

KEYNOTE

Improving Radiology Turnaround Times: AI Enhanced Efficiencies in the Lung Cancer Pathway



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Improving Radiology Turnaround Times: AI enhanced efficiencies in the Lung Cancer Pathway

Intelligent Health UK – 24 May 2023

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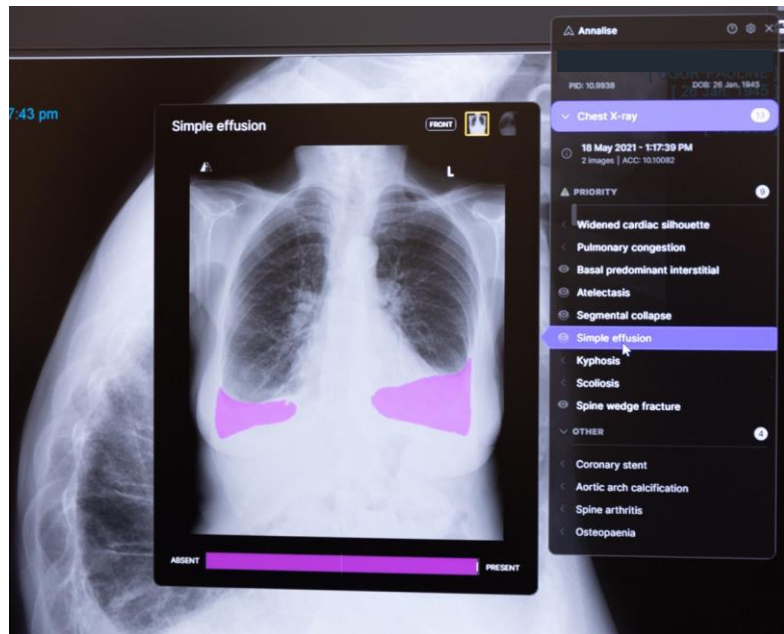
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NIHR

National Institute
for Health Research



Lung Cancer is a BIG problem!

EACH YEAR
**LUNG
CANCER**
COSTS THE NHS
AROUND
**£ 2.5
Billion**

EACH YEAR
IN THE UK THERE ARE
47,000
LUNG CANCER DIAGNOSES &
35,300
DEATHS DUE TO LUNG CANCER



STAGE I

IF DETECTED AT

STAGE IV



OUT OF 100

75

5

PEOPLE WILL
SURVIVE
LUNG CANCER



ONLY



OF
PATIENTS
ARE DETECTED
AT STAGE I

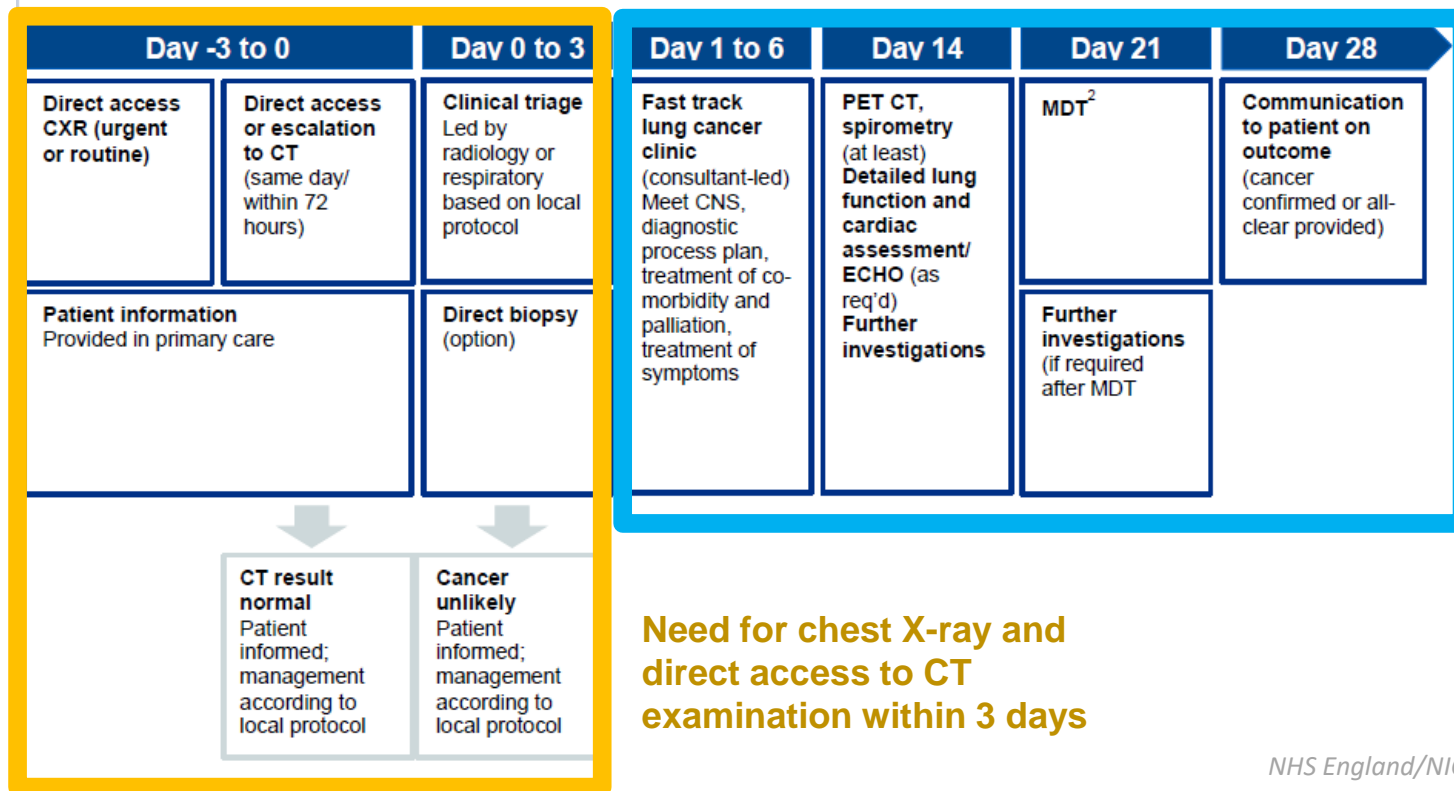
THERE IS AN **URGENT** AND **GROWING** NEED
TO IMPROVE EARLY DIAGNOSIS

IN **LUNG CANCER**



National Optimal Lung Cancer Pathway , NOLCP

28 day pathway



All investigations for confirmation of lung cancer/type by 28 days from triage

Need for chest X-ray and direct access to CT examination within 3 days

Clinical Problem

Can an AI enabled pathway improve the NOLCP?

- Improve % of patients getting a CT exam?
- Improve time to getting a CT exam (<72hrs)?
- Improve time to getting CXR and CT reports?

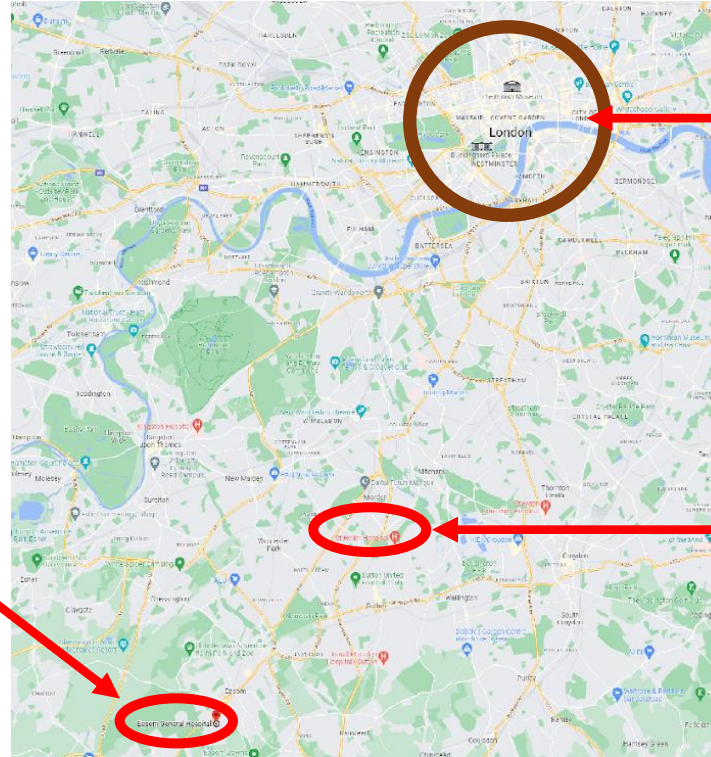
How do staff feel about introduction of AI?

Epsom & St Helier University Hospitals NHS Trust

Catchment population of 490,000 in SWL/Surrey
(incidence of lung ca in London is 140/100,000p ~ 700 pax pa)



Epsom Hospital, Surrey



Central London



St Helier Hospital, Sutton

Epsom & St Helier University Hospitals NHS Trust

Radiology Dept Staff

- Total = 195 staff altogether (medical/non-medical)
- Radiologists = 25 ; Reporting radiographers = 4

In prior audit 2021 (5 July – Oct, 3m)

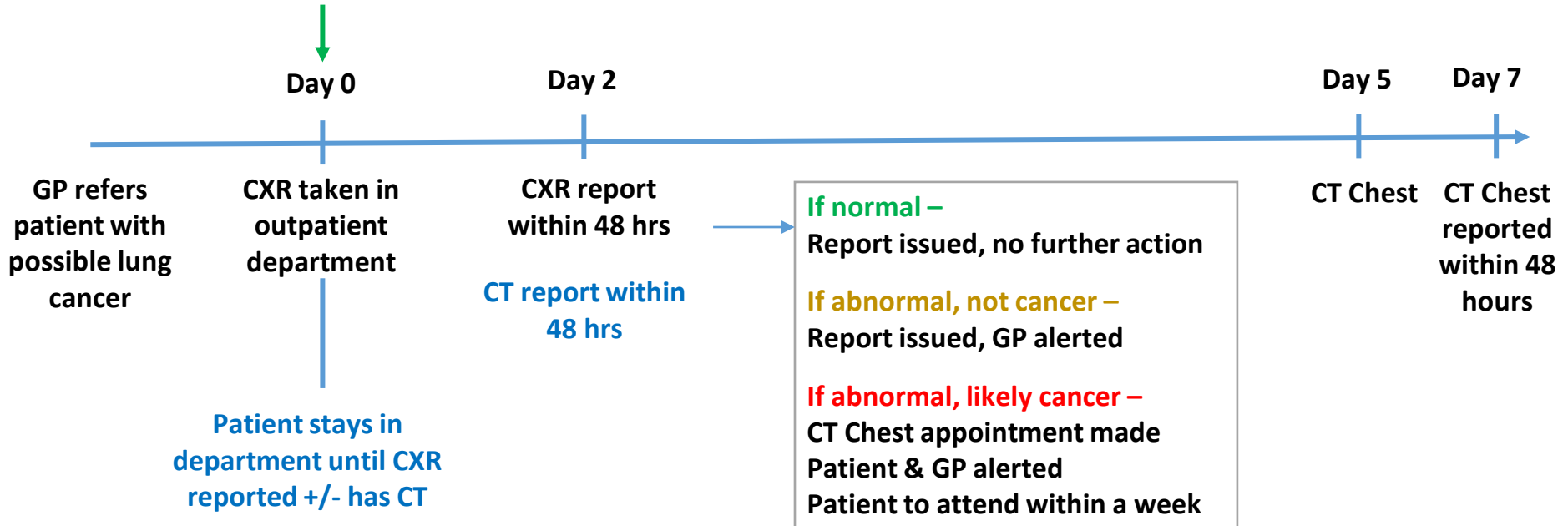
- 5700 CXRs referred -> 86 had a CT study -> 20 suggestive of cancer

CXR/CT in within 5 days – only 66% cases

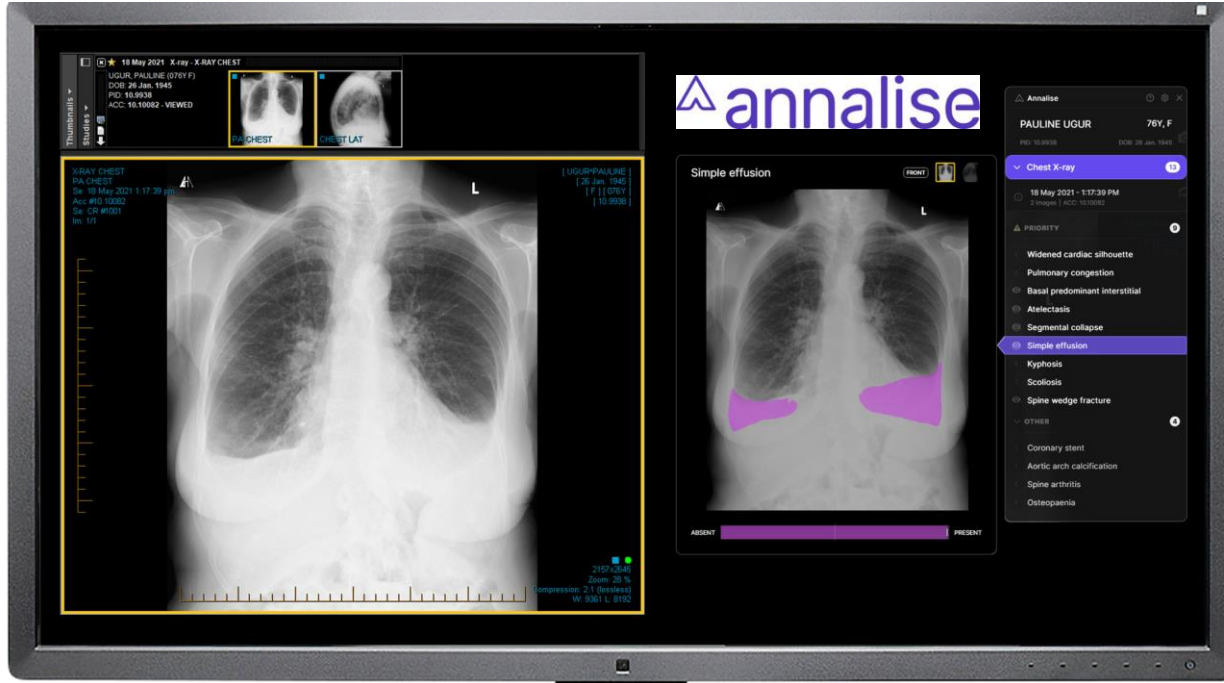
Patient Pathway

AI triage for possible lung ca

Radiographer calls duty reporter to report within 30 mins; if agree with AI = same day CT



Choosing the AI product – Annalise Enterprise CXR

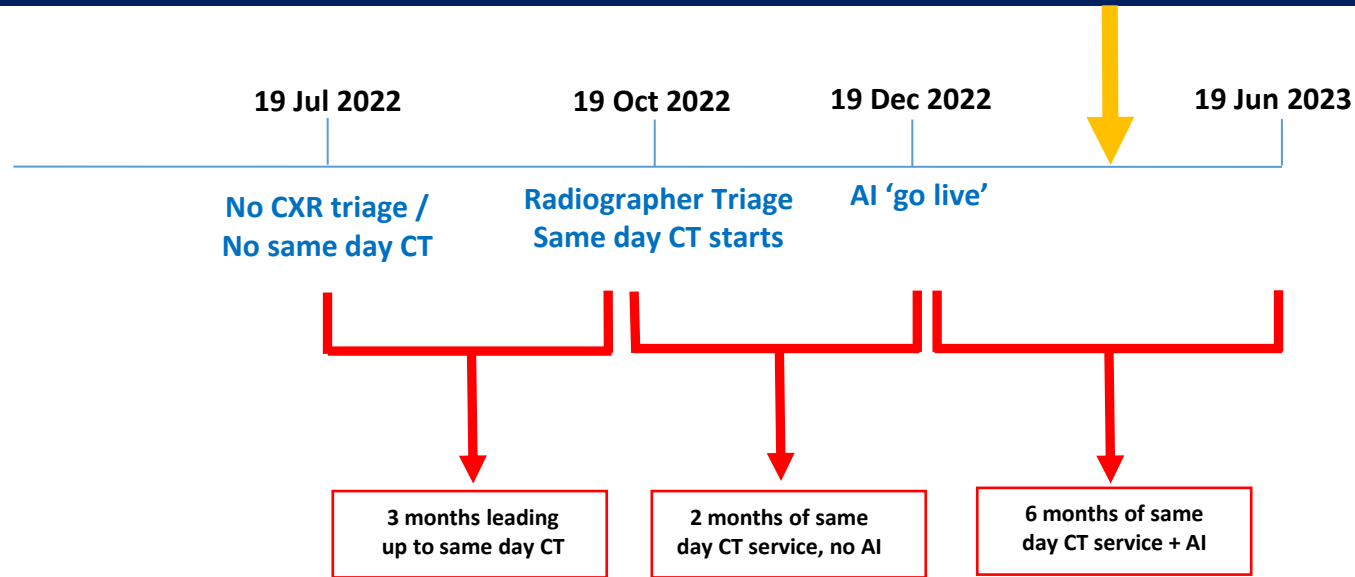


Can flag >120 pathologies
Only 14 were “turned on” specific to lung cancer

1. Cavitating mass
2. Cavitating mass internal content
3. Diffuse perihilar airspace opacity
4. Hilar lymphadenopathy
5. Inferior mediastinal mass
6. Multiple pulmonary masses
7. Pleural mass
8. Single pulmonary mass
9. Single pulmonary nodule
10. Superior mediastinal mass
11. Focal airspace opacity
12. Lung collapse
13. Segmental collapse
14. Diffuse pleural thickening

Evaluation of AI

**We're Here!
Still evaluating...**



Primary Outcomes

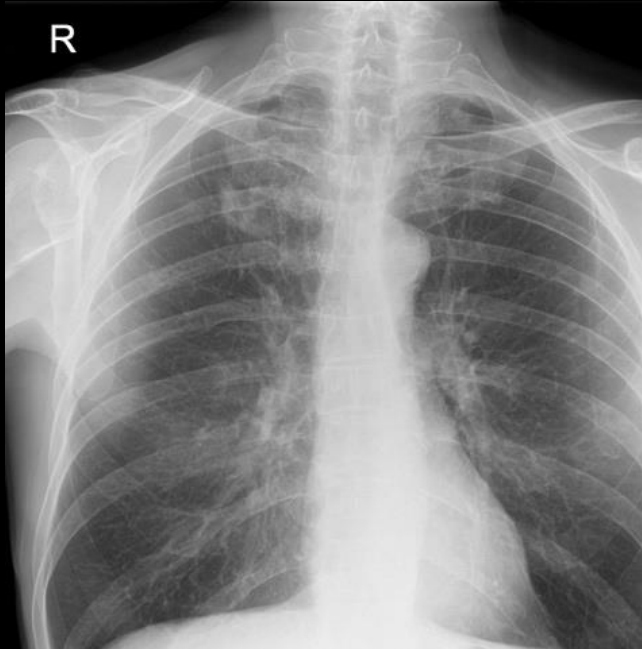
- % patients getting CT within 3 days of CXR
- time to CT Chest (& report) when suspicious lesion on CXR
- Appropriateness of CXR AI triage

% CT referrals & Turnaround Times

	No CXR triage	Radiographer triage	AI triage
Time period	3 months	2 months	4 months
Period Dates	10.7.22 – 9.10.22	10.10.22– 18.12.22	19.12.22 – 12.4.23
Total CXRs performed	3959	3833	7359
CXRs with possible lung ca (radiology report)	77 (2%)	72 (2%)	149 (2%)
CT follow-up same day	3/77 (4%)	14/72 (19%)	47/149 (32%) ↑
CT follow-up within 3 days (72 hours)	32/77 (42%)	43/72 (44%)	93/149 (62%) ↑
CT follow-up within 5 days (120 hours)	52/77 (68%)	57/72 (79%)	121/149 (81%) ↑
CT follow-up within 30 days	75/77 (97%)	68/72 (94%)	136/149 (91%) ↓

Turnaround Times *(days, unless specified)*

	No CXR triage	Radiographer triage	AI triage
Time period	3 months	2 months	4 months
Total CXRs performed	3959	3833	7359
Average time from CXR exam to CT exam (days)	4.8 (0-27)	3.6 (0-37)	2.5 (0-20) ↓
Average time for CXR report to CT report (days)	5.8 (0-30)	4.3 (0-37)	4.2 (0-24) ↓
Average time from CXR exam to CXR report (all)	0.9 (0-12)	0.6 (0-30)	0.4 (0-17) ↓
Average time from CXR exam to CXR report (possible lung cancer)	0.8 (0-4)	0.6 (0-7)	0.2 (0-5) ↓
Average time from CXR exam to CXR report (no finding of lung cancer)	0.9 (0-12)	0.6 (0-30)	0.4 (0 - 17) ↓



▼ Chest X-ray 4

6 Feb 2023 - 11:17:57 AM
2 Images | ACC: RVR05011230083

▲ NOLCP 4

- Focal airspace opacity ×
- Solitary lung nodule ×
- Solitary lung mass ☆ ×
- Cavitating mass(es) ×

⊕ ADD FINDING...

AI FEEDBACK

- Normal film (true negative)
- Great pickup
- Significant/bad miss

COMMENTS

Submit feedback

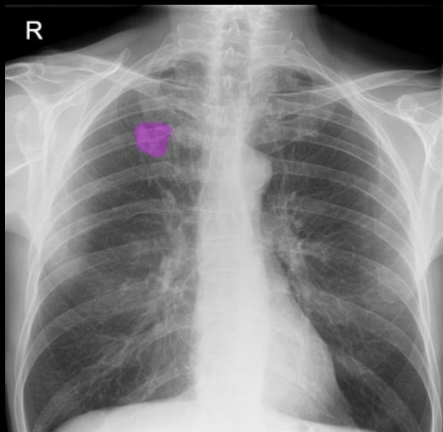
59yo Male – sent by GP Lung Cancer?

Imaging incompletely acquired
first time

4 differentials brought up by the
AI tool

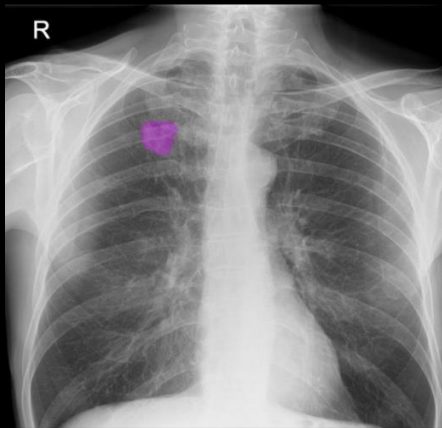
4 differential diagnoses flagged – same region

Solitary lung mass



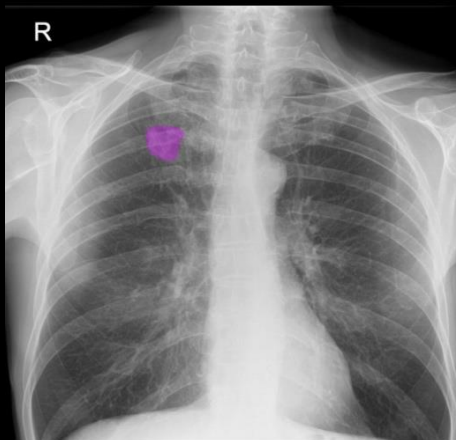
Solitary lung mass

Cavitating mass(es)



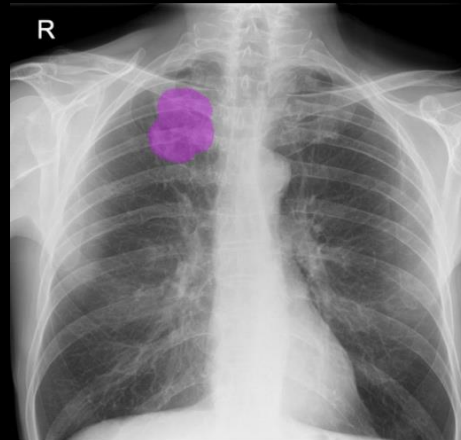
Cavitating mass (es)

Solitary lung nodule



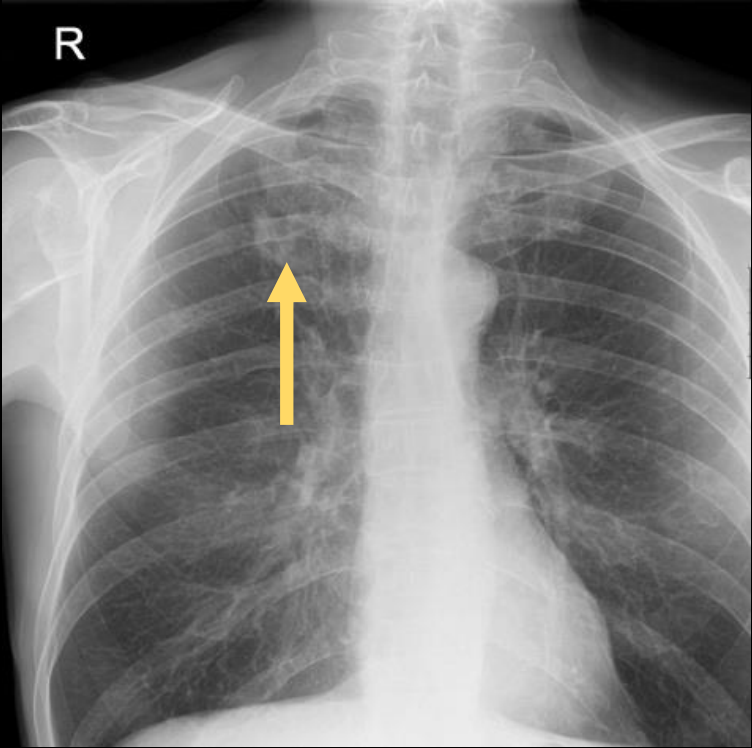
Solitary lung nodule

Focal airspace opacity

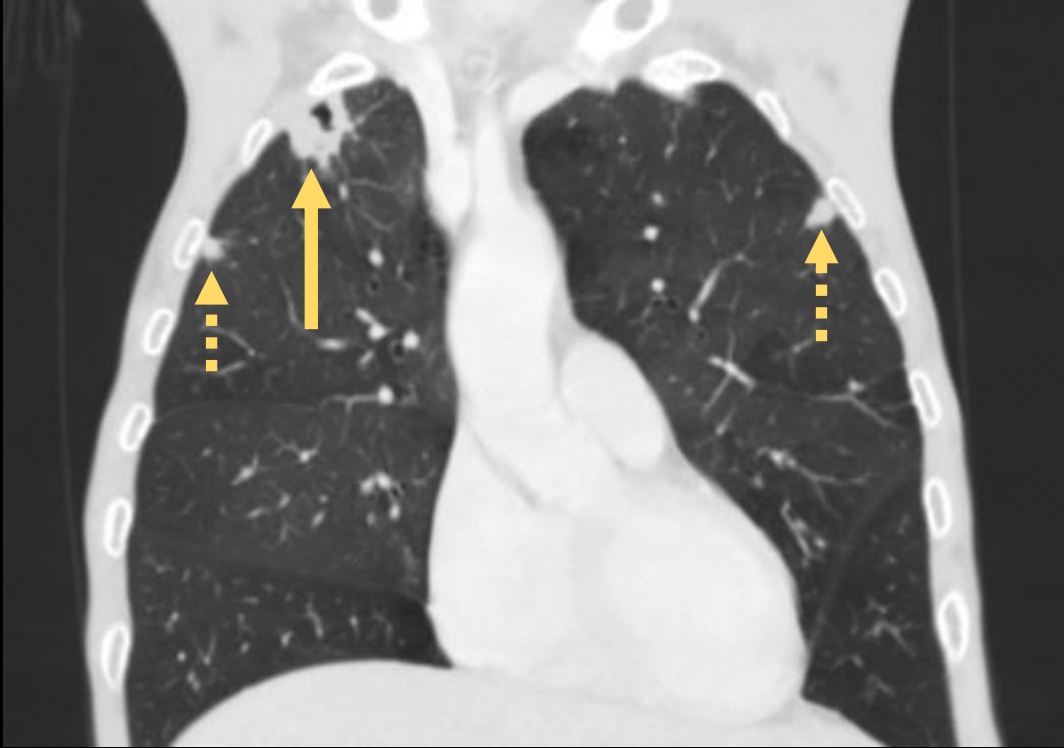


Focal airspace opacity

Chest X-Ray



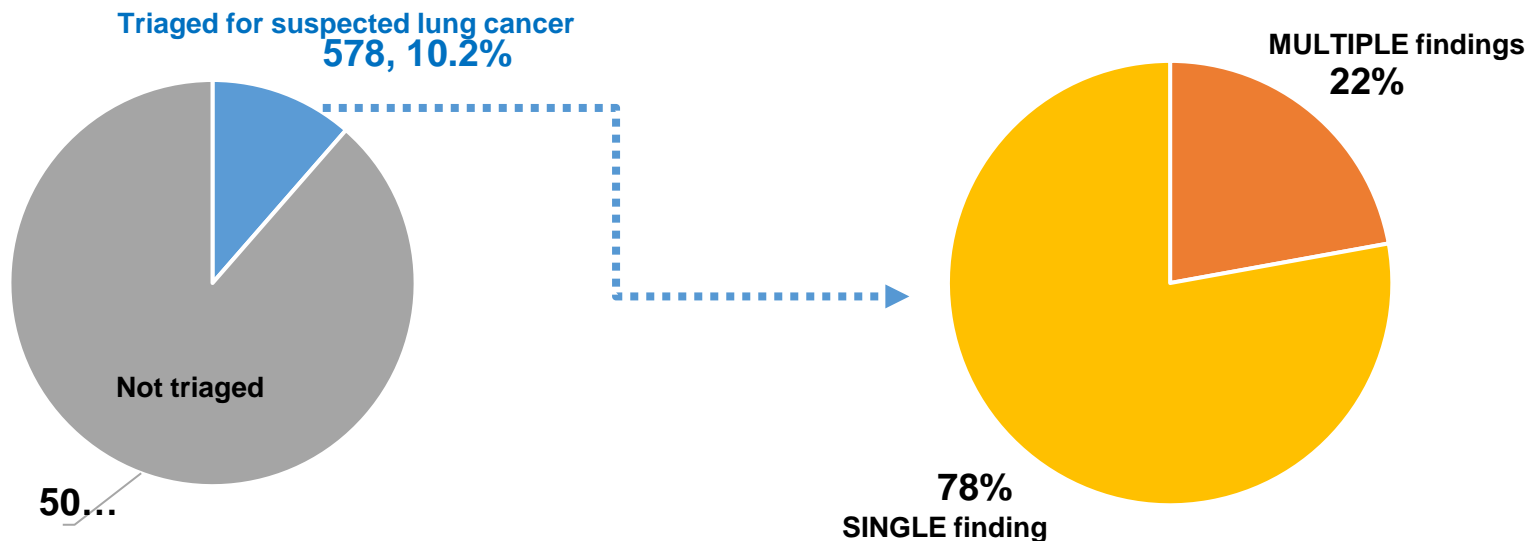
Chest CT



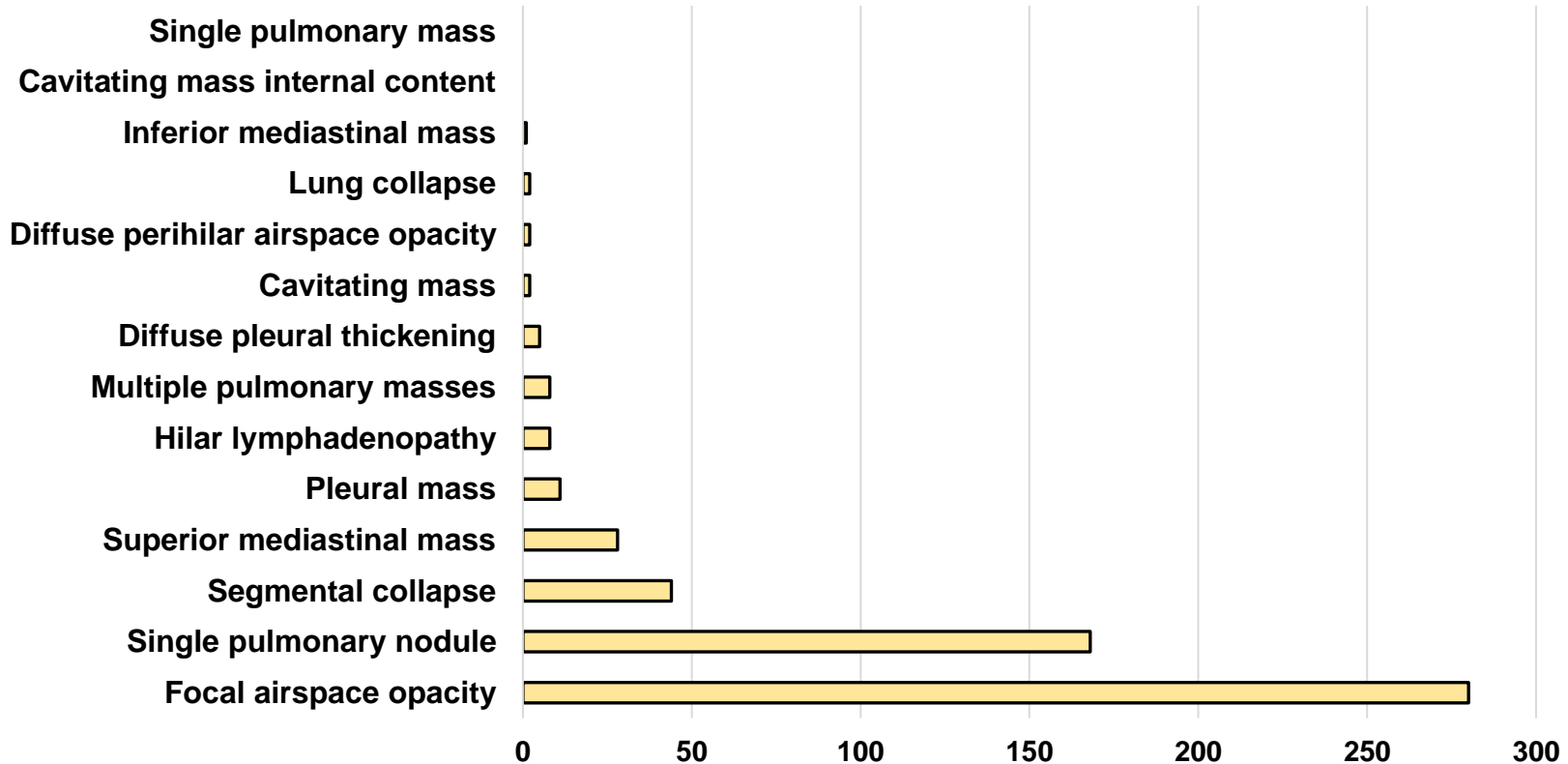
AI findings

(NOLCP triage findings – 3 months data, courtesy Annalise.ai)

5613 consecutive CXRs referred by GP, between 19.12.2022 to 10.03.2023



AI findings (*NOLCP triage findings*)



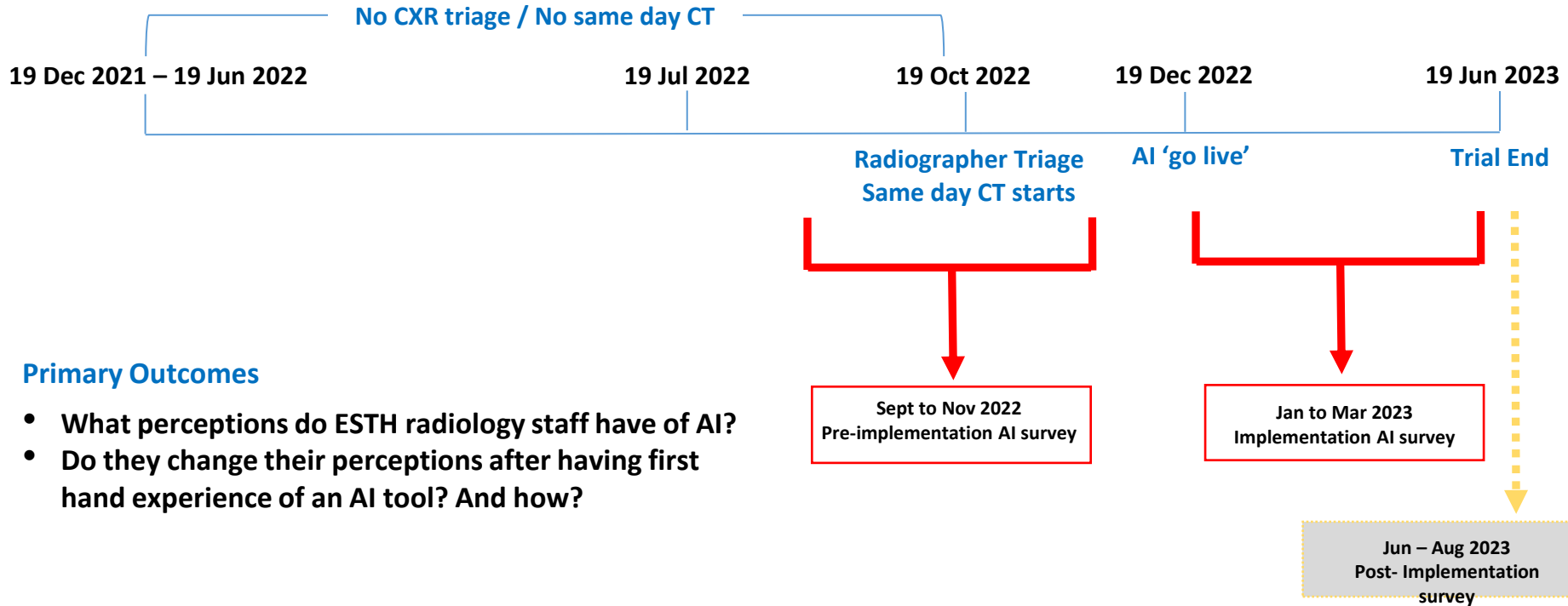
AI findings (*NOLCP triage findings*)

Suspected Lung Cancers (Radiologist Report = Ground Truth)

	AI +	AI -	Total
Report +	TP: 68	FN: 48	116
Report -	FP: 510	TN: 4987	5497
Total	578	5035	5613

Sensitivity: 58.6%
Specificity: 90.7%
PPV: 11.8%
NPV: 99.1%
Accuracy: 90.1%

Service Evaluation of AI



Primary Outcomes

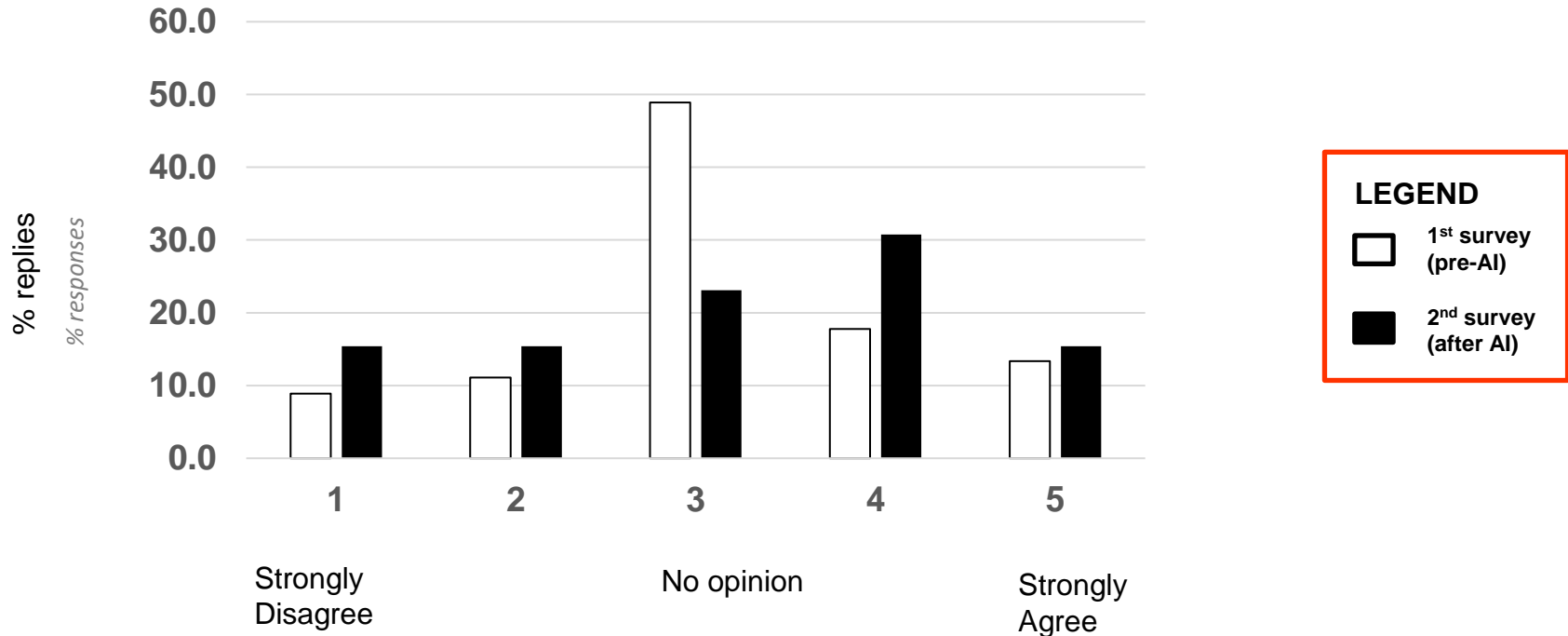
- What perceptions do ESTH radiology staff have of AI?
- Do they change their perceptions after having first hand experience of an AI tool? And how?

ESTH Staff Survey

Pre-implementation survey = 45 responses (23% response rate)

Implementation survey = 26 responses (13% response rate)

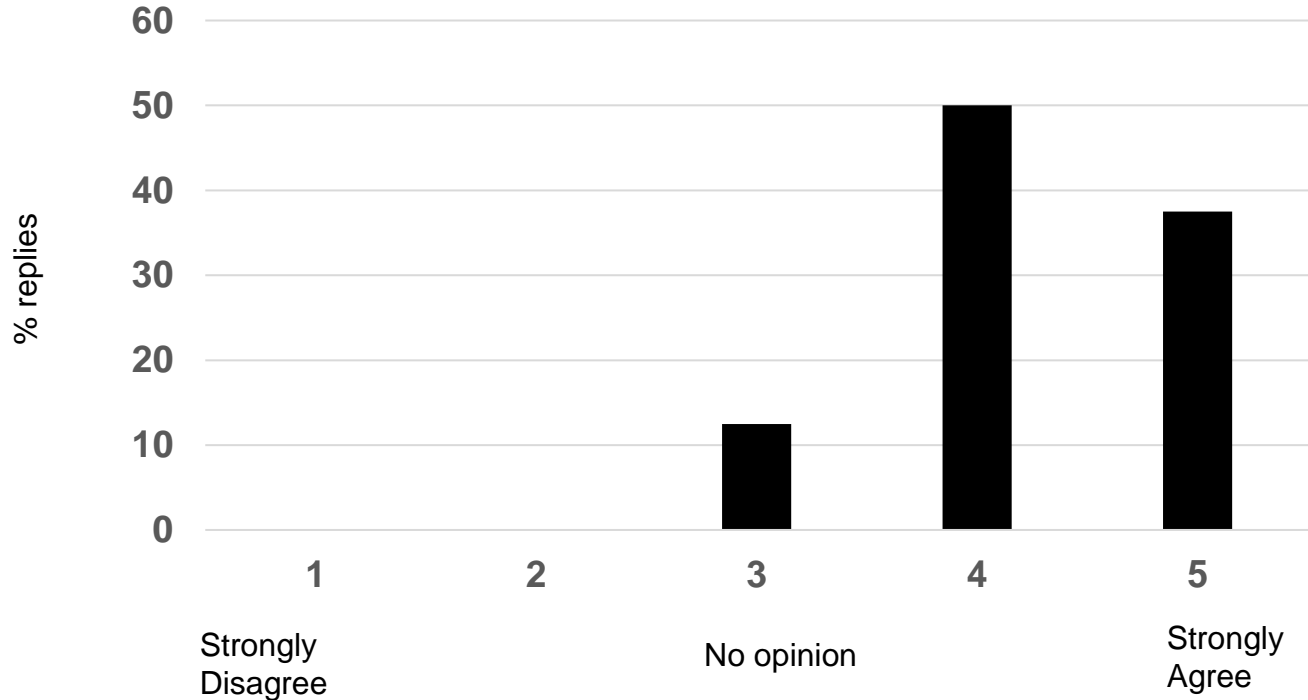
I would be comfortable for an AI tool to be used to diagnose my own CXR if I was referred to hospital.



ESTH Staff Survey

Specific queries regarding AI tool directed at those reporting CXRs only (n=8)

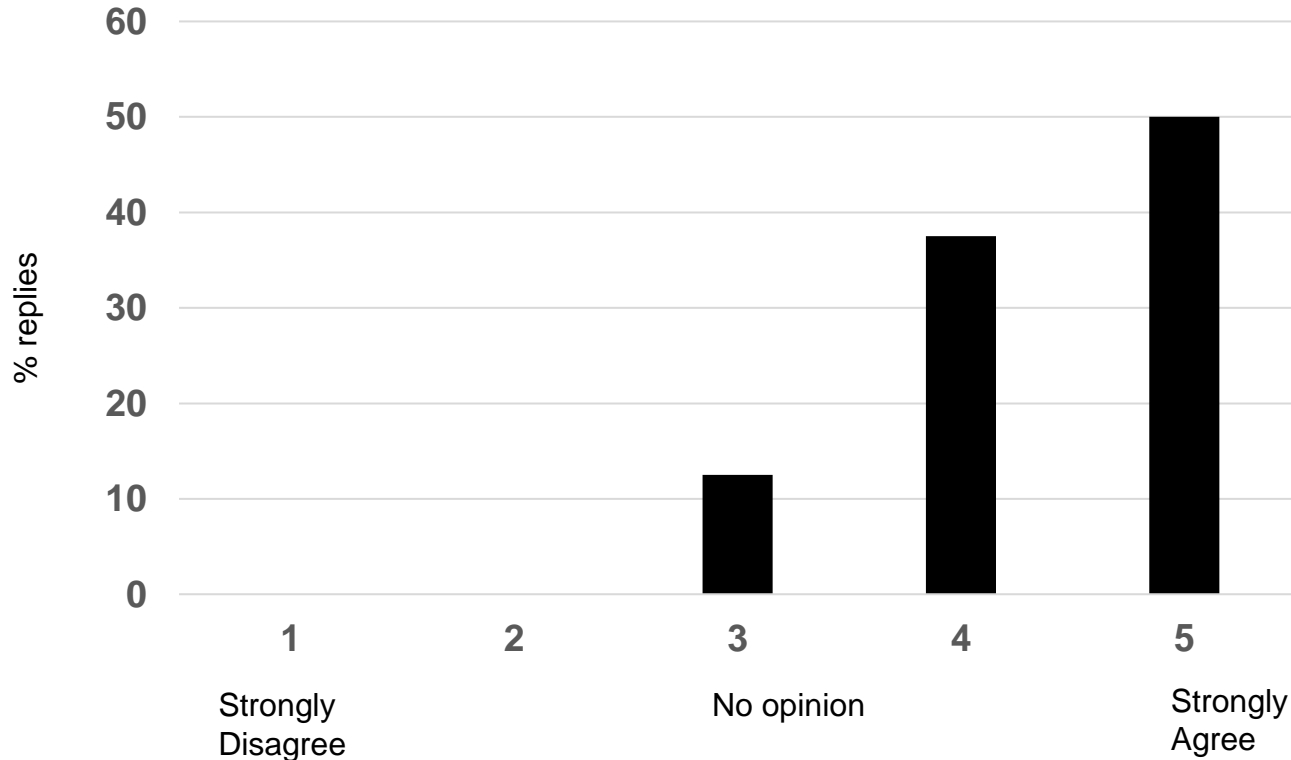
I **enjoy** using the AI tool in my reporting sessions



ESTH Staff Survey

Specific queries regarding AI tool directed at those reporting CXRs only (n=8)

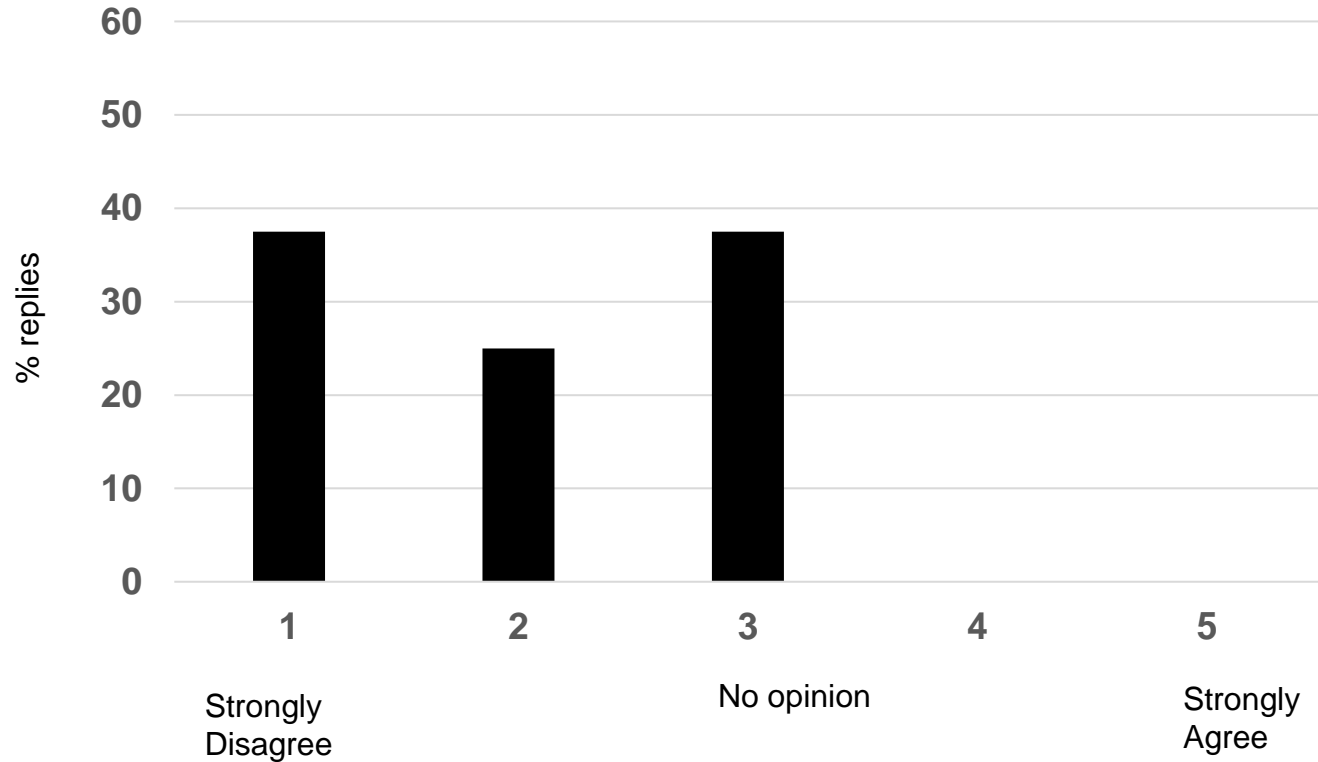
I feel able to recognise the limitations of the AI tool



ESTH Staff Survey

Specific queries regarding AI tool directed at those reporting CXRs only (n=8)

I feel I am **becoming reliant** on the AI tool for making CXR decision/diagnoses



- *When we send AI positive CXRs to reporters but they don't know what has been flagged.*
- *Increases work if positive as need to report, sort out CT scan and inform patient of CT. Not everyone can do this. CT not always able to scan. Patient not always willing to wait. Unclear who's responsibility it is.*
- *AI increasing waiting times for patients in Xray OPD as need to check AI results and wait for report to be issued.*
- *Too many false positives*

Future Steps

- **Currently only 4 months post AI implementation**
 - To continue until 19 June 2023 (6 months total)
 - Results still being regularly analysed – lots questions still to answer
 - Regular updates and data collection fortnightly
- **Expand the use case for the AI tool for urgent CXR findings**
- **Implement AI tools for CT Chest evaluation of lung cancer**
- **Evaluate a case for AI funding – business plan**
 - Do we same money and time? Does this make financial sense?
 - Secured funding to use AI tool for another year (until June 2024)

Thank you to our wonderful team!

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INTELLIGENT HEALTH UK 2023

Breaking down the barriers
between tech and healthcare