AI tools (e.g., tuberculosis, pneumonia) within the ASEAN IVO ecosystem

Collaborative:

- A network of ASEAN IVO member institutes validating the tool clinically
- New partners from other ASEAN country.

Conclusion

Targets:

- Build an accessible, accurate ASEAN-wide AI platform for urinary stone screening on KUB X-ray.
- Help GPs detect and localize stones, bridging the healthcare gap in remote and underserved communities.

Method:

- Web-app with real-time visual alerts, bounding boxes and confidence scores (YOLOv12m: F1-score 76.18%, Precision 78.82%, Recall 73.71% on 16,763 images).
- High-Recall YOLOv12 model to minimize false negatives.
- Develop Cloud-to-Edge deployment for offline use on low-cost tablets.
- Federated Learning as a privacy-preserving backend, sharing only anonymous model parameters.

Scientific and Societal Impact:

- Cross-border model refinement without moving patient data, and robustness to varied image quality across hospitals.
- Fewer missed stones, and fewer cases of acute renal failure and systemic infection.
- ASEAN Rural Triage Network, new partners, and a Standardized ASEAN Medical AI Blueprint.