BUILDING IN-HOUSE RADIOLOGY AI:

Initial Results from the Pulmonary Embolism AI Initiative

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AGENDA

- Background
- Methodology
- Current Results
- Project Progress
- Conclusion
- Acknowledgement

BACKGROUND

CLINICAL IMPACT OF PULMONARY EMBOLISM

- Important **cause of in-patient mortality and morbidity**
- **Rapid deterioration** if untreated
- Effective **treatment available** :
  - *Anticoagulants*
  - *Thrombolytics*
  - *Catheter-based thrombectomy*
  - *Surgical thrombectomy*
- Requires urgent diagnosis by **CT Pulmonary Angiogram (CTPA)** to initiate treatment for good patient outcome
- Increasing urgent CTPA and other imaging requests posts a **clinical dilemma** for both **Radiologists** and **Clinicians**

CLINICAL IMPACT OF PULMONARY EMBOLISM

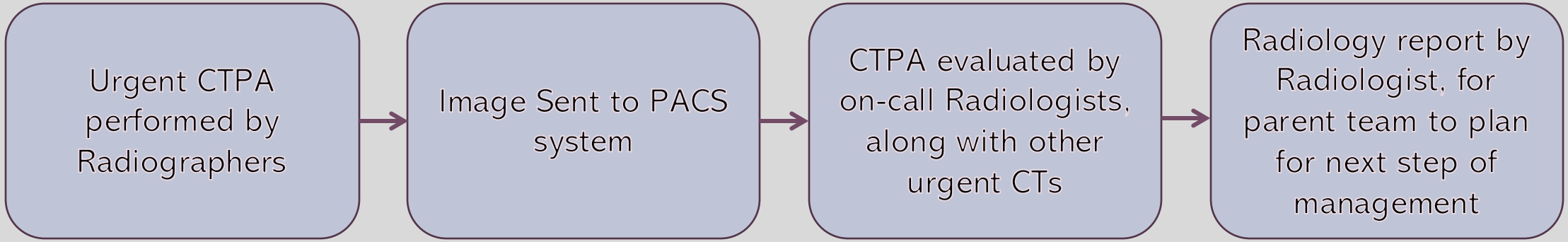
The Pulmonary Embolism AI Initiative (Aims) :

1. To create an in-house AI pipeline for interpreting CT images to improve patient care.
2. The final AI solution shall screen CTPAs with a high negative predictive value (NPV) and detect right heart strain, flagging positive cases for immediate review and treatment.
3. Additionally, it shall provide explainable predictions for manual verification by Radiologists.

CLINICAL IMPLEMENTATION OF AI

- TO TACKLE THE CLINICAL DILEMMA

Original Workflow (Without AI)



- Immense on-call workload
- Positive CTPA may be read late after studying other urgent CTs and may delay treatments
- Long report turn-around-time : Radiologists not only has to detect PE from CTPA, but also go through the entire CT thorax and upper abdomen for incidental findings

CLINICAL IMPLEMENTATION OF AI

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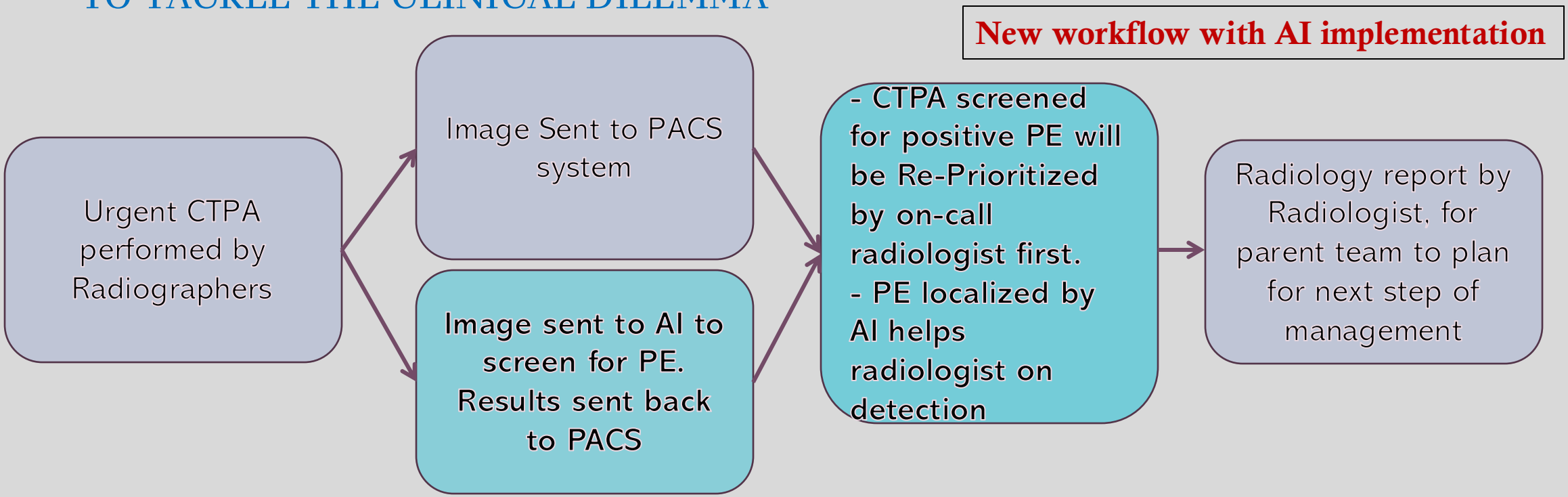
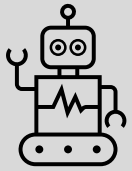


- Improve turn-around-time for positive PE → early treatment
- Improve accuracy (improved detection by AI support)

VALUES AND PURPOSES

Early Detection

- Automatic screening of positive CTPA during busy on-call hours
- Re-prioritize higher-risk cases
- Reduce reporting turn-around time for positive cases
- **Enable early treatment**

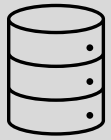


Diagnostic Support

- Enhance accuracy with AI-assisted detection
- Increase reading speed and confidence with highlighted findings (AI explainability)

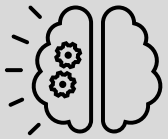
Clinical Research Opportunity

- Review prognostic factors for PE and Wells' criteria in Chinese Population



Data Mining

- Generate service insights for future AI development and workflow optimization.



Capacity Building

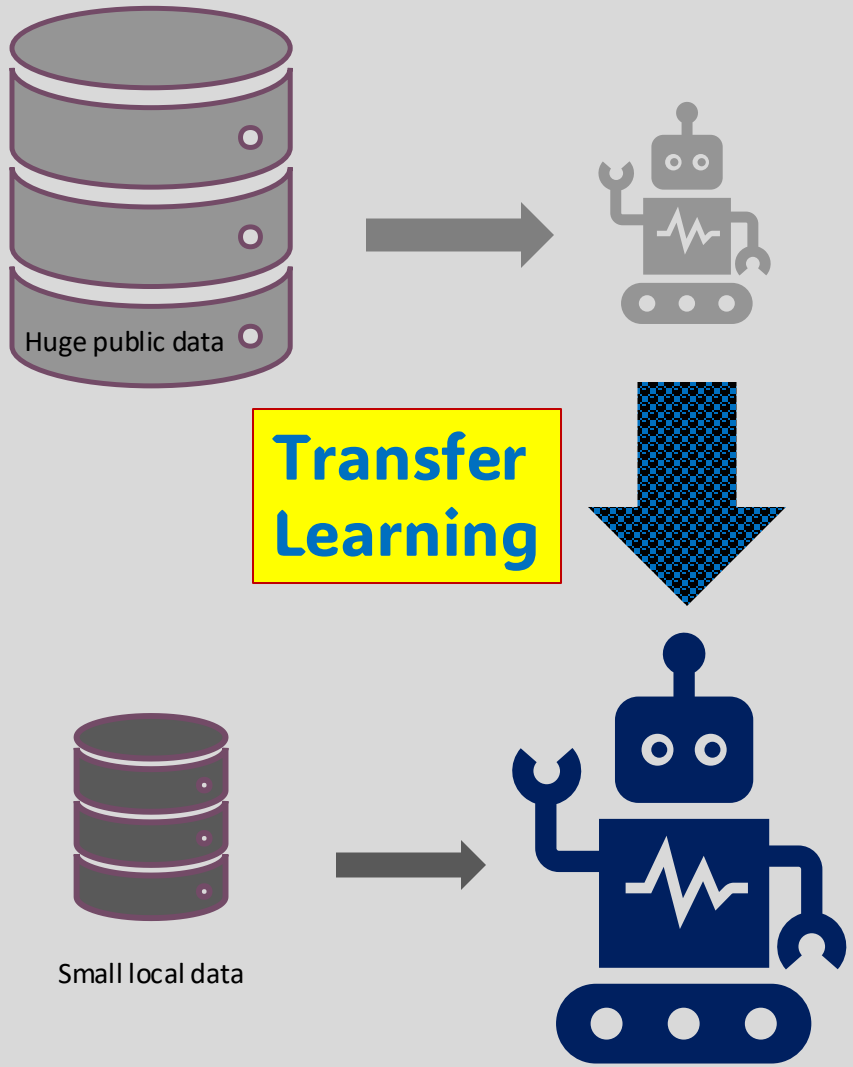
- For HA AI section and Radiologists on advanced imaging AI development
- For Radiologists to understand logics and caveats of AI solutions

METHODOLOGY

DATA SETS

Robust methodology by leveraging a huge public dataset and fine tuning using a local HA dataset

- Public Dataset – labelled by expert Chest Radiologists
  - RSNA Classification Dataset (9,446 studies, 2.3 million images)
  - RSNA Localization Dataset (14,865 images with bounding boxes)
- Local Data
  - 573 CTPA cases from QMH
  - 173 positive for PE
  - Used for fine-tuning and validation



BASE MODELS

Classification Model

- Adopted and modified RSNA 2020 challenge winning model
- Transfer learning to adapt to local population

Localization Model

- YOLOv11 architecture
- Provides bounding boxes for explainability

RESULTS

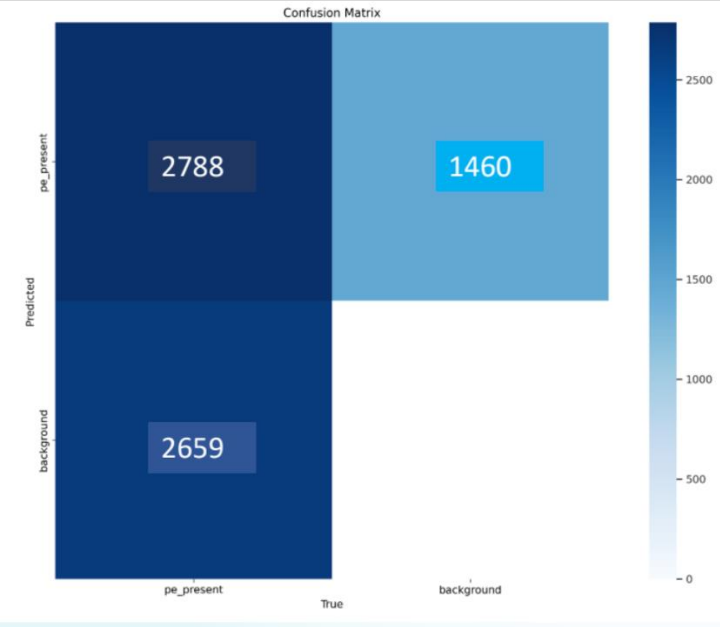
TRAINING AND VALIDATION RESULTS

Performance of Classification Model (RSNA Datasets)

- AUC of 0.952 on RSNA validation dataset
- AUC of 0.920 on representative validation set

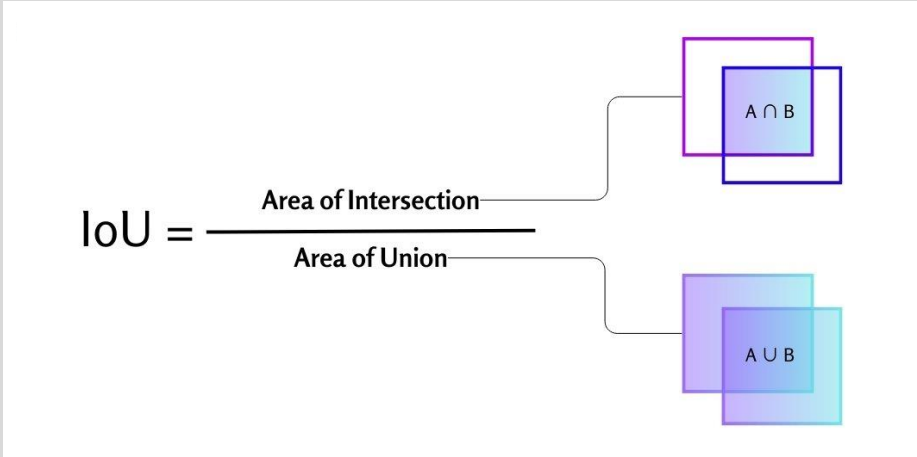
	Training	Ratio of pos/neg	Validation	Ratio of pos/neg	Val Loss	AUC
1	*~1,431k*	*5:95*	*~359k*	*5:95*	*0.207*	*0.556*
2	*~154.4k*	*50:50*	*~38.6k*	*50:50*	*0.277*	*0.952*
3	***~154.5k***	***50:50***	***~40.7k***	***5:95***	***0.394***	***0.92***

TRAINING AND VALIDATION RESULTS



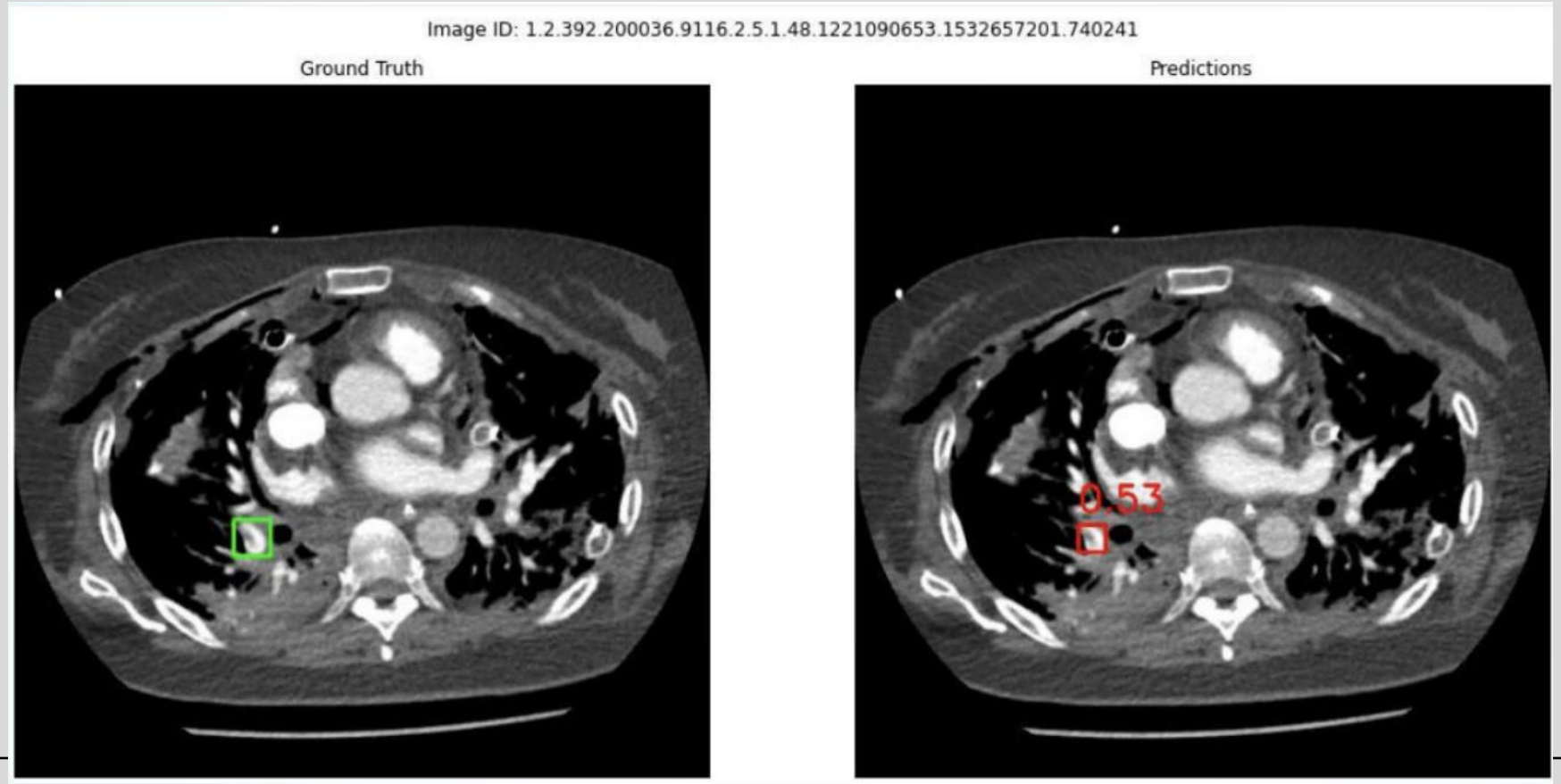
Performance of Localization Model

- Precision: 0.52
- Recall: 0.47
- Accurately localized 69.2% of cases in local dataset testing
- Intersect over union (IOU) threshold : >0.5
- Successfully avoids mislabeling PE mimics



PERFORMANCE ON LOCAL PE CASES (QMH)

- True positives



Doctor's Annotation

AI's Prediction

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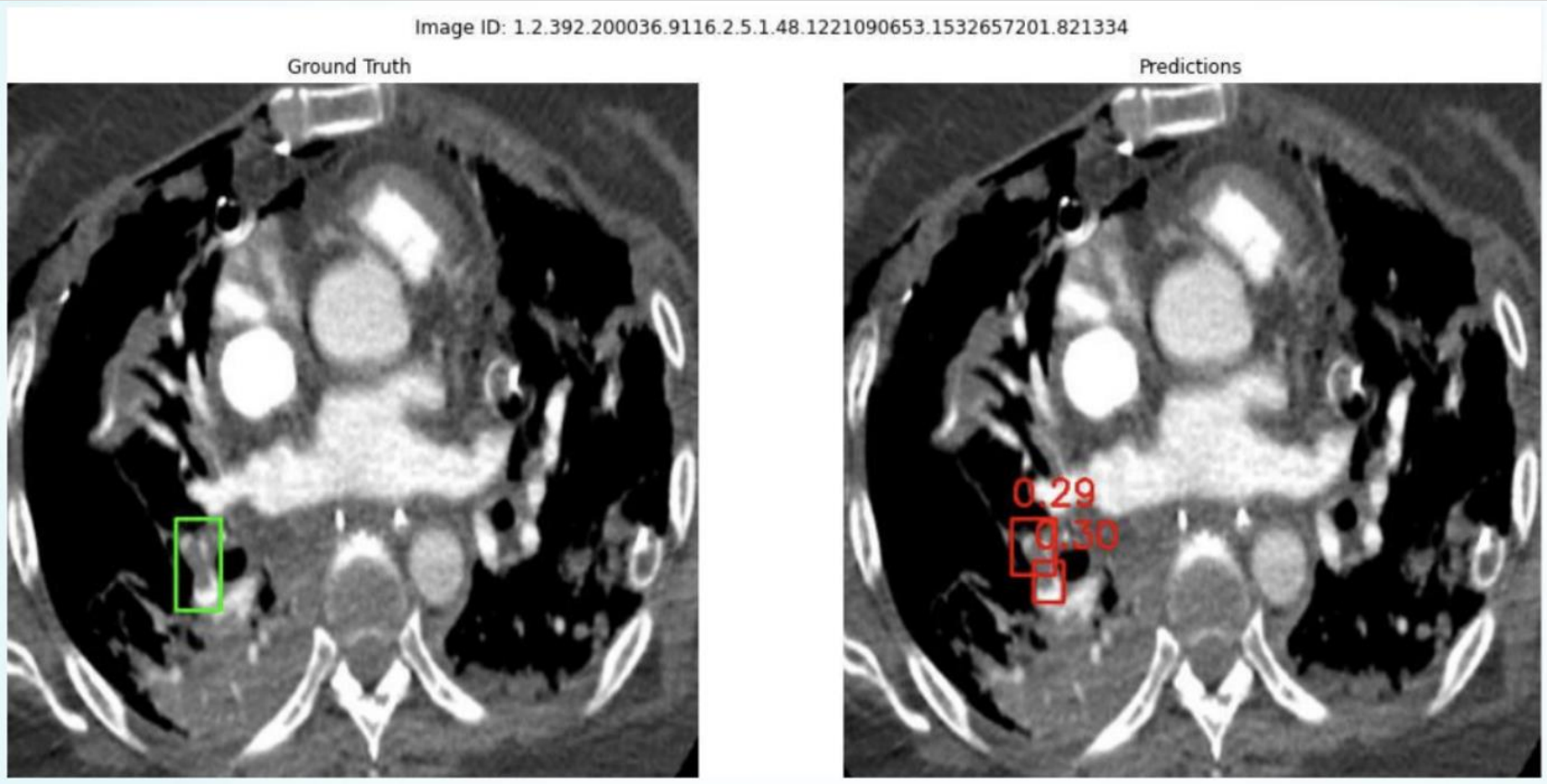

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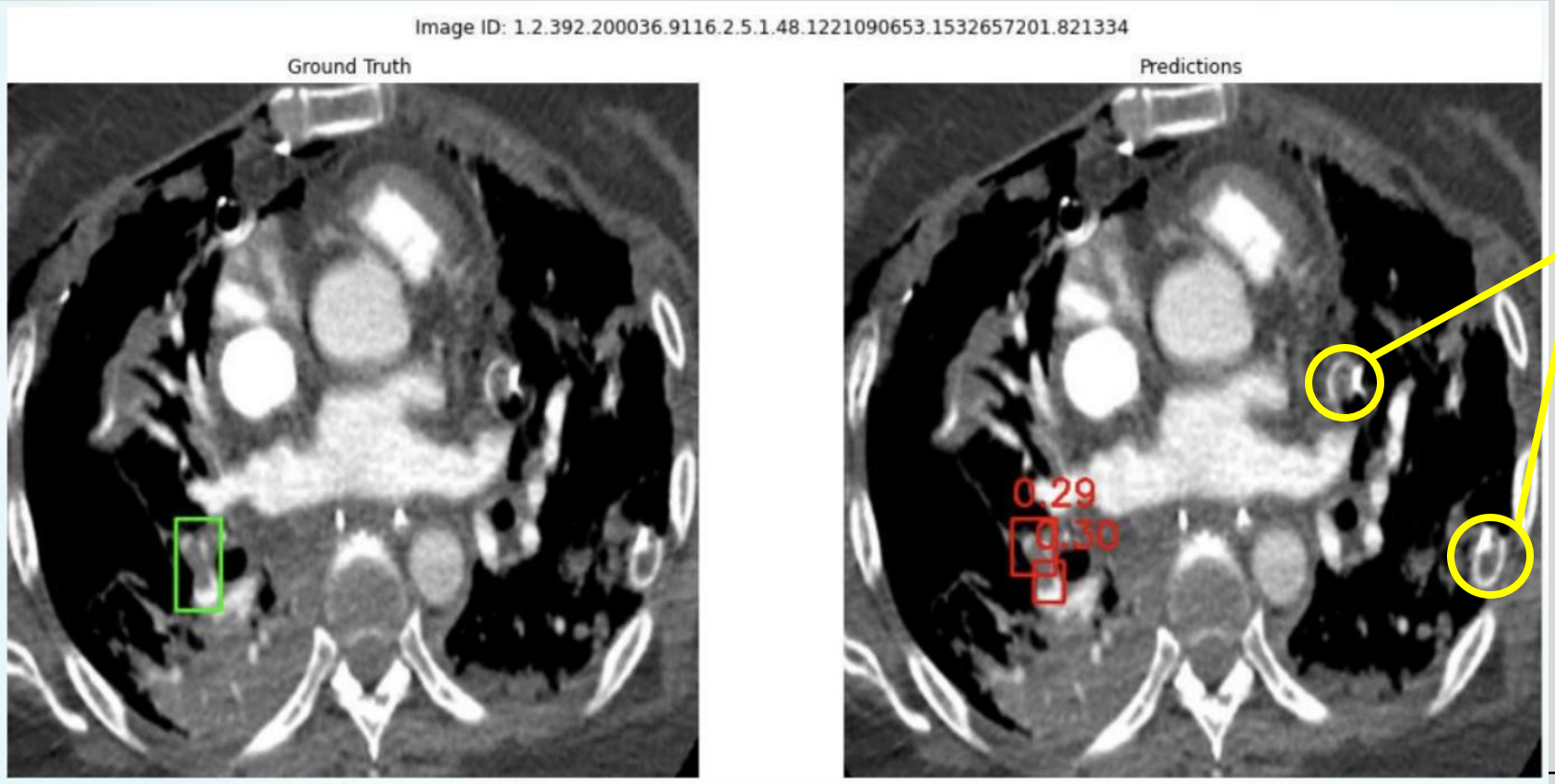


Pericardial and Pleural drains

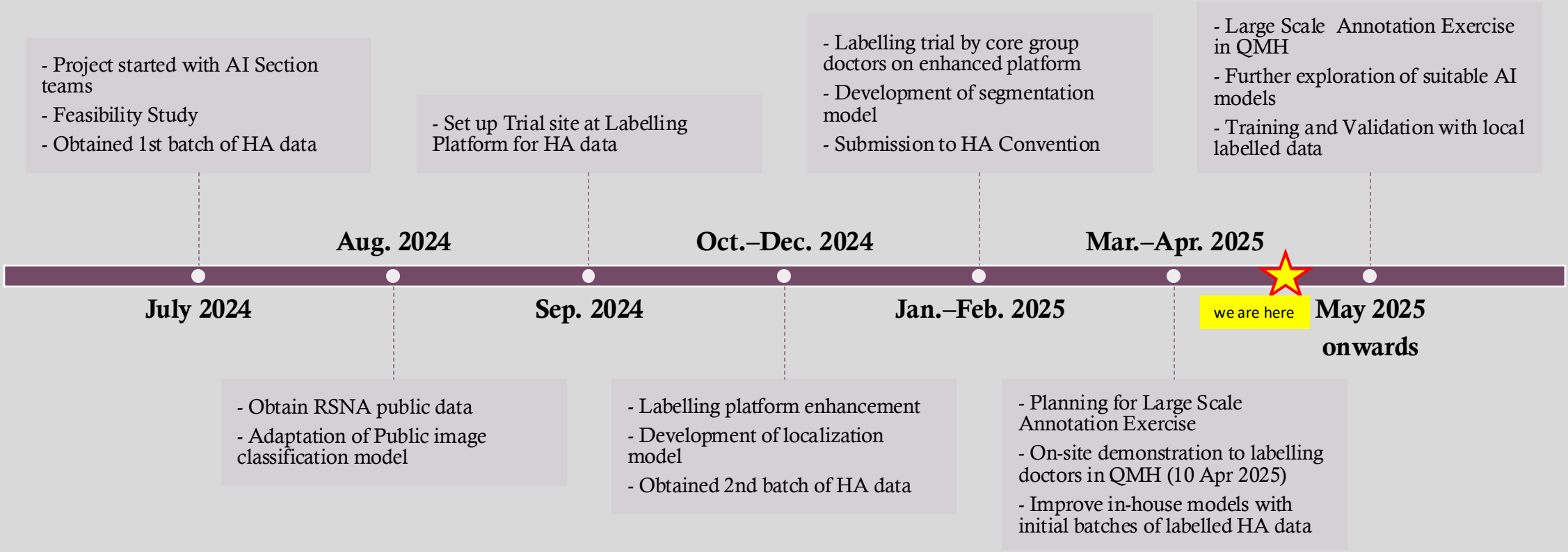
- Mimic filling defects of PE
- **AI avoided false positive prediction of PE mimics**

Doctor's Annotation

AI's Prediction

PROJECT PROGRESS

TIMELINE OVERVIEW



NEXT STEPS

Large Scale Annotation Exercise

- 573 QMH PE cases (173 positive) retrieved
- HA in-house labelling platform (AIAP) upgraded
- Large scale annotation exercise by QMH radiologists in May
- Including classification, localization and right heart strain annotation

Model Development

- Local data will be used for training of current models through transfer learning
- Validation of base models on local dataset
- Development of segmentation model for RV/LV ratio

Pipeline Development

- Continue development of a complete AI pipeline and final model
- Integrate models into clinical workflow
- Performance monitoring and feedback loop

Scaling

- Pulmonary embolism is not an isolated problem in QMH
- Explore implementation in other Clusters
- Explore bigger scale, HA-wide annotation exercise for further training

CONCLUSION

- **Feasibility of Local AI Development**
  - First in-house CT AI solution at HA
  - Demonstrates potential for clinical applications
- **Addressing Growing Demand**
  - Utilizes advanced technology
  - Collaborative effort between clinical and IT teams
  - Support frontline doctors (Clinicians and Radiologists)
- **Improving Patient Outcomes**
  - Early detection and treatment for better patient outcomes

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Thank you very much!