Radiology & AI Workshop: Cost benefit analysis – Insights from pilot studies

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Agenda

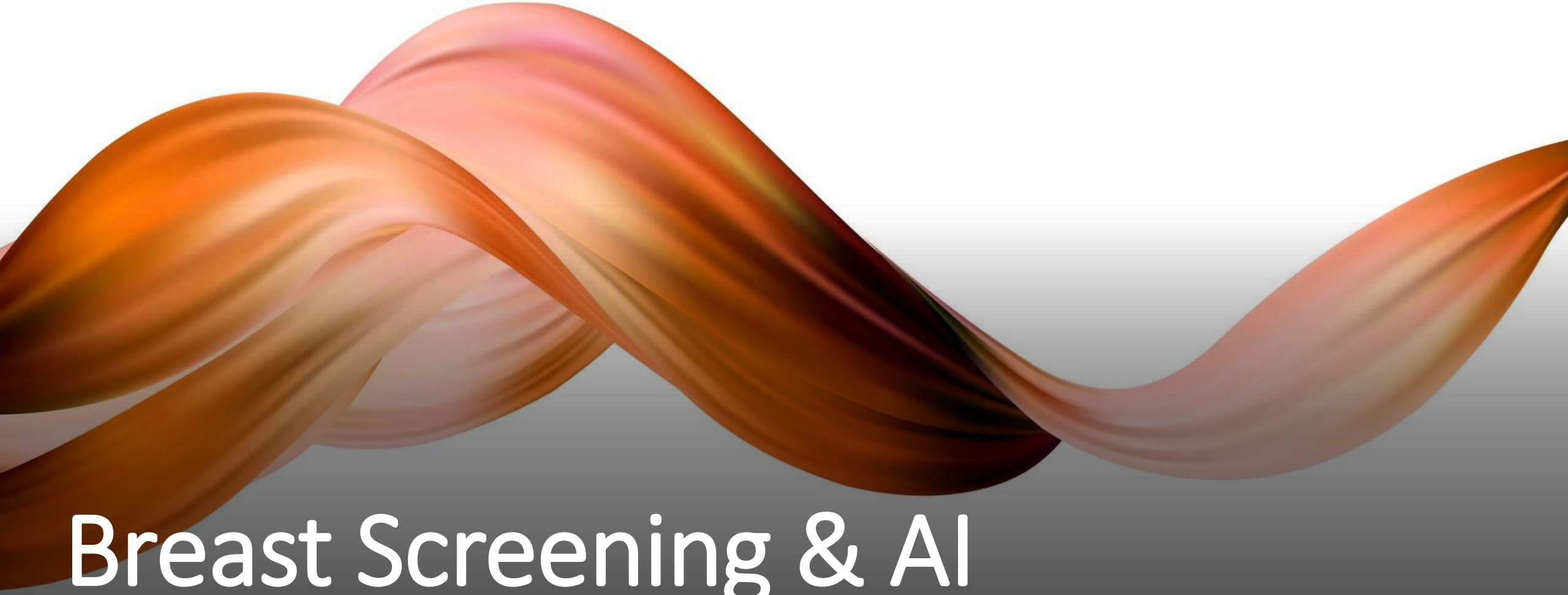
Why cost benefit analysis

Using AI in Breast Screening

Using AI in CXR reporting

Steps of a cost benefit analysis

- Establish a framework for your analysis
- Identify your costs and benefits
- Assign a value to each cost & benefit
- Tally the total value & compare



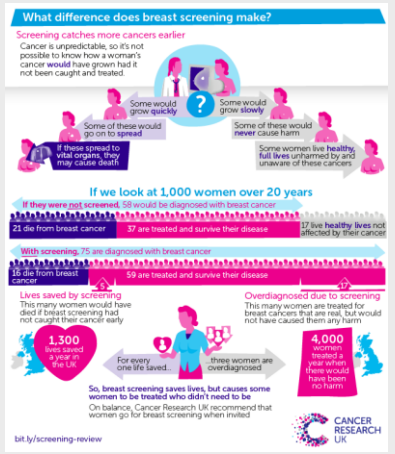
Breast Screening & AI

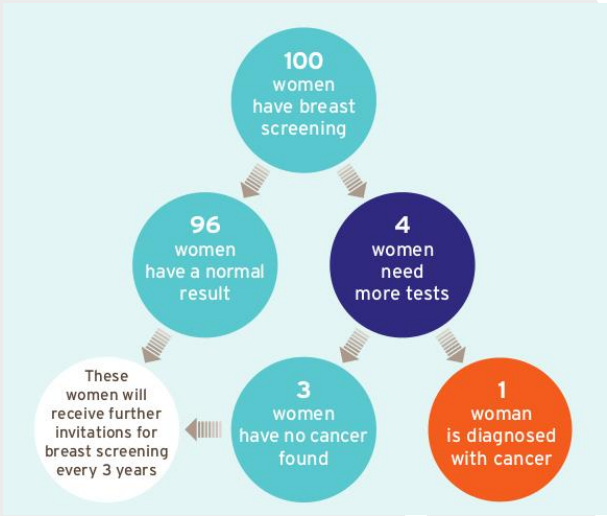
Breast Cancer Screening

- About 1 in 8 women in the UK are diagnosed with breast cancer during their lifetime.
- Breast screening aims to find breast cancers early

- BENEFITS
- Very early cancers are much easier to treat.
- Early diagnosis can result in a cure.
- Evidence demonstrates 1300 lives saved a year by screening.
- Early stage cancers → 9 in 10 chance (90%) 5 year survival.

- HARMS
- false positives and false negatives
- Screening doesn't always find cancer.
- False positives = anxiety
- False negatives = delayed diagnosis.





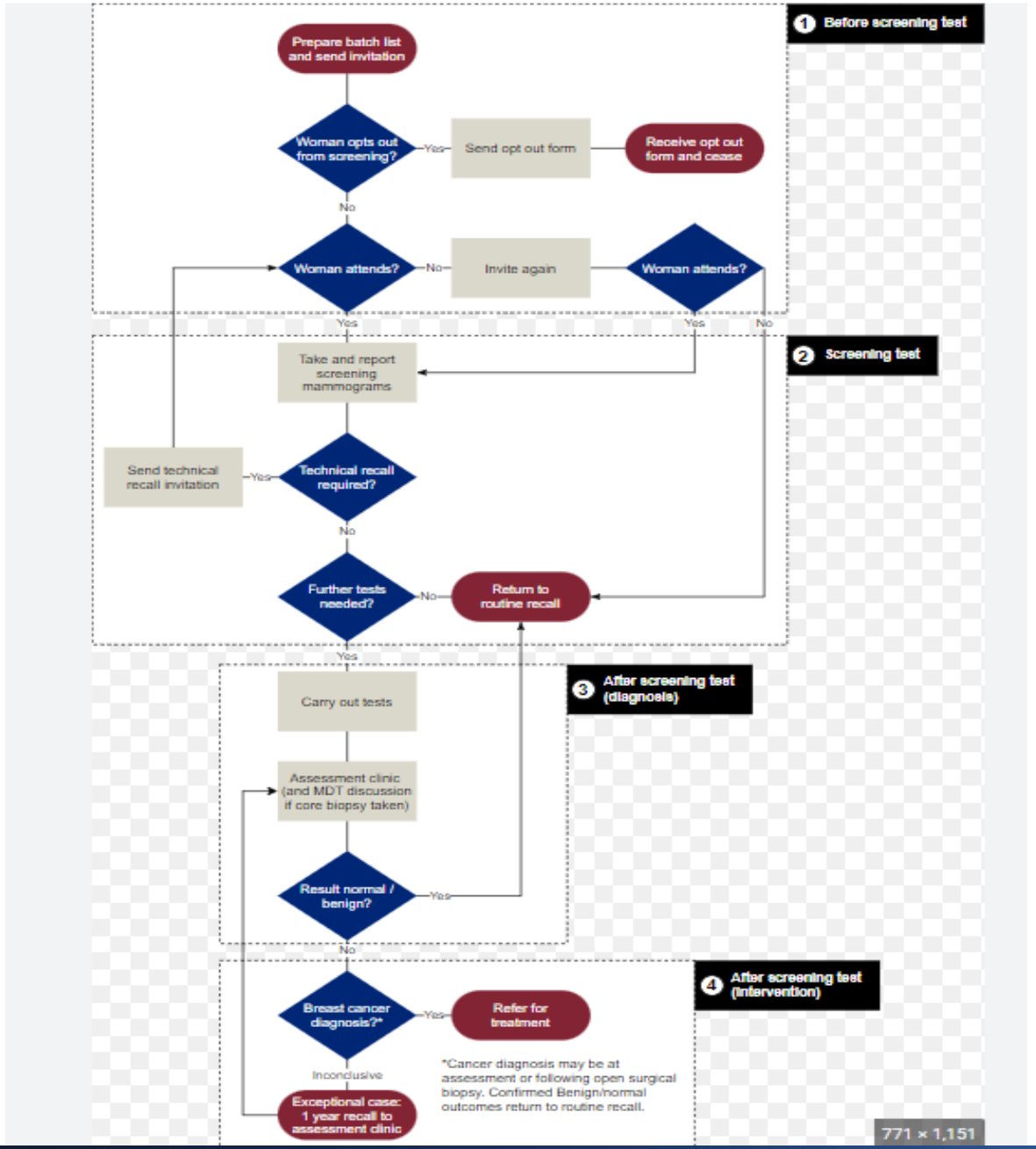
Current challenges in breast cancer screening

- **Ageing population:** associated with increasing incidence of cancer
- **Understaffing:** 25% of NHS Breast Screening Programme units operate with just one or two consultant radiologists and have no cover for sickness or absence
- **Retirements:** 21% of breast radiologists are likely to retire by 2020 and 38% by 2025
- **Vacancies:** Around 13% of consultant breast radiologist posts across the UK are vacant. The number of unfilled posts has doubled since 2010. Too few of these specialists are being trained

2016 RCR report reveals workforce crisis in UK breast cancer screening and diagnostic services

END TO END BREAST SCREENING PATHWAY

- (Figure 1- https://www.gov.uk/government/publications/breast-screening-pathway-requirements-specification/breast-screening-pathway-requirements-specification)



AI use in Clinical Pathway

Send invite

- Inform frequency of screening; risk stratification
- Clinic management/ reduce DNAs by identifying times/ dates/sites
- Use for communication/ information

Capture Image

- Assess image quality
- Dose optimisation
- Quality control assessment

Read image

- Triage & prioritisation
- Breast density
- Lesion detection, classification & characterisation

Confirm outcome

- Supporting classification in mammogram, ultrasound, MRI reading & pathology

Role of AI

Multiple opportunities to measure outcomes in this pathway at different stages:

In the screening diagnostic phase, outcomes that could be measured are recall rates for abnormal mammogram and cancer diagnosis on histology. Further outcomes to do with normal results could also be considered including normal response letter. Or even focus on making workforce more resilient.

In the treatment phase, outcome measurements would be centred around response to different treatment options- surgery/ chemotherapy/ radiotherapy or hormone treatment. Here QUALY scores, or even patient experiences could be considered including morbidity during and after surgery.

I find it particularly fascinating as the potential of Artificial Intelligence (AI) in this pathway can further impact outcome measurements, in all the different stages. This is an area I am very interested in as it will be useful to look at the outcomes, cost and therefore the potential value of AI for the patient.

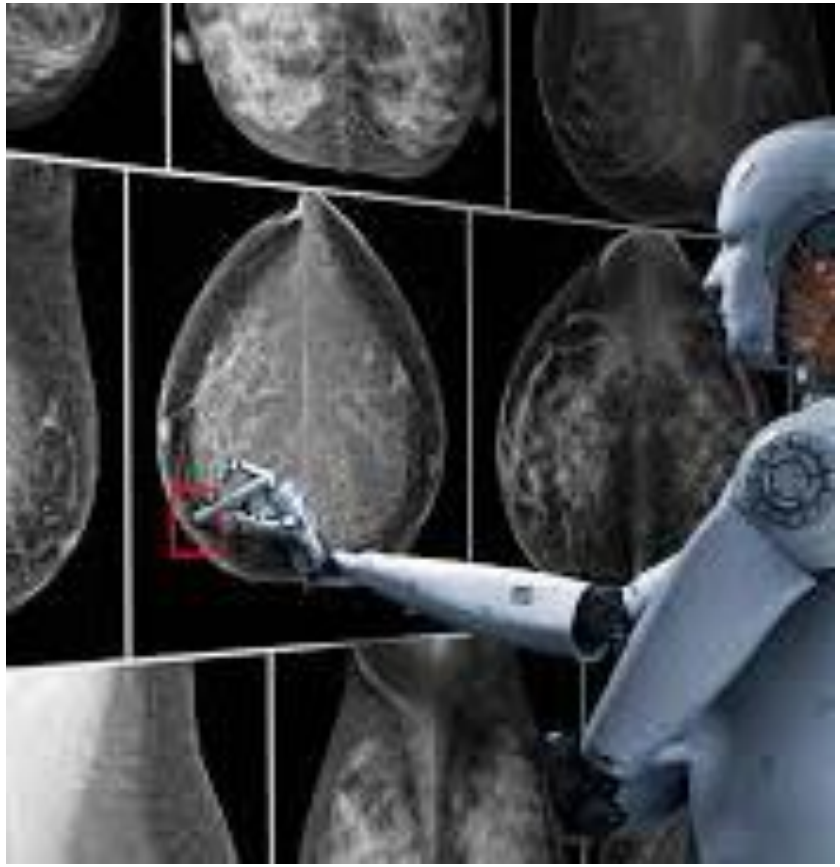
I am interested in its ability to augment the speed of recall whereby still retaining another human in the two reader mammogram pathway. This has huge potential to affect the cancer diagnosis outcome, and in turn the treatment outcomes.

Outcomes to measure:

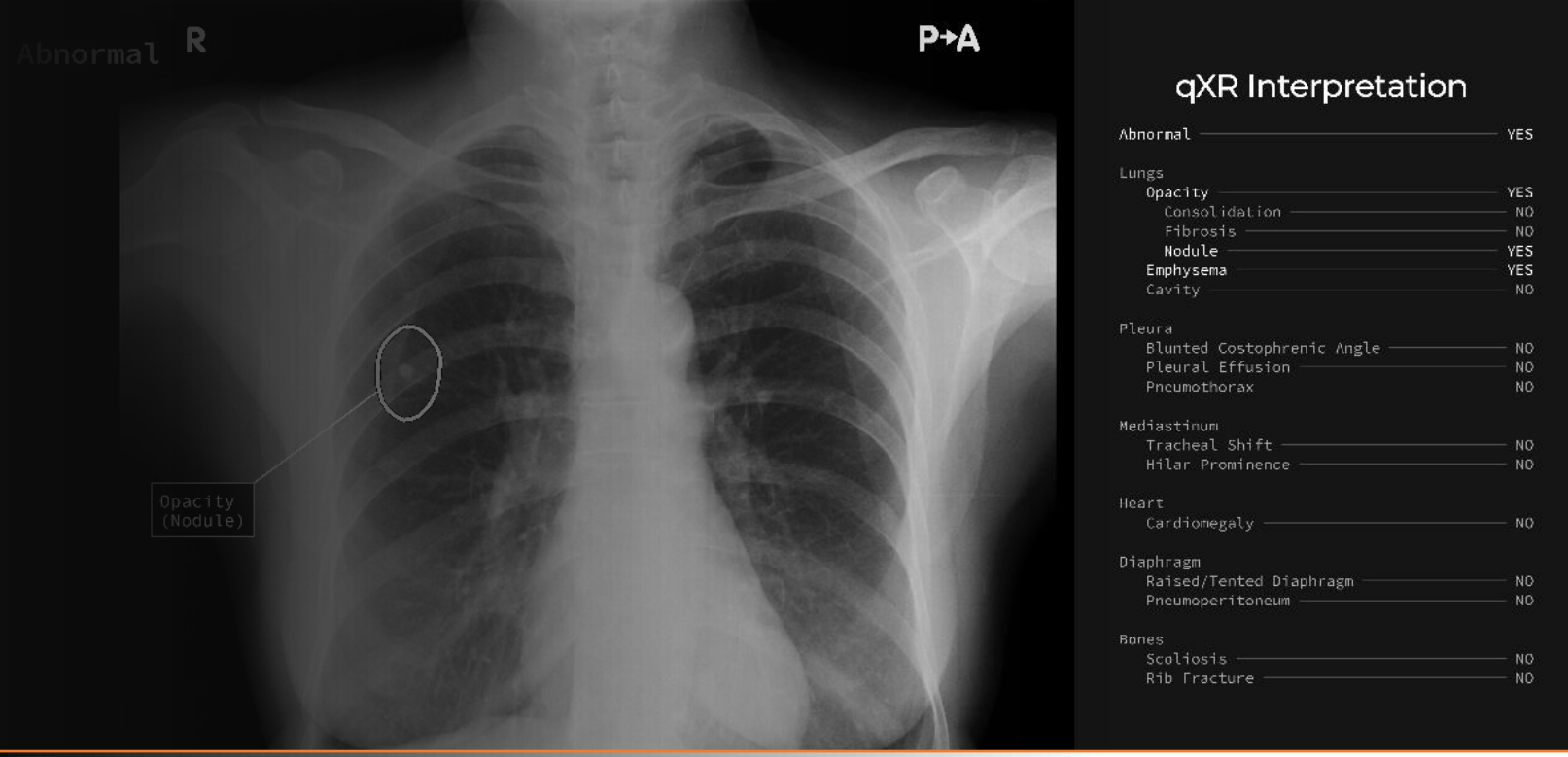
- Identify the key quantifiable measures-
- Provider-reported:
  - Recall rates of mammograms
  - Total biopsy rates
  - Benign biopsy rate
  - Cancer diagnosis rate (on histology)
  - No of days from diagnosis to treatment plan (process)
  - No of days from mammogram to diagnosis (process)
- Patient-reported:
  - Stress & anxiety
  - Emotional functioning
  - Ability to work

Impact of AI

- Huge potential patient benefits, including faster cancer diagnostic pathways by triaging cancers using AI, while at the same time reducing the number of unnecessary mammogram recalls and benign ultrasound biopsies, reducing extra clinic visits, and the anxiety associated with these visits (Lives saved-Time saved-Costs saved)
- AI also has the potential to provide democratisation of care by reducing the variability in recall rates between different screening centres.
- An exciting scope is to see if AI will reduce the incidence of interval cancers, while simultaneously detecting grade 3 cancers. This finding would be of great benefit within breast screening centres and would aid in the adoption of AI as it could potentially improve long-term survival of patients.

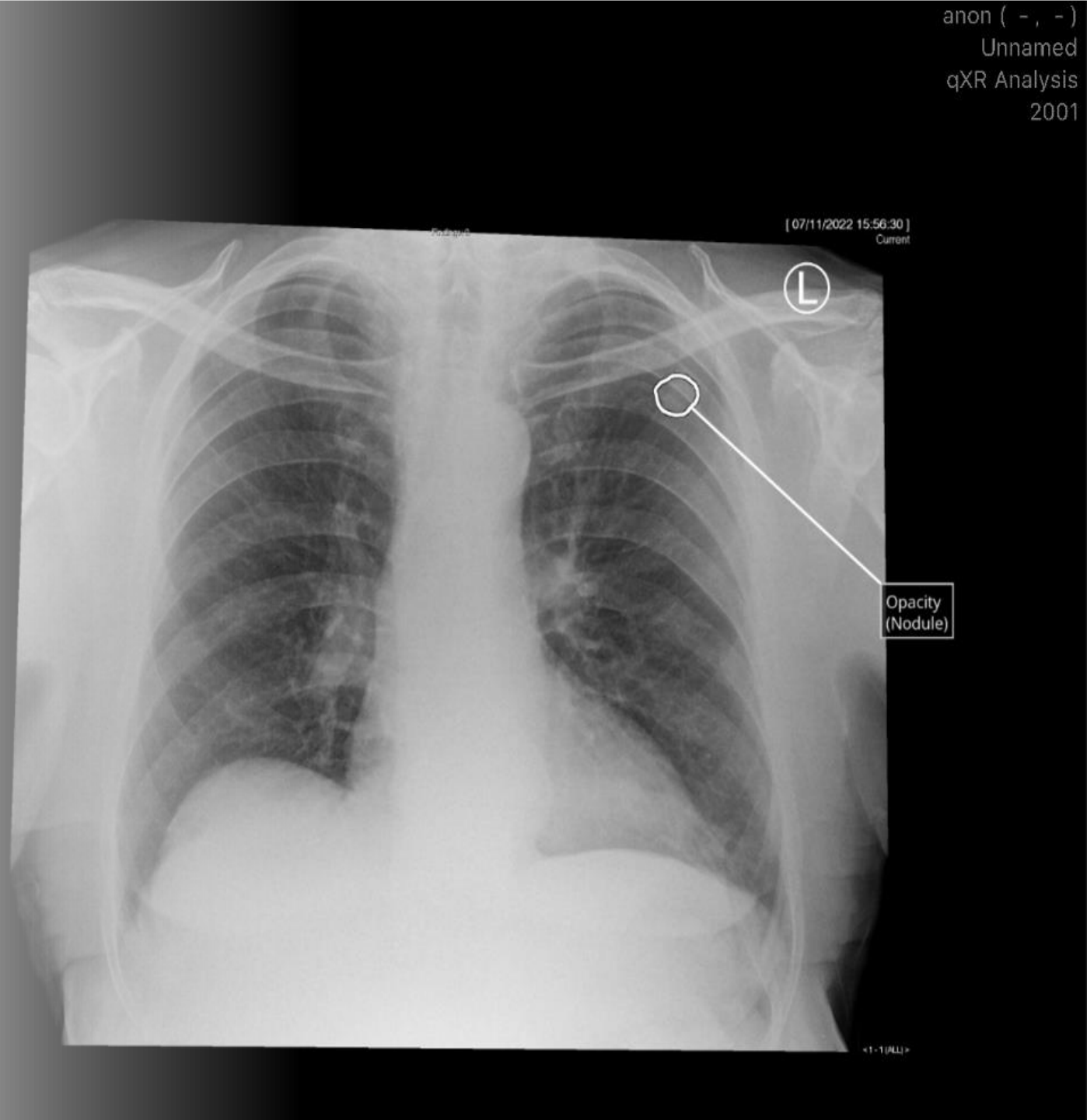


CXR & AI


Abnormal
R
P→A
Opacity
(Nodule)
qXR Interpretation
Abnormal YES
Lungs
Opacity YES
Consolidation NO
Fibrosis NO
Nodule YES
Emphysema YES
Cavity NO
Pleura
Blunted Costophrenic Angle NO
Pleural Effusion NO
Pneumothorax NO
Mediastinum
Tracheal Shift NO
Hilar Prominence NO
Heart
Cardiomegaly NO
Diaphragm
Raised/Tented Diaphragm NO
Pneumoperitoneum NO
Bones
Scoliosis NO
Rib Fracture NO

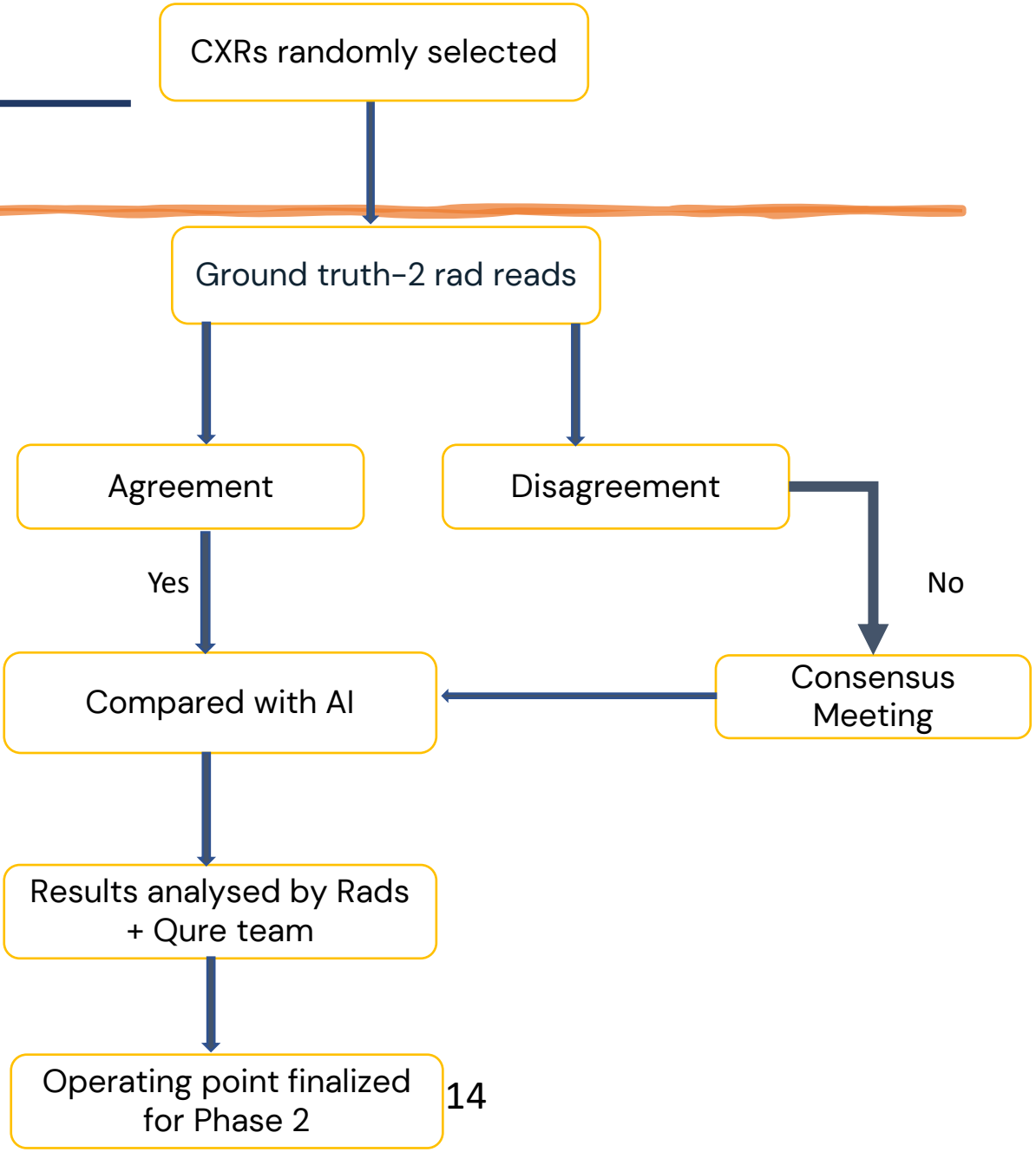
The need for CXR AI

- GP and OP approx. 120 Chest X-ray daily
- GP CXR are reported within 24-48hours
- Hypothesis: AI - qXR has the potential to triage at least 40% of normal CXR away from the consultant radiologist reporting worklist
    - Allowing faster diagnosis for lung cancer
    - More time for specialists for complex imaging reporting



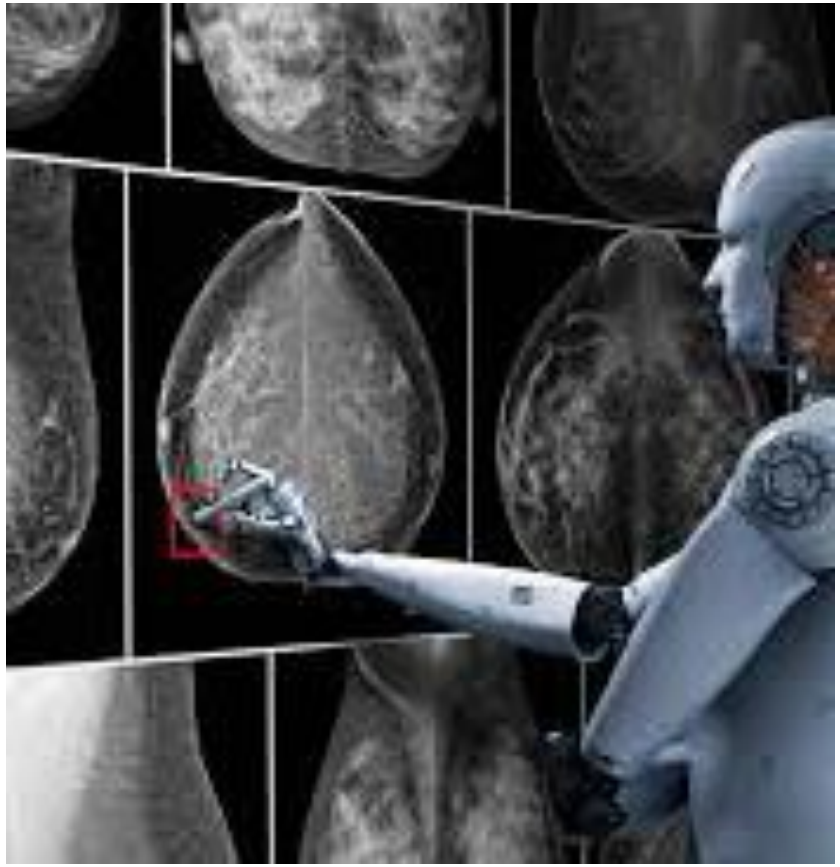
Methodology- A Collaborative Approach

- 522 Chest X-Ray randomly selected ~ 3 months
- OP and GP Pathway
- 2 independant reads by Consultant Radiologist
- Discordant cases were discussed
- AI and Radiologist was compared on Qure Application
- Adjustment to operating points
- Data was recorded and analysed



Impact of AI

- ~58-60% of normal CXR have the potential to be assigned for final reporting by a non-consultant as low risk of errors – Consultant could get to abnormal scans faster (faster turnaround time – faster cancer diagnosis); Radiographers upskilled/ training/ career growth
- Time saving of up to 2 hours - More time for consultant radiologist to focus on specialist and complex imaging reporting
- Faster diagnosis for subtle cancer cases; improved accuracy



Thank you