Implementation of Quality Assurance for CTA PE Interpretation Utilizing Artificial Intelligence Monitoring to Avoid Missed Diagnosis of Acute Pulmonary Embolism

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Purpose

Background

- Artificial Intelligence (AI) is becoming more common in radiology, aiding in early detection and potentially improving accuracy and patient care

- Studies report radiologist error rates up to 4%, varying by sample size, modality, patient group, and skill-set of radiologists

- In one study, retrospective application of AI identified 77% missed pulmonary embolism cases by radiologists*

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Purpose

Opportunity for Improvement

BASELINE

At our institution AI is utilized for detection of acute pulmonary embolism (PE), notifying radiologists via a desktop widget when PE is identified by the AI algorithm

Retrospective application of the AI tool to 912 CTA PE studies (2 months) identified 20 missed PE of 103 studies positive for PE

Few anecdotal instances of missed PE cases noted due to radiologists overlooking AI widget notifications

At least once, a discordant result went undetected for over 2 weeks

No established quality assurance (QA) process to ensure review of notification or concordance

Intervention

Implement a systemic QA process to maximize utility of the AI tool

- Check for concordance with radiologist's report

- Check accuracy of AI interpretation

- Ensure appropriate follow up for discordant /missed cases

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Methods

Establishing QA Process

- Team of QA radiologists and PACS administrators established

- PACS administrators screened all cases positive by AI interpretation for discrepant radiologists' reports

- QA radiologists determined if a PE was potentially missed

- If missed PE suspected by QA radiologist, study was referred back to the interpreting radiologist

- If interpreting radiologists agreed that study was positive for PE, addendum of report was issued and referring provider informed as necessary

- Key outcome was number of overlooked PE

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Methods

QA Workflow

- QA period from Dec. 2019 through Mar. 2020
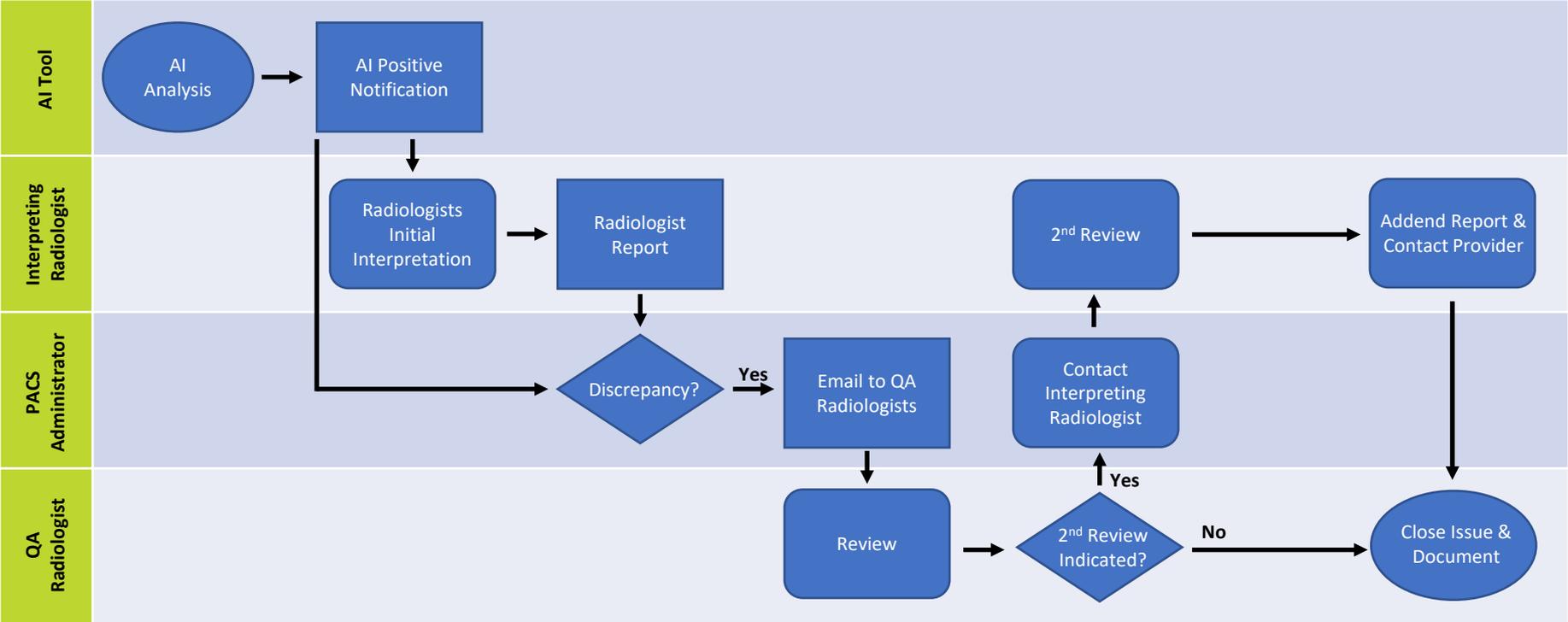
Results

Discordant Studies Identified

335 Cases Flagged Positive by AI

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115 Discordant Cases	220 Concordant Cases

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◄ **18 Cases Positive for PE on 2nd Review**
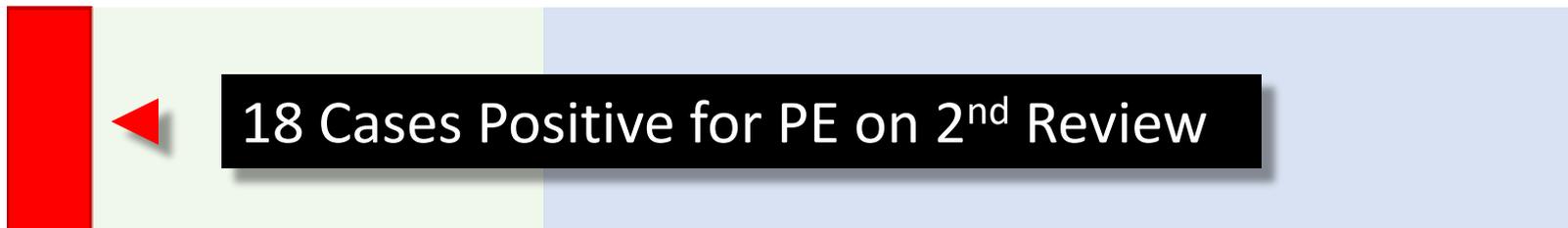
Results

PE Detection

- Of 335 cases flagged by AI as positive, 238 cases deemed truly positive for PE for a PPV of 71 %

- 220 cases correctly identified as positive for PE by initial radiologists interpretation
   - 18 cases positive for PE overlooked on initial interpretation

- **8.2 % improved PE detection rate** with use of AI and QA process

Results

Overlooked Cases

- 18 cases overlooked despite correct AI identification
  - 13 cases caused by human error (did not see notification)
  - 5 cases caused by technical error (notification not received or received late after initial interpretation)

- All 18 cases reviewed by the QA team and communicated to referring providers within 12 hours
  - 17 received anticoagulation subsequently
  - 1 lost to follow up
  - No adverse outcomes reported

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Results

Overlooked Cases: Study Type and PE Locations

Study Type

5 Overlooked Incidental PE

13	3	1	1
CTA PE	CT CAP	CTA Aorta	CT Abd

PE Location

11	6	1
Subsegmental	Segmental	Lobar

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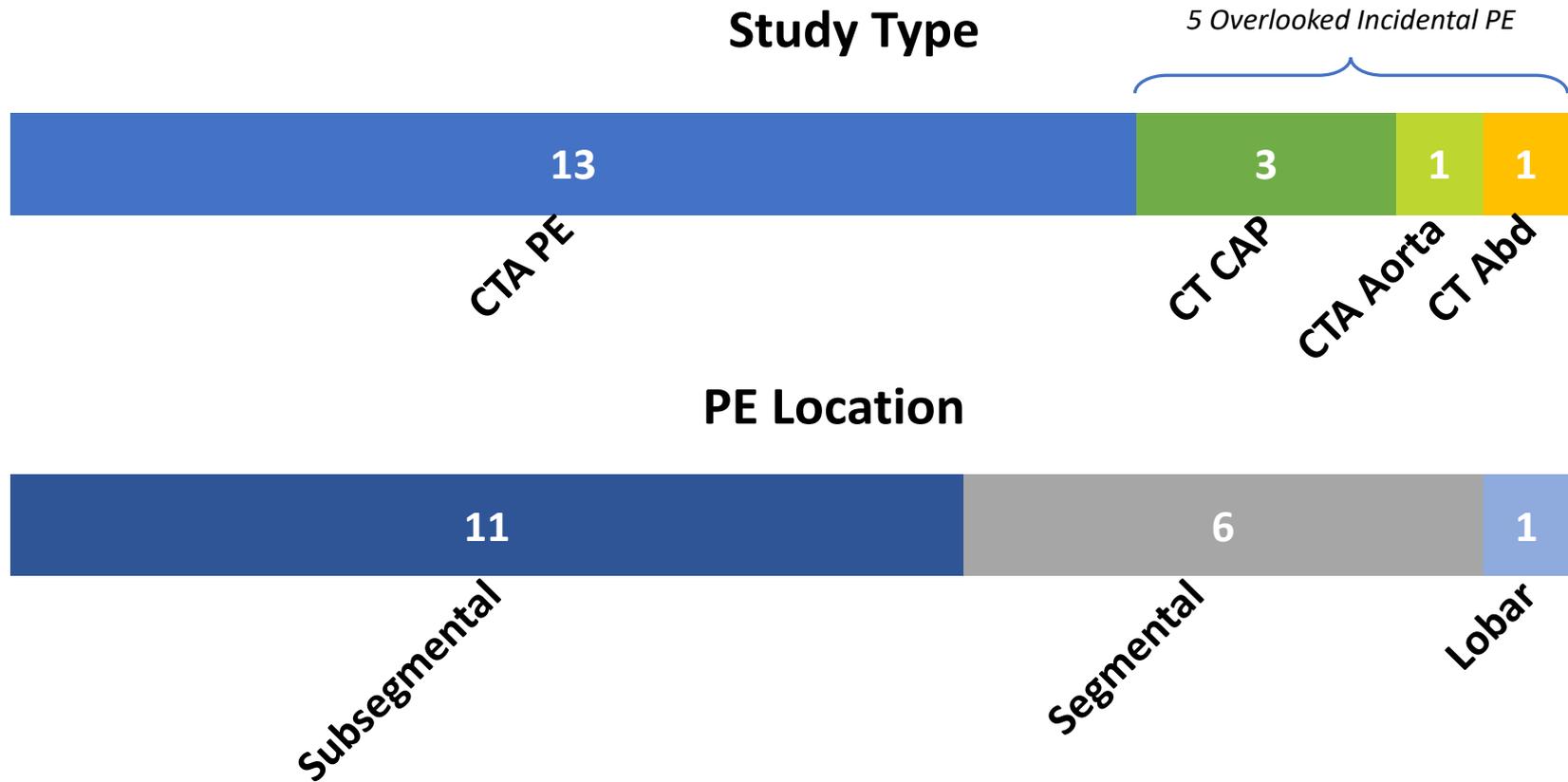
Conclusions

- AI assistance with QA process improved detection of acute PE with downstream changes in patient treatment

- Key factors for AI success:
  - Having "local champions" advocating for AI
  - Radiologists' interest in new technology and potential added value of AI
  - Departmental culture of innovation

- Key hindering factors for AI success:
  - Inconsistent AI performance
  - Large variance in acceptance and engagement by radiologists

- Path forward includes collaboration with AI developers to build automated mechanism to identify discordant cases in real time, increasing acceptance of AI by demonstrating clinical value, and continued QA processes monitoring for discrepant cases

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