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Implementing AI in Hospitals and Trusts in England

HOSPEEM Webinar: Partnerships in Digital Skills Development
17 November 2021 | 10.30 - 12.30 (CET)



Overview

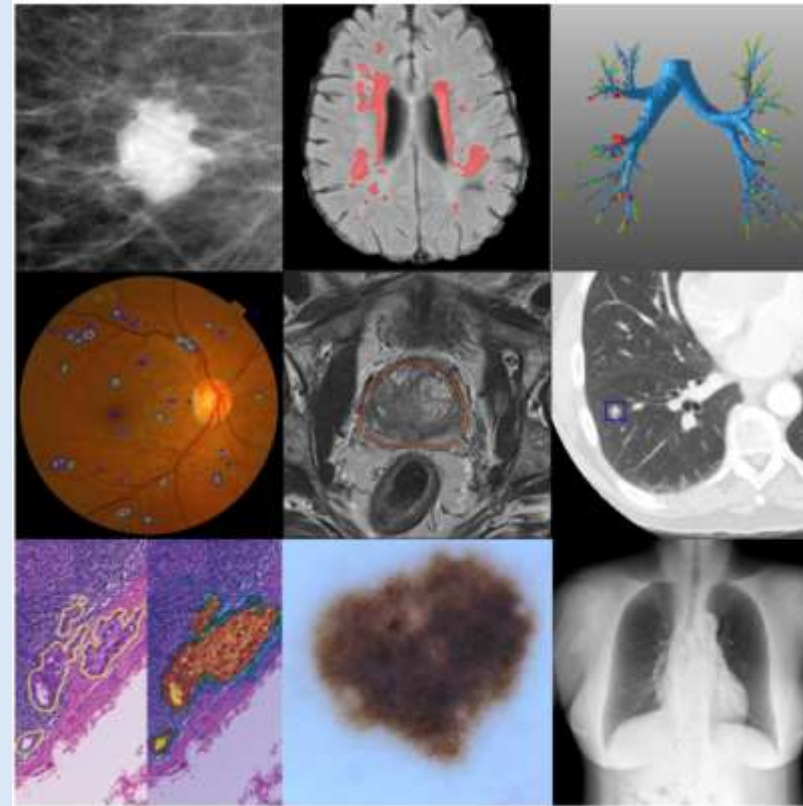
My team have been working on research database, AI training/validation and AI integration

- Focused on Imaging
- AI tools to aid existing healthcare workers
- Understand what is required from hospitals to onboard AI
- Better understand what staff groups (e.g. clinical scientist) might be involved in commissioning and monitoring AI in the future

Deep Learning Applications

Computer Aided Diagnosis

- mammographic mass classification
- segmentation of lesions in the brain
- leak detection in airway tree segmentation
- diabetic retinopathy classification
- prostate segmentation
- lung nodule classification
- breast cancer metastases detection in lymph nodes
- skin lesion classification
- bone suppression in x-rays



Litjens, Geert, et al. "A survey on deep learning in medical image analysis"

Medical Image Analysis 42 (2017)

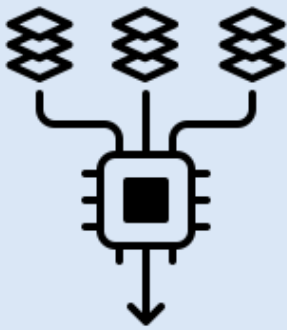
**WHAT IS THE UNDERLYING
REQUIREMENT FOR ALL OF THESE?**

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DATA

WHAT IS THE UNDERLYING REQUIREMENT FOR ALL OF THESE?

DATA



Training



Validation



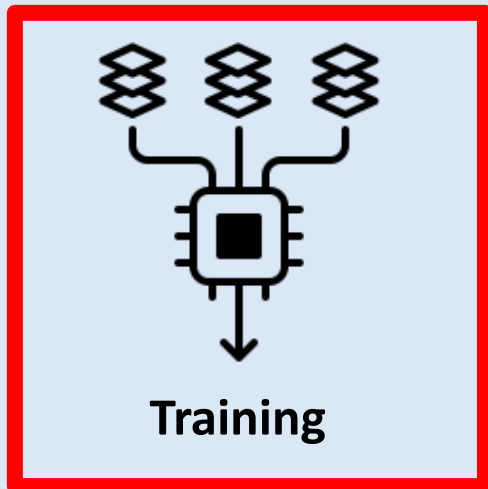
Monitoring

AI in Healthcare (Deep Learning)

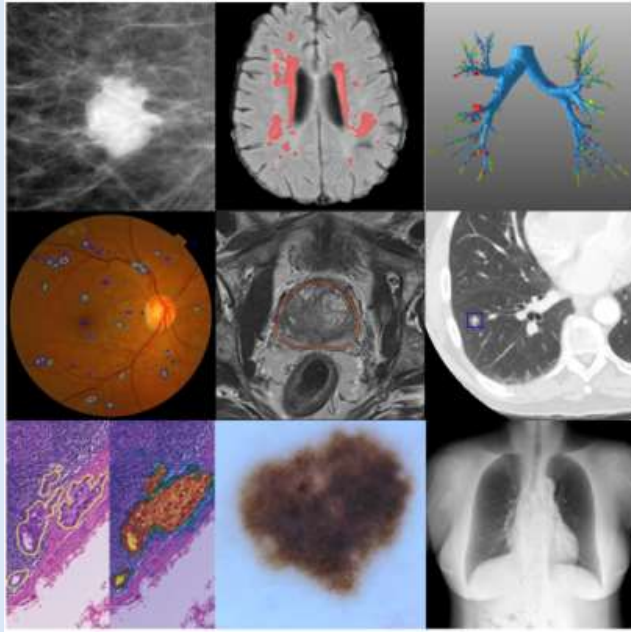
- **Some example key questions**
 - What data is needed to train AI?
 - Where do you get it from?
 - How can an AI access the market?
 - Is CE mark/UKCA enough?
 - Who should provide the evidence?
 - Do NHS trusts have the expertise to know if AI tools are safe/effective?
 - How should AI tools be deployed?
 - Do we need to monitor AI tools after market?

WHAT IS THE UNDERLYING REQUIREMENT FOR ALL OF THESE?

DATA



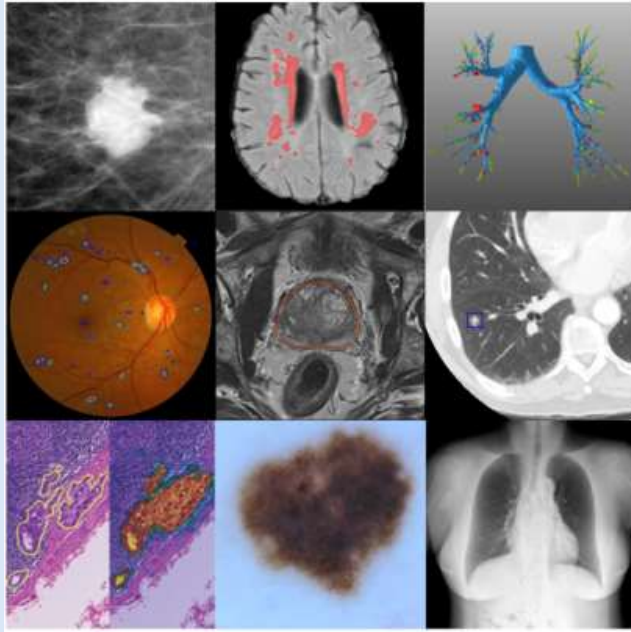
AI IN MEDICAL IMAGING



DATASETS NEED TO BE

| | | |
|---------|----------------|------------|
| LARGE | REPRESENTATIVE | UP-TO-DATE |
| TRACKED | UNBIASED | ACCESSIBLE |

AI IN MEDICAL IMAGING



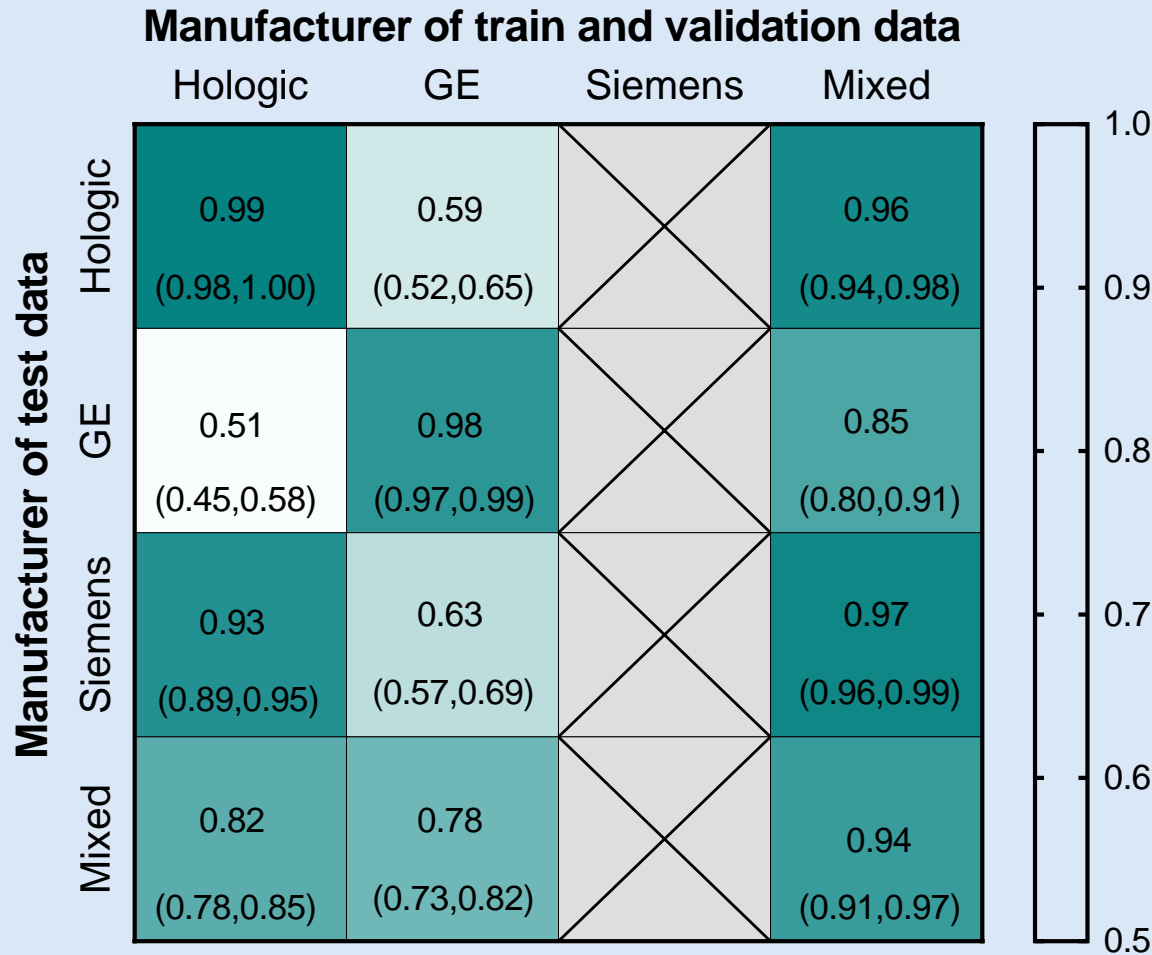
- AI needs to be
 - Safe
 - Effective
 - Generalisable
 - Fair

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|---------|----------------|------------|
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Study of effect of **generalisability** of AI Breast Density Tool

Sandra Gomes, Matthew Trumble, Lucy M Warren, Peter Harris, Mark D Halling-Brown, David R Dance, Rosalind Given-Wilson, Rita McAvinchey, Louise Wilkinson, Matthew Wallis, Richard Sidebottom, Iain Lyburn and Kenneth C Young

Results – Area under ROC curve



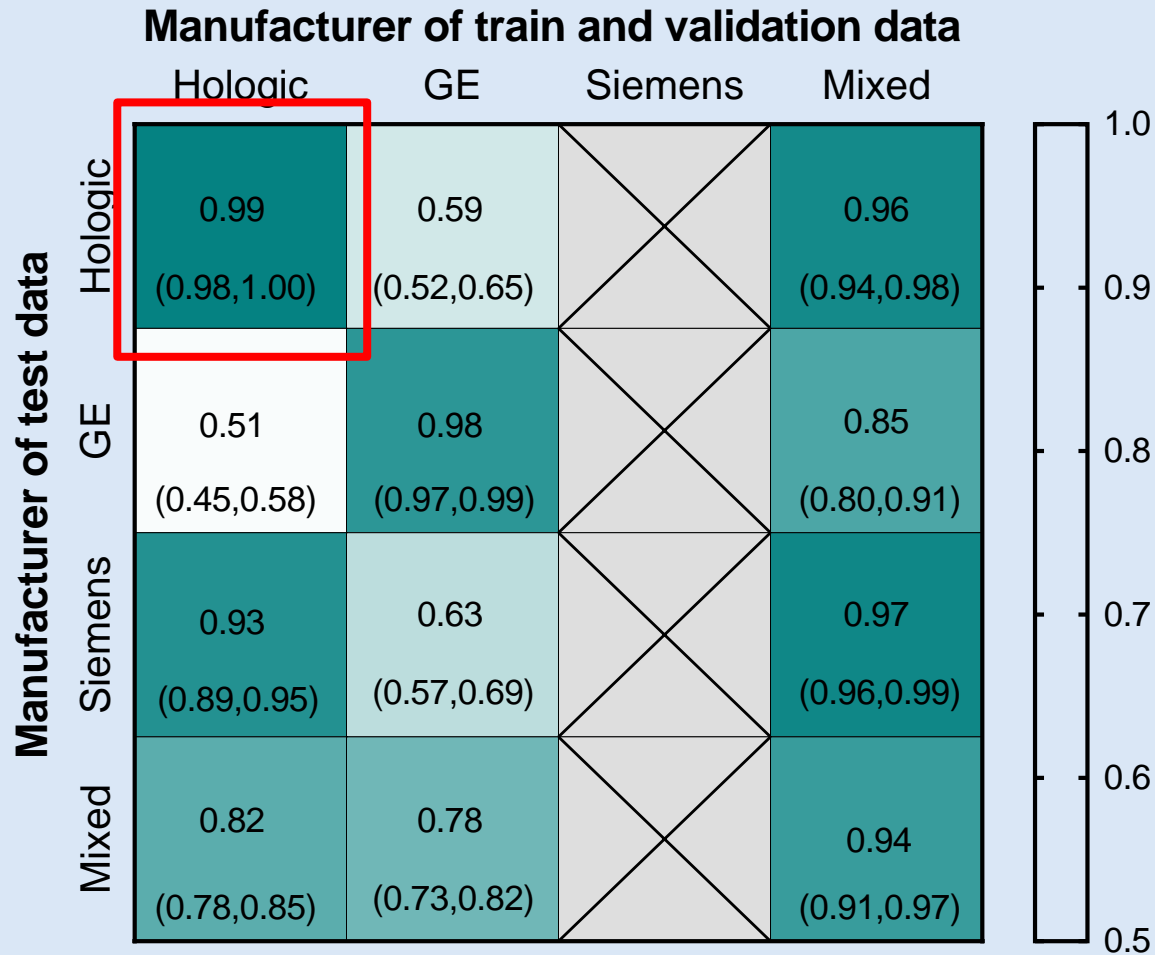
Good performance when using:

- model on same manufacturer as training data

OR

- Model trained on variety of manufacturers

Results – Area under ROC curve



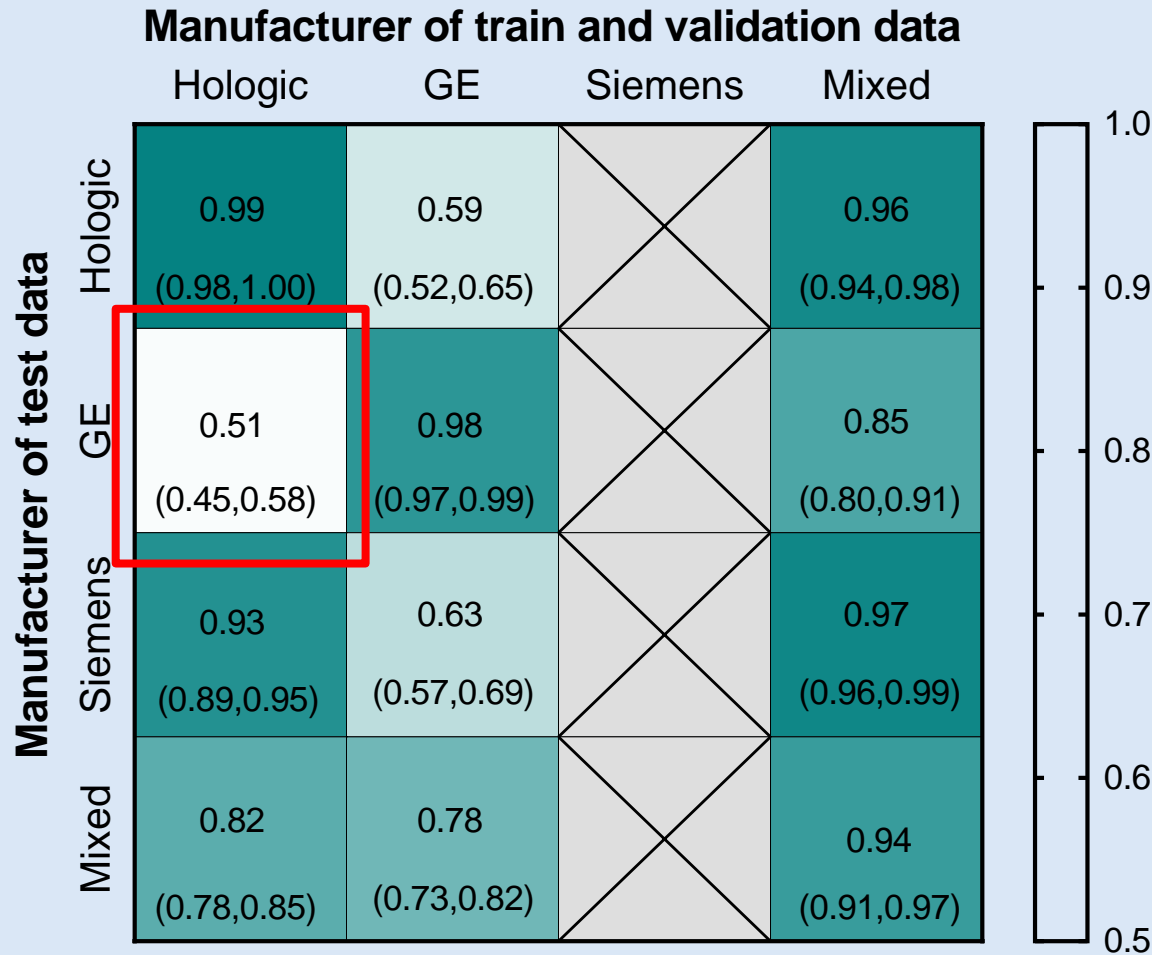
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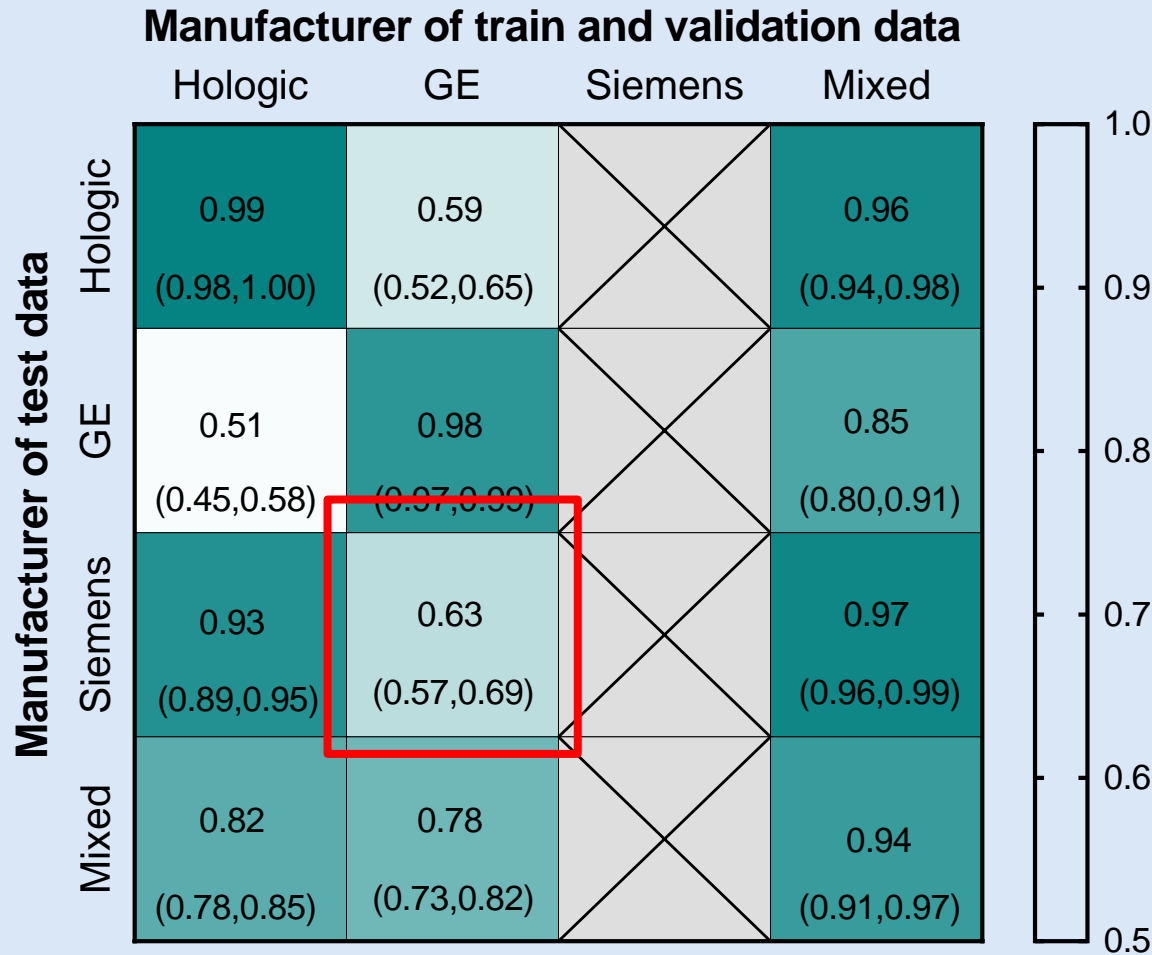
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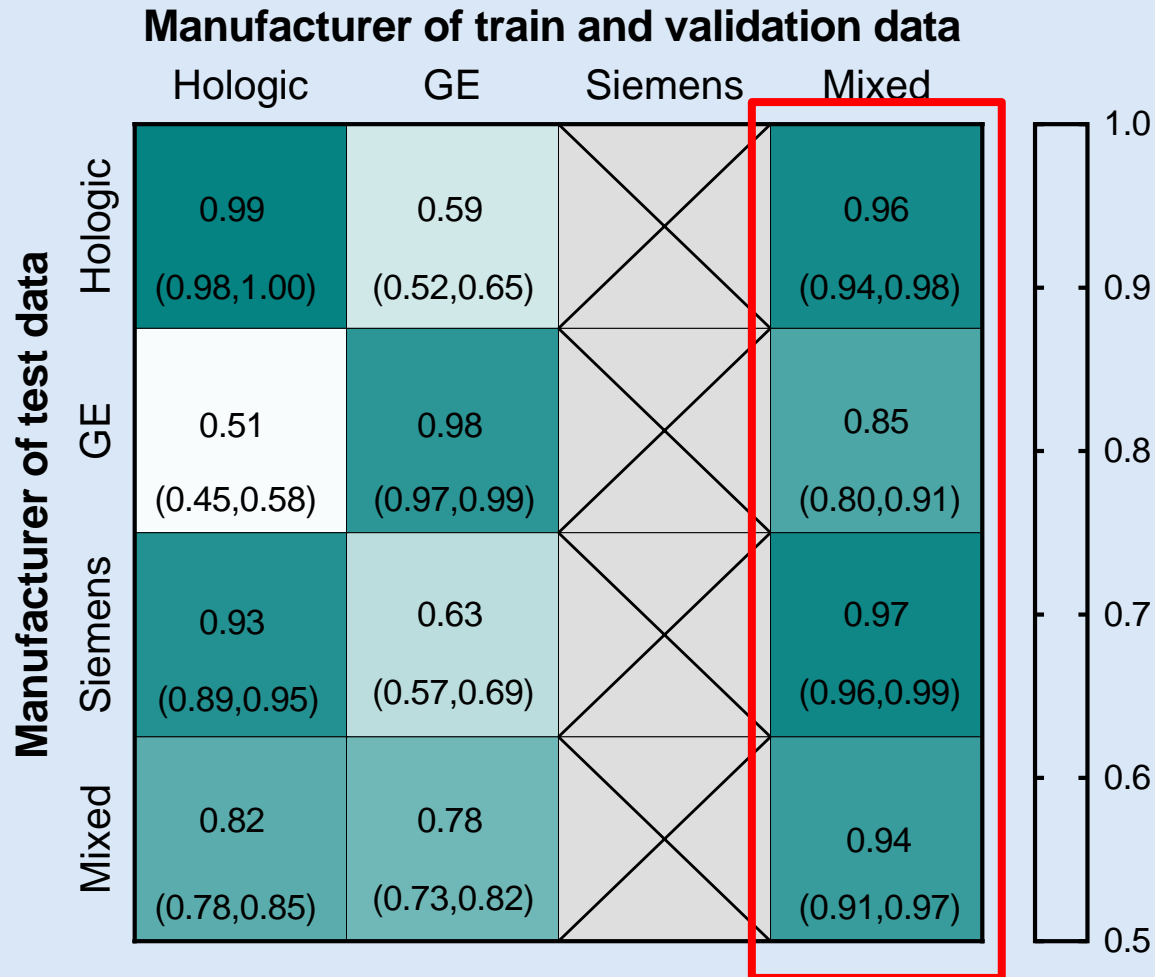
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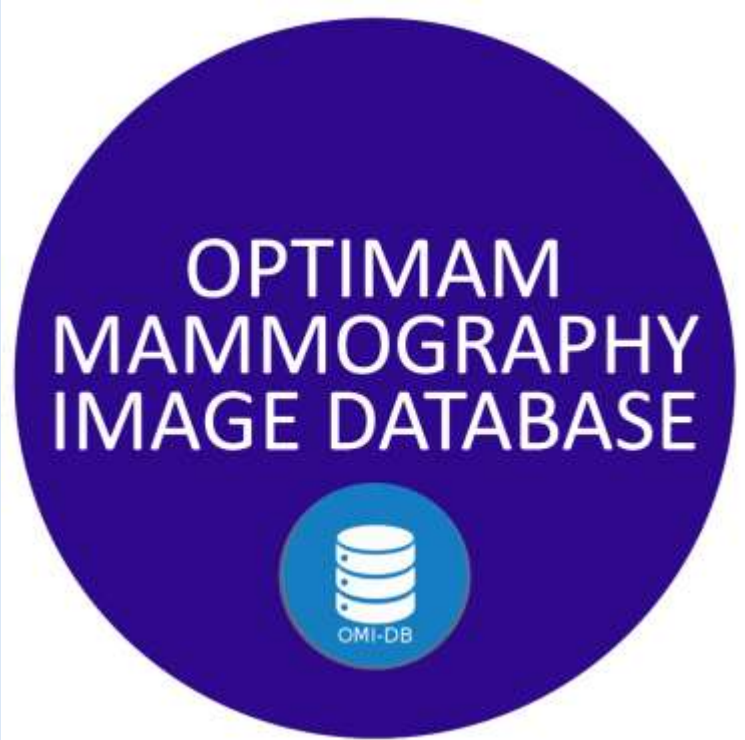
Where to get Training Data from

- Vendors tend to approach hospitals directly
 - Is this okay? No!
- Large-scale national databases required

Research Databases

- **OPTIMAM** – FFDM, Tomo, US, MRI
 - 3 sites (>180,000 cases) – Recruiting 5 new sites
- **PROSPECTS** - Tomosynthesis
 - 7 sites (>100,000 cases)
- **Million Women Study**
 - 24 sites (> 400,000 cases)
- **MeDICI** - FFDM
 - 100+ sites (~6,000 cases)
- **LORIS** –FFDM, **SMALL** - FFDM
 - 100+ sites (< 1,000 cases)
- **National Covid-19 Chest Imaging Database** – CXR, CT, MRI
 - 20+ sites (> 10,000+ cases)
- **NucMed Medical Image Database** – PET-CT
 - 2 sites (<2,000)
- **Breast Academy** – Radiology training platform
- **Several more in the pipeline**

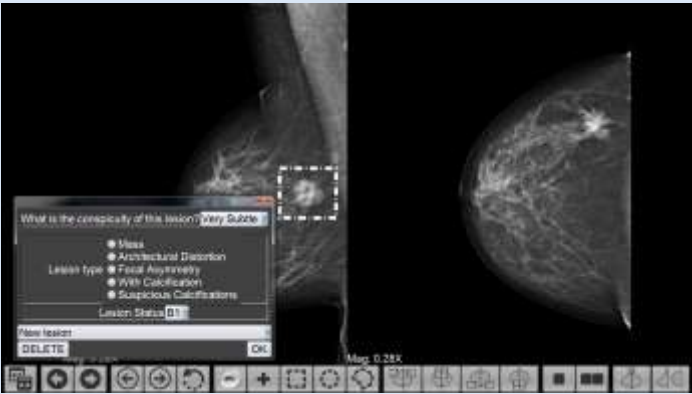
OPTIMAM



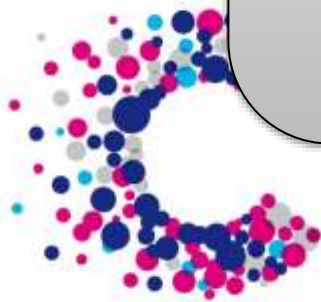
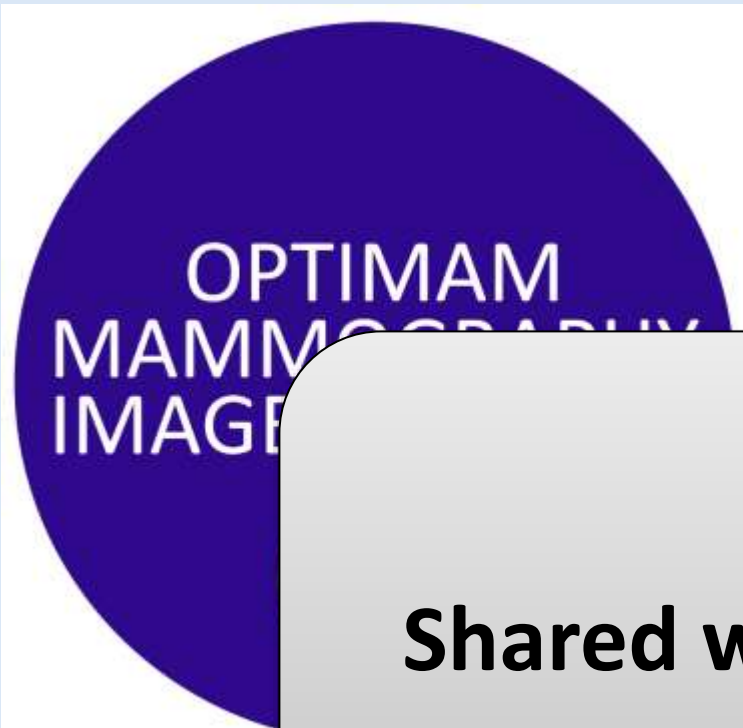
| | |
|--------------------------------|----------------|
| Clients | 194,144 |
| Studies | 410,661 |
| Images | 3,565,945 |
| Total number of clients | 194,144 |
| Interval Cancer Clients | 2,264 |
| Malignant Clients | 8,497 |
| Benign Clients | 4,773 |
| Normal Clients | 171,910 |



CANCER RESEARCH UK

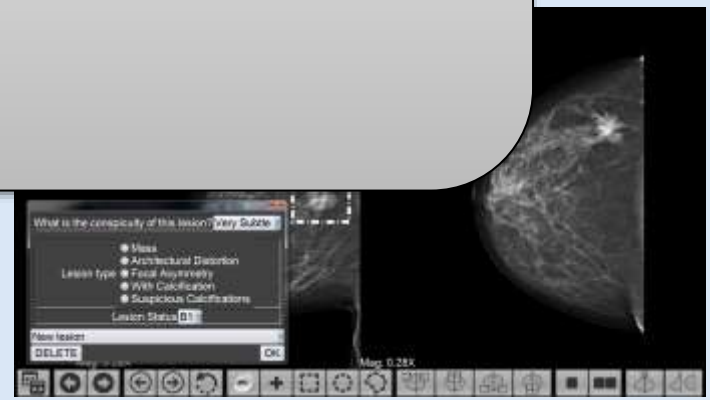


OPTIMAM Sharing






Shared with over 70 groups


| | |
|-------------------------|-----------|
| Clients | 194,144 |
| Studies | 410,661 |
| Images | 3,565,945 |
| Total number of clients | 194,144 |
| | 2,264 |
| | 8,497 |
| | 4,773 |
| | 171,910 |



We have been collecting pseudonymised chest X-rays, CTs and MRIs into the [National COVID-19 Chest Imaging Database \(NCCID\)](#) since May 2020.

NCCID partners:    

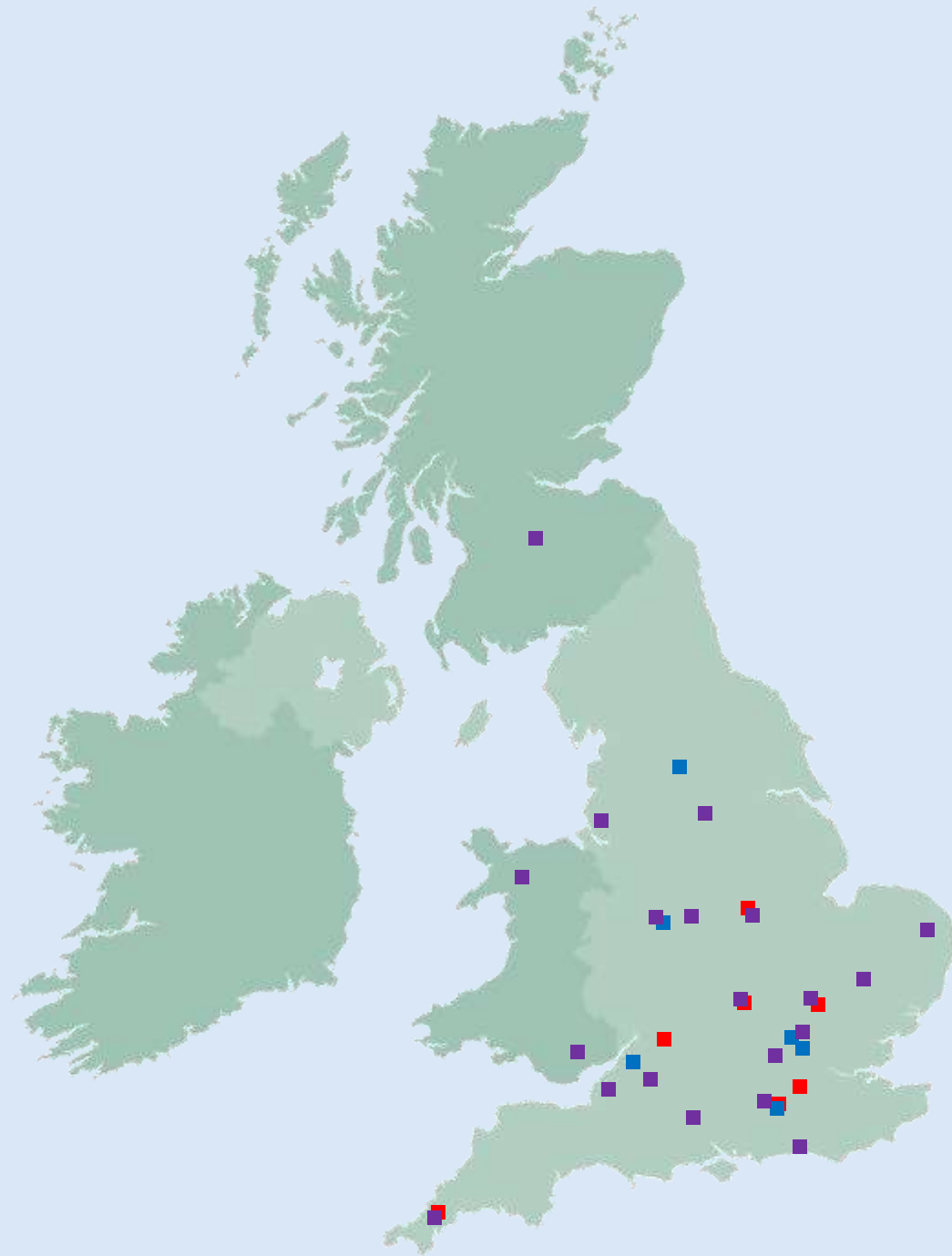
Data collected:  26 NHS centres/trusts  18,604 patients  55,500 images

NCCID data users:  14 approved data users

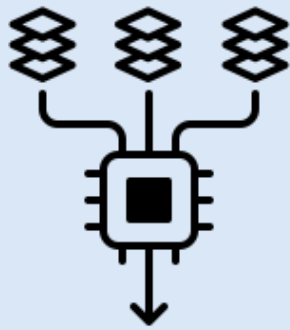
If you work at a hospital site and are interested in contributing data to the NCCID, please reach out directly to imaging@nhsx.nhs.uk

If you are involved in research or technology development and would like to apply for access to the NCCID training dataset, please follow the instructions at this link: <https://nhsx.github.io/covid-chest-imaging-database/>

OPTIMAM
PROSPECTS
NCCID

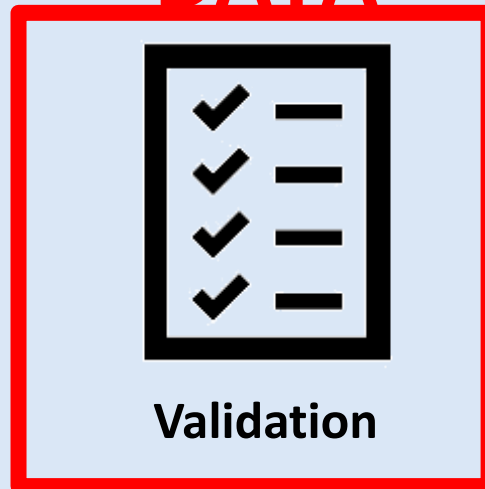


WHAT IS THE UNDERLYING REQUIREMENT FOR ALL OF THESE?



Training

DATA



Validation



Monitoring

Why is independent evaluation needed?

Manufacturer studies

- May not include details on accuracy and completeness of location information of CAD
- May not report on practical problems in real clinical use
- May not include UK population and systems

INDEPENDENT Evaluation

- Can use relevant UK population and data
- Helps to design UK clinical trials

Desirable Properties of Validation Data

DATASETS NEED TO BE

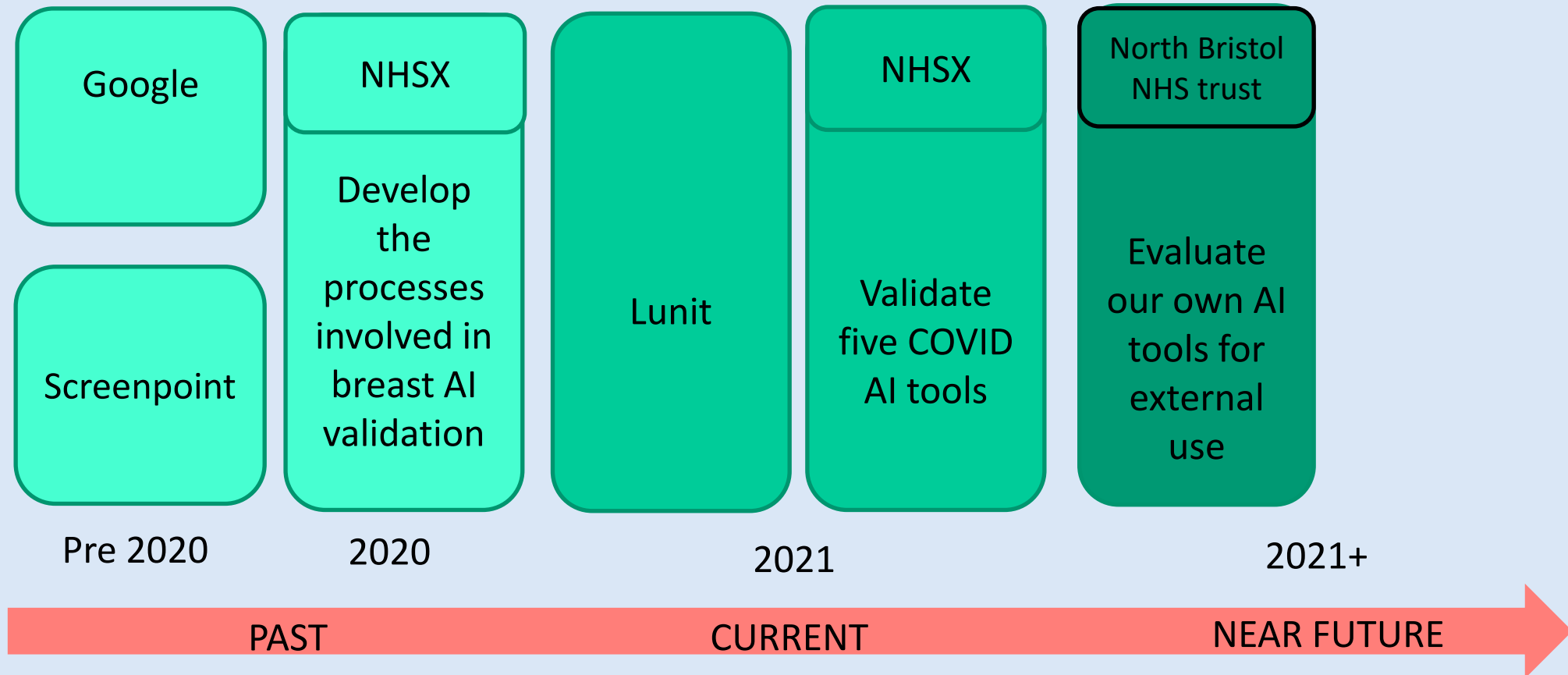
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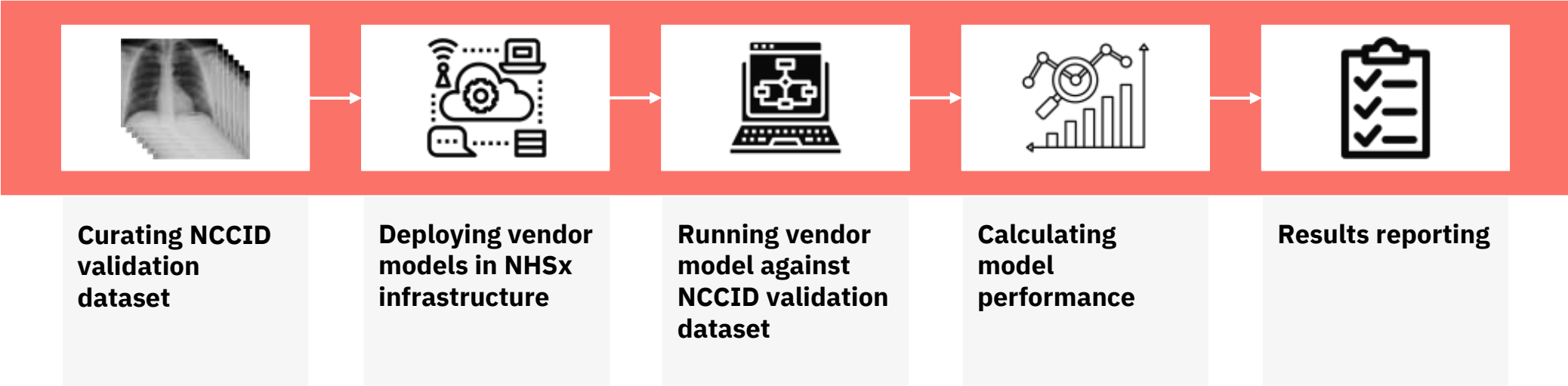
Desirable Properties of Validation Data

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| LARGE | REPRESENTATIVE | UP-TO-DATE |
| TRACKED | UNBIASED | ACCESSIBLE |
| INDEPENDENT, UN-TOUCHED & AVAILABLE | | |

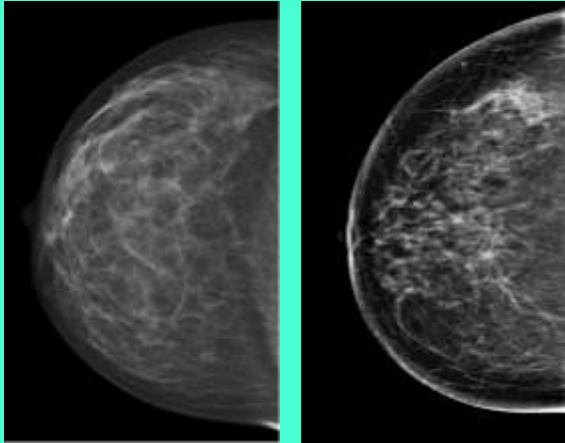
Evaluating specific AI products





Evaluating AI generalisability

Manufacturer



Blur

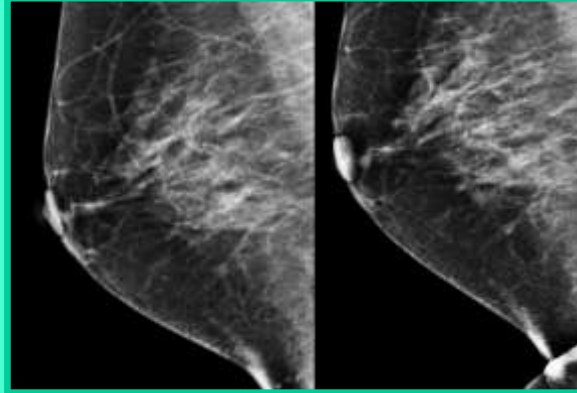
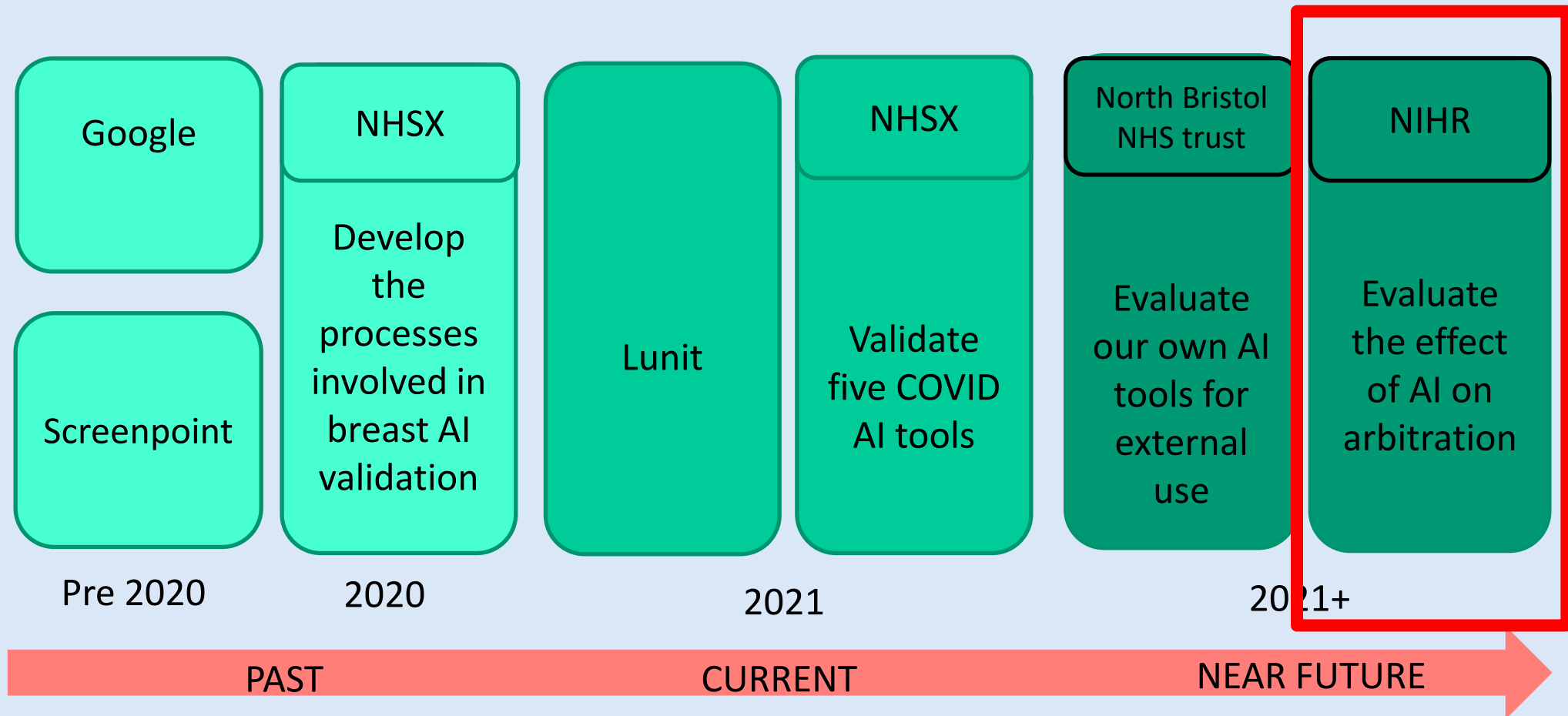


Image Quality

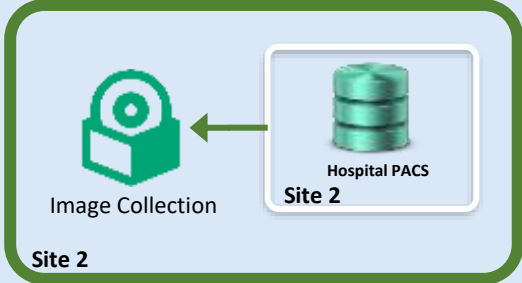
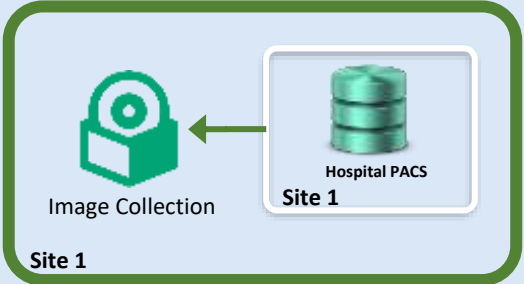


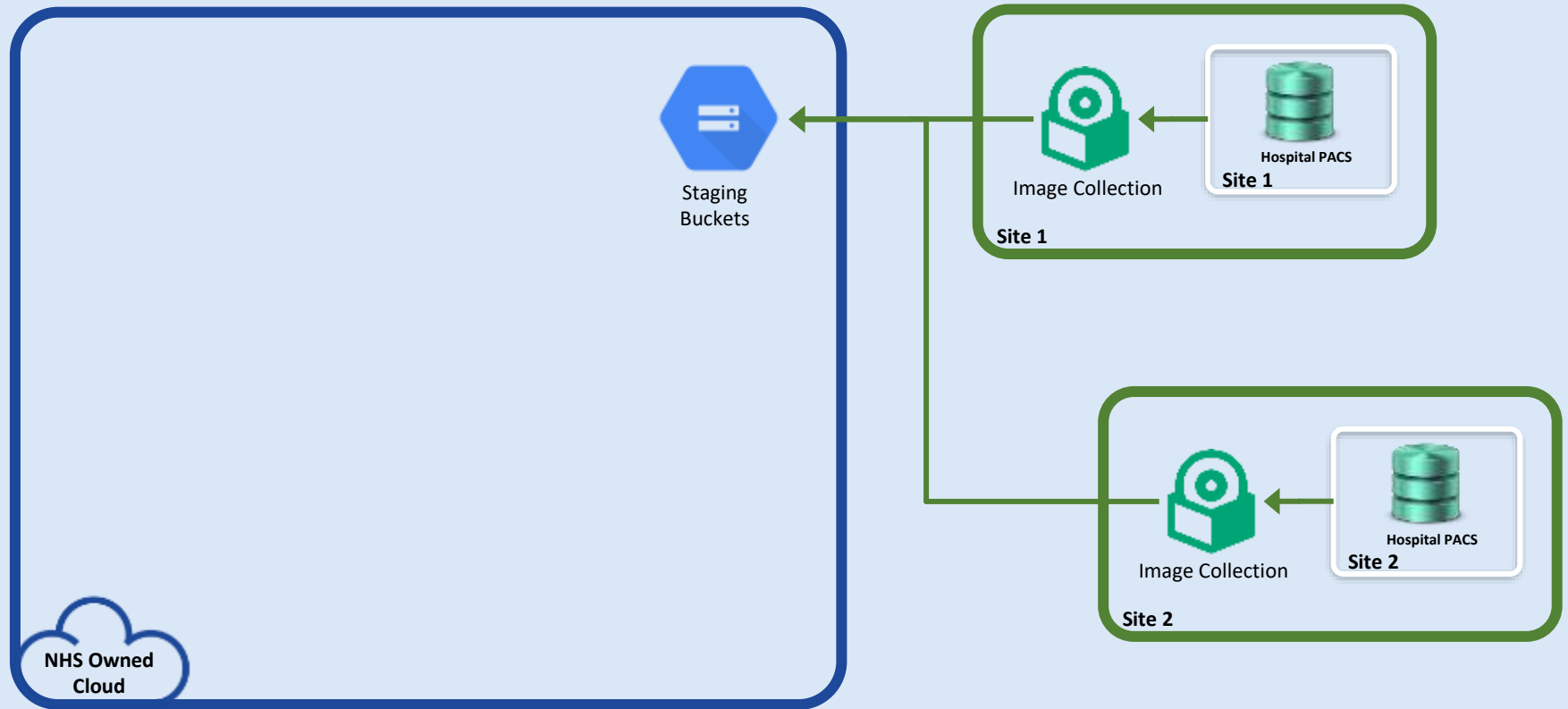
Evaluating specific AI products

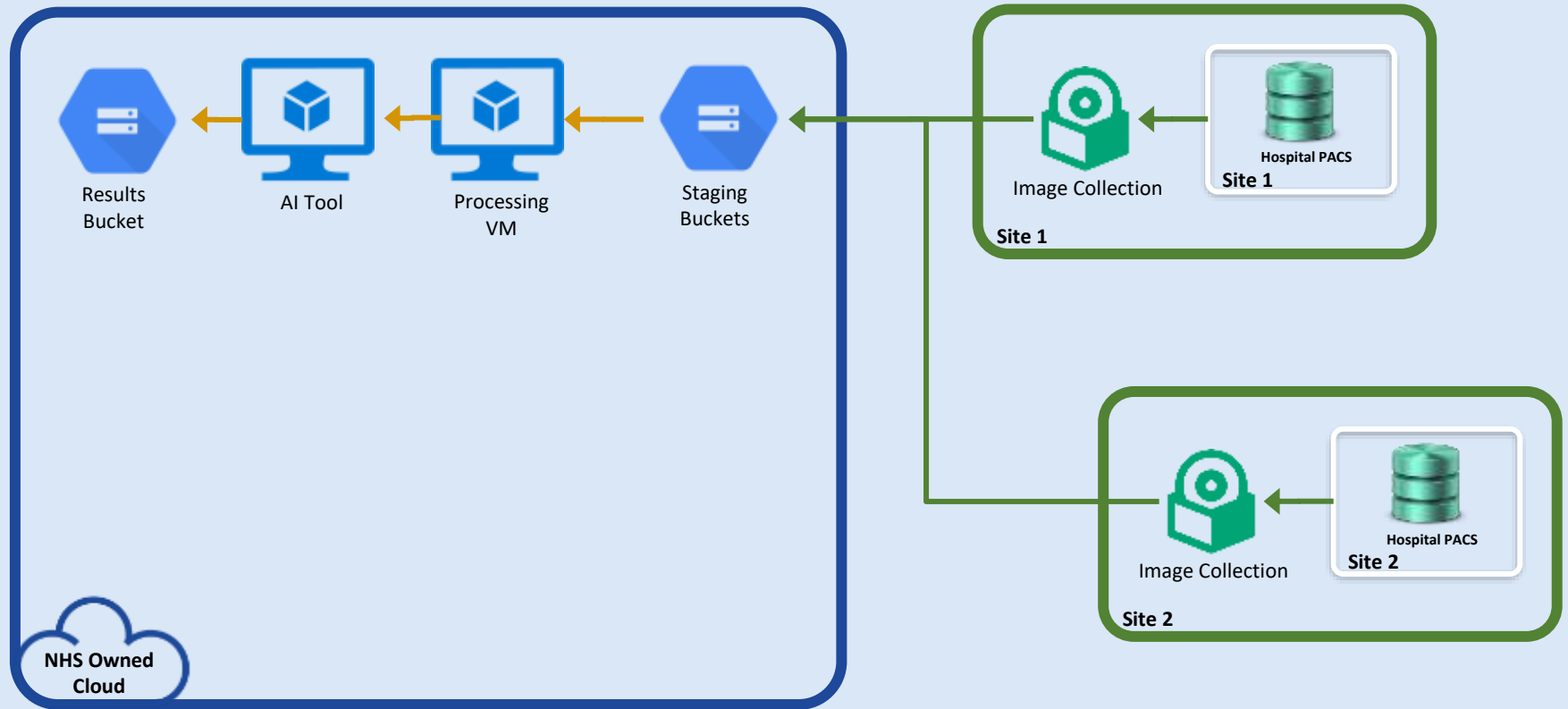


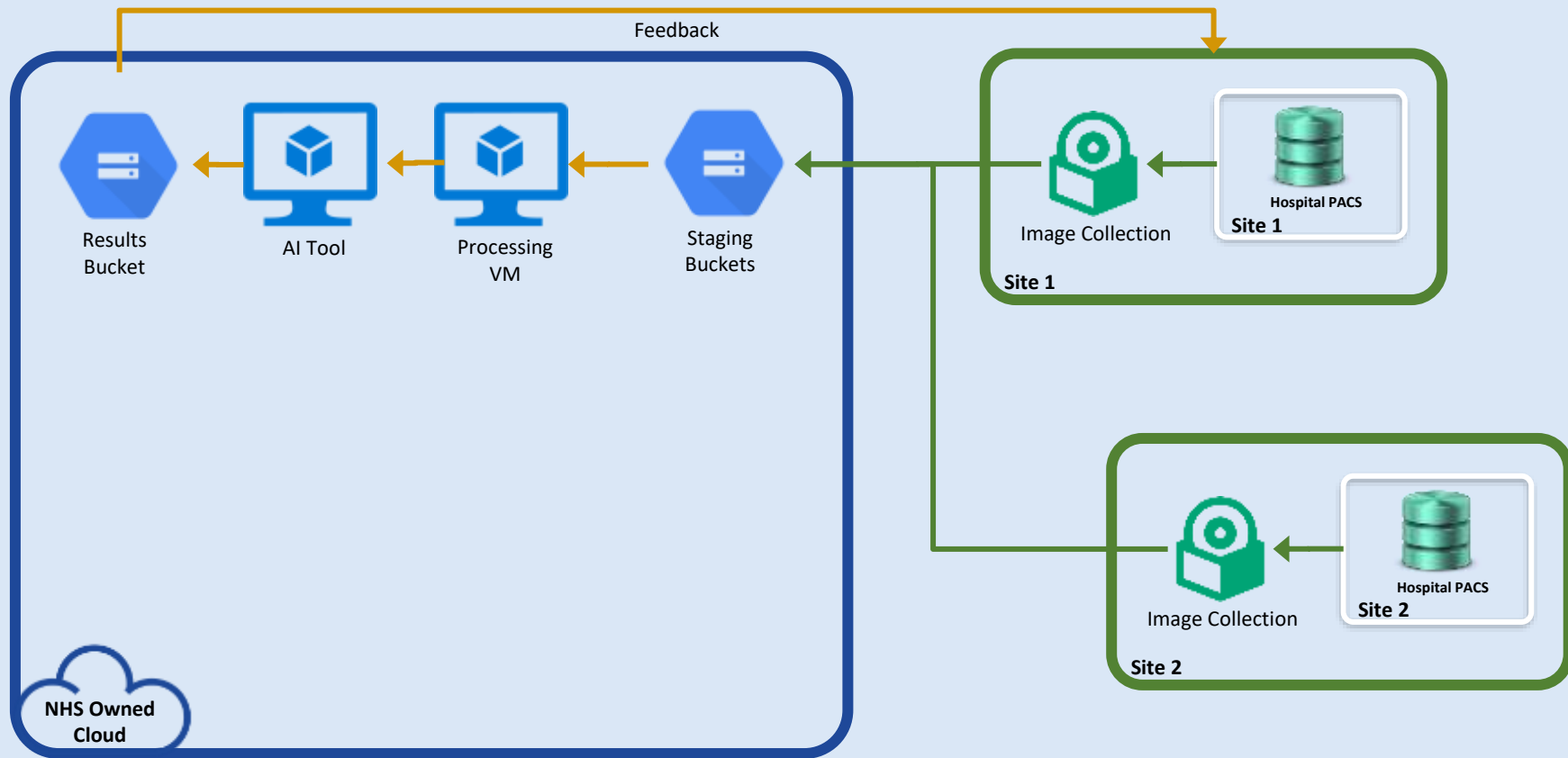
AAC funded Prospective Trial

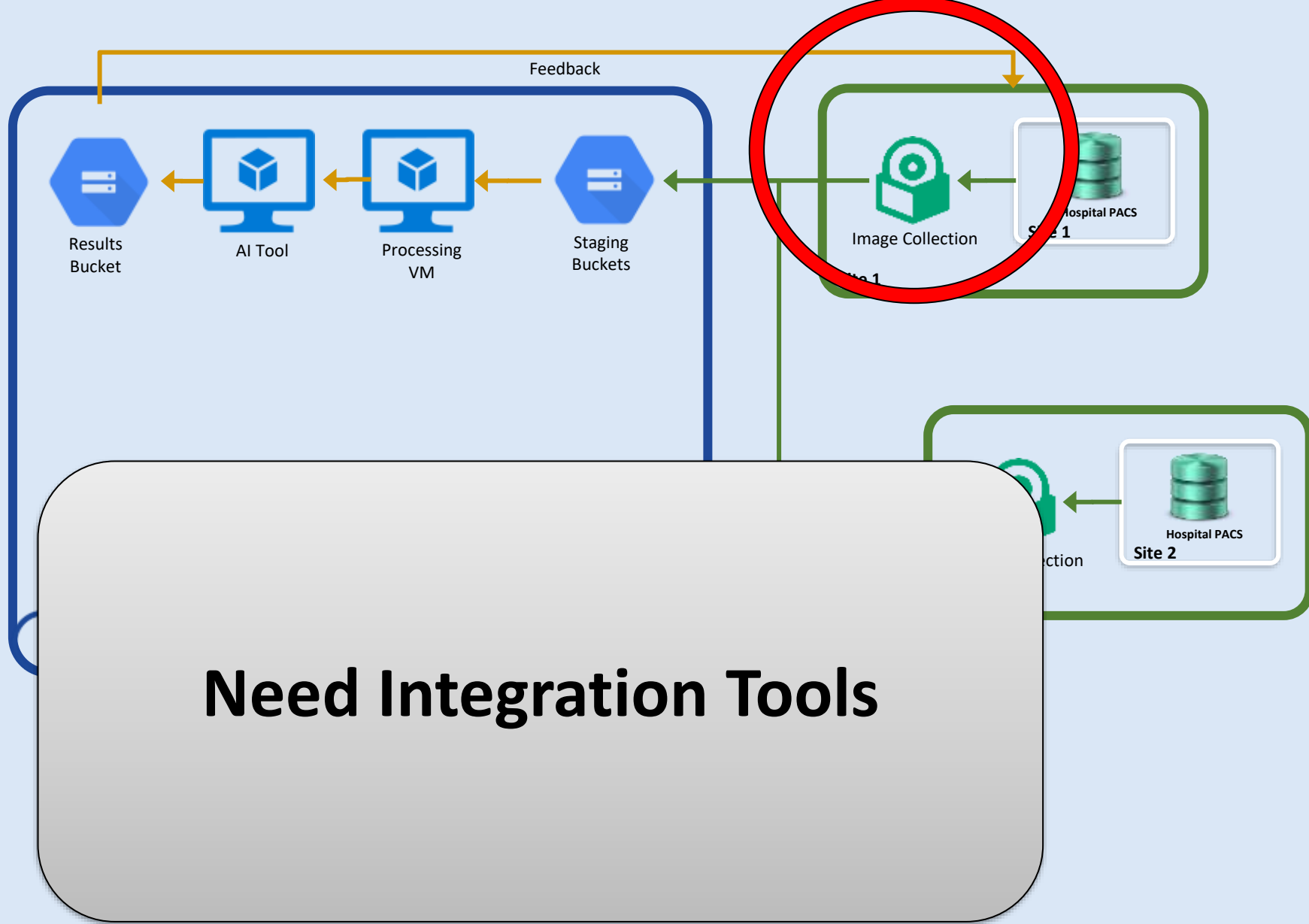
- Involving Google, Imperial, St Georges and RSNFT
- Phase III AAC award
- Three parts
 - Part A – Large scale retrospective validation
 - Part B – Prospective (simulated) arbitration study
 - Part C – Feasibility of integration



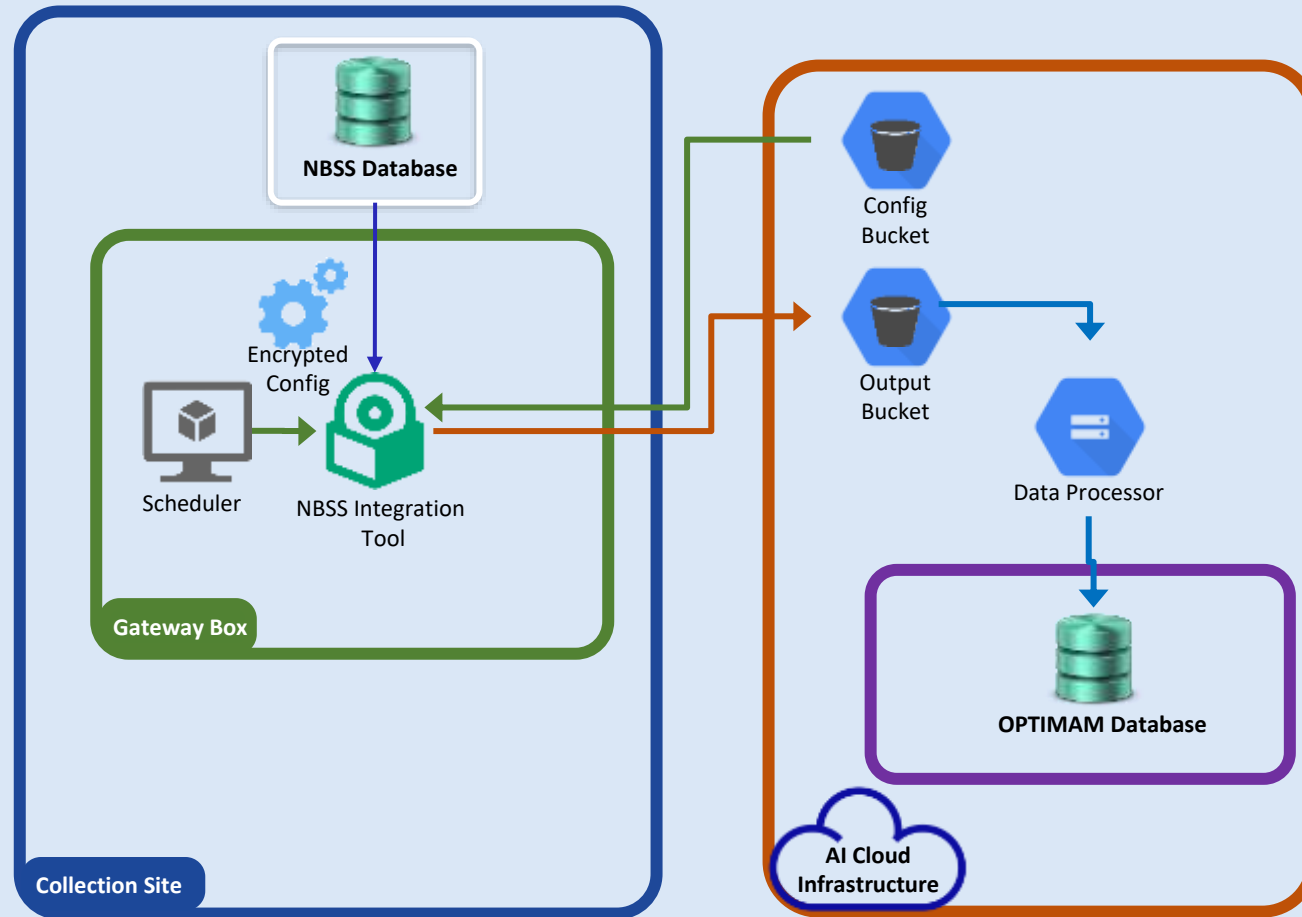




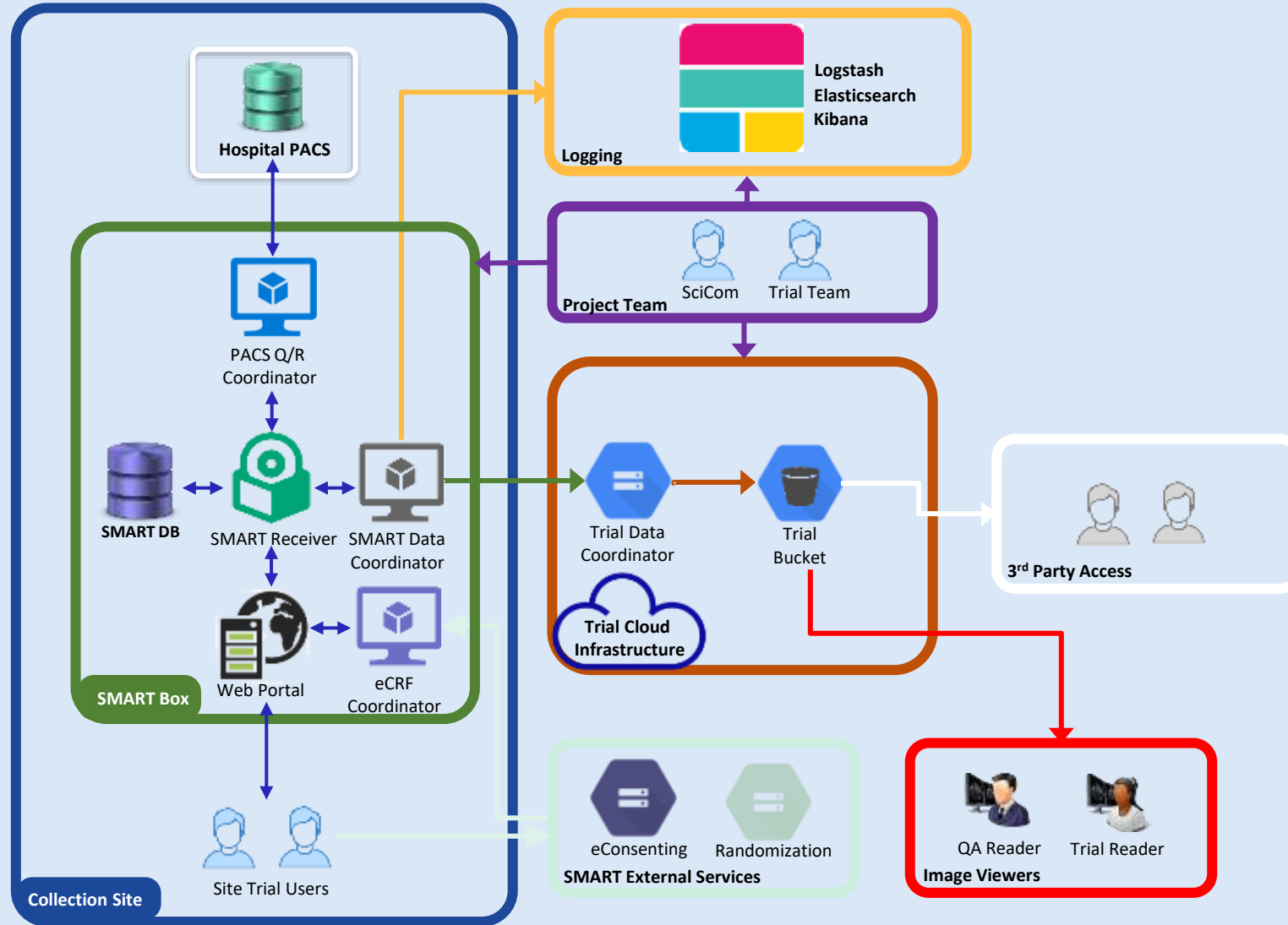




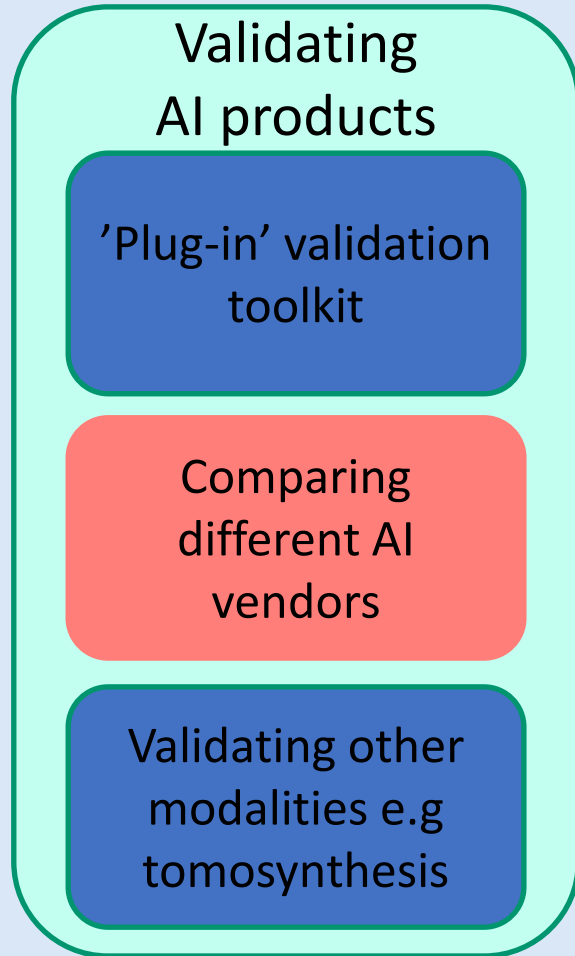
Clinical System Integration Tools



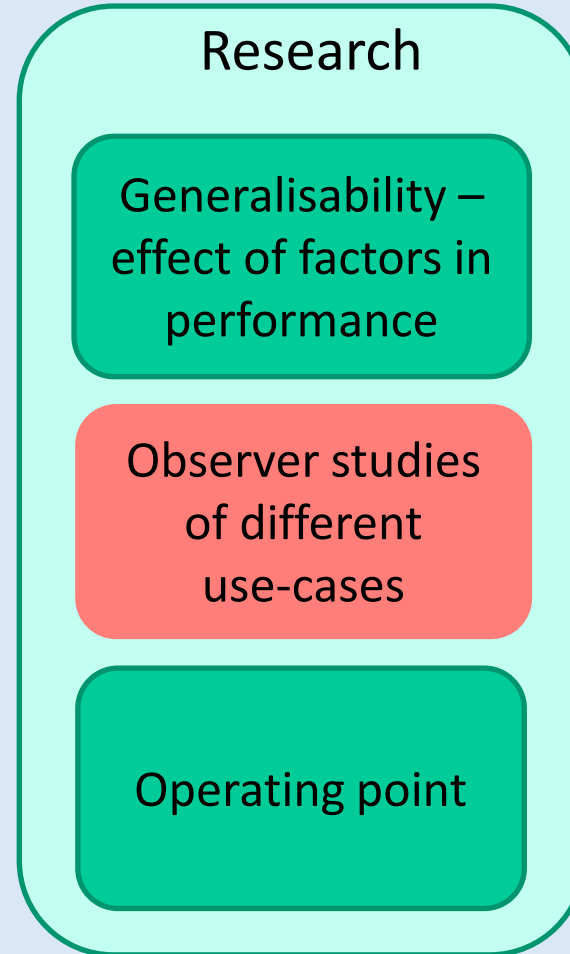
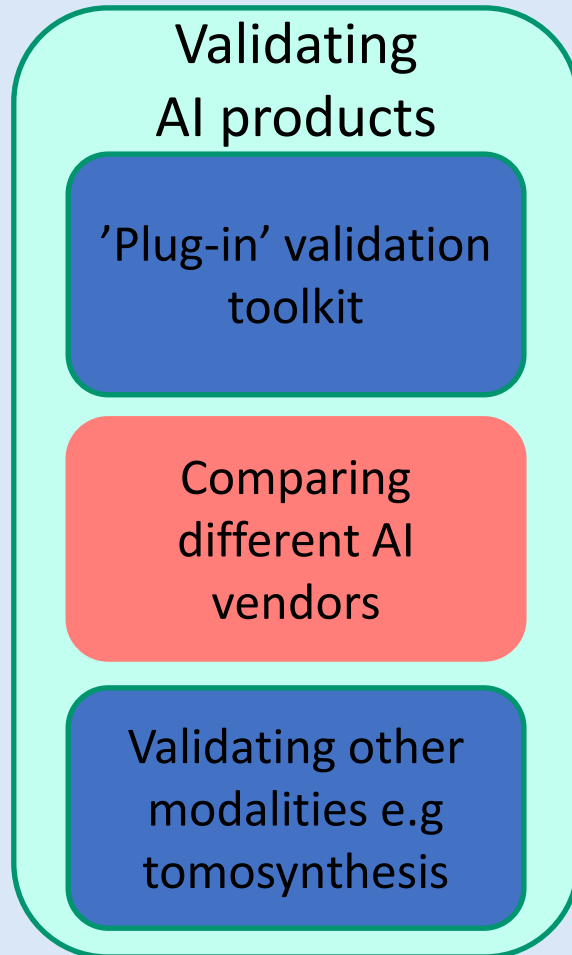
PACS Integration Tools



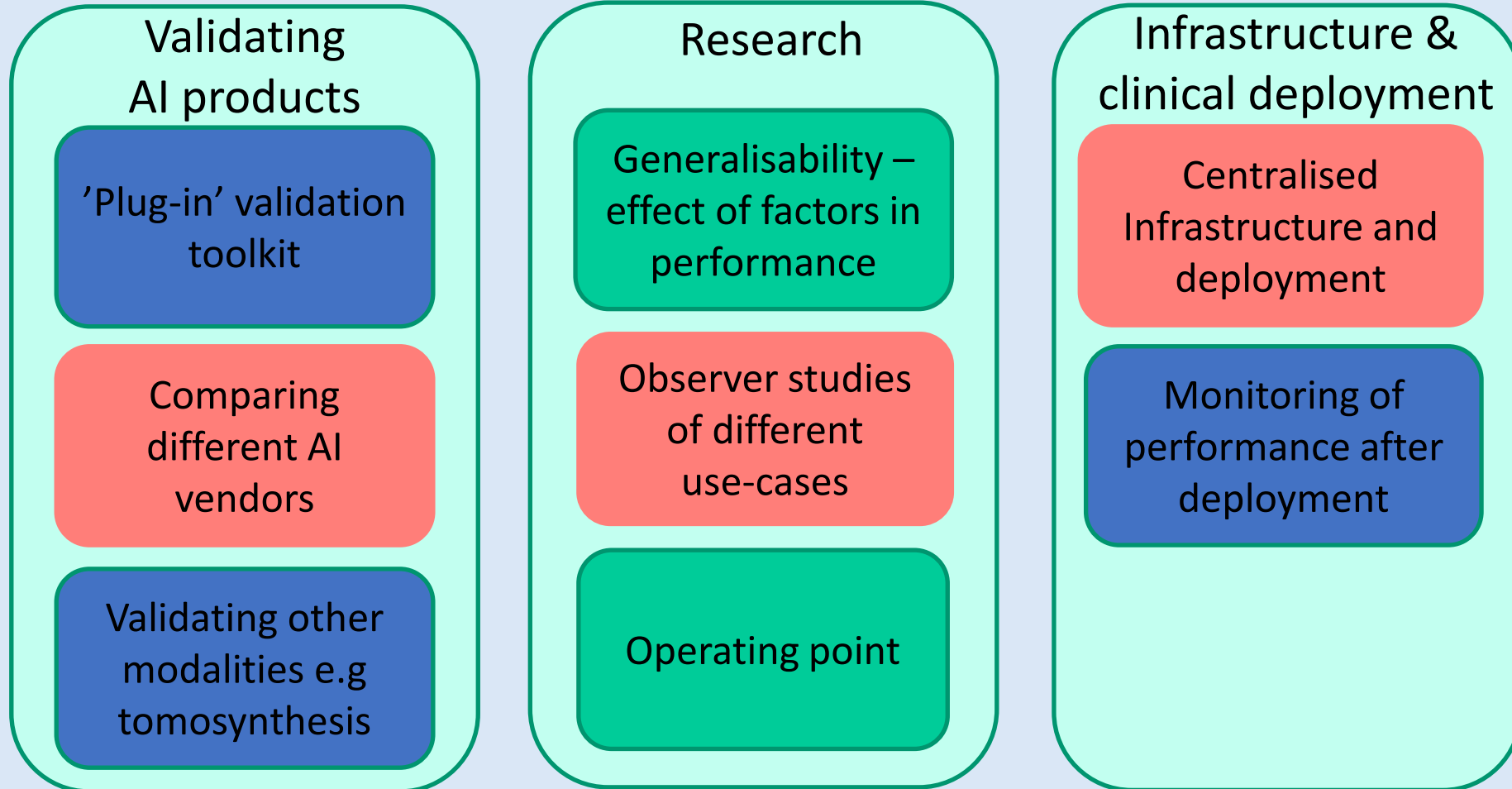
Future areas of investigation



Future areas of investigation



Future areas of investigation



Take Homes – In my opinion

- For AI - correct collection and availability of **data** is vital for
 - Training
 - Validation
 - Monitoring
- It would be unwise to expect individual hospitals to validate AI
- A national approach would be preferred

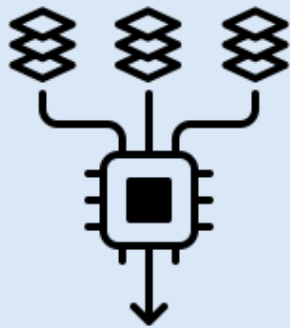
Contact Details

- Prof Mark Halling-Brown
- mhalling-brown@nhs.net

EXTRA SLIDES IF THERE IS TIME

WHAT IS THE UNDERLYING REQUIREMENT FOR ALL OF THESE?

DATA



Training



Validation



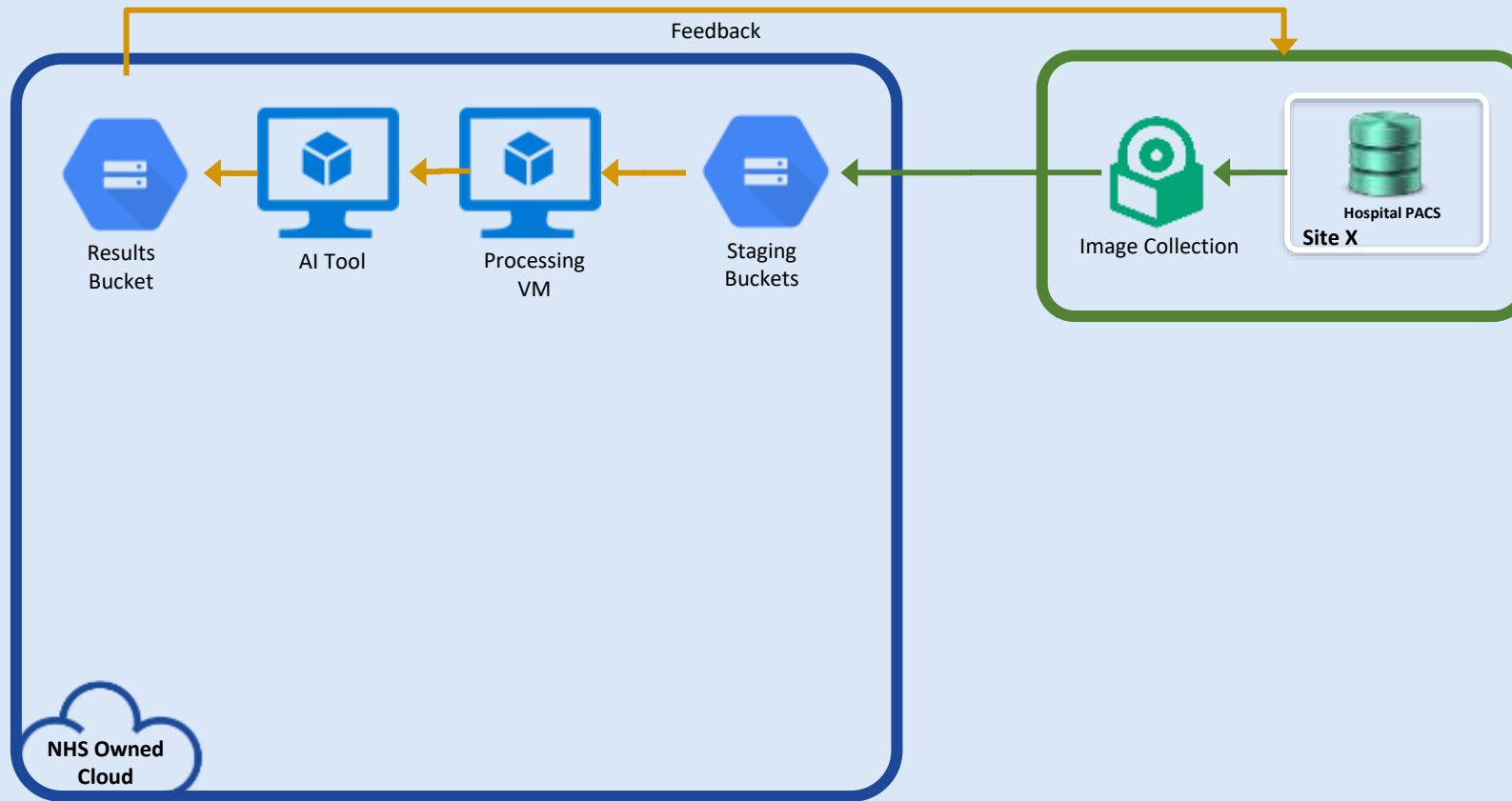
Monitoring

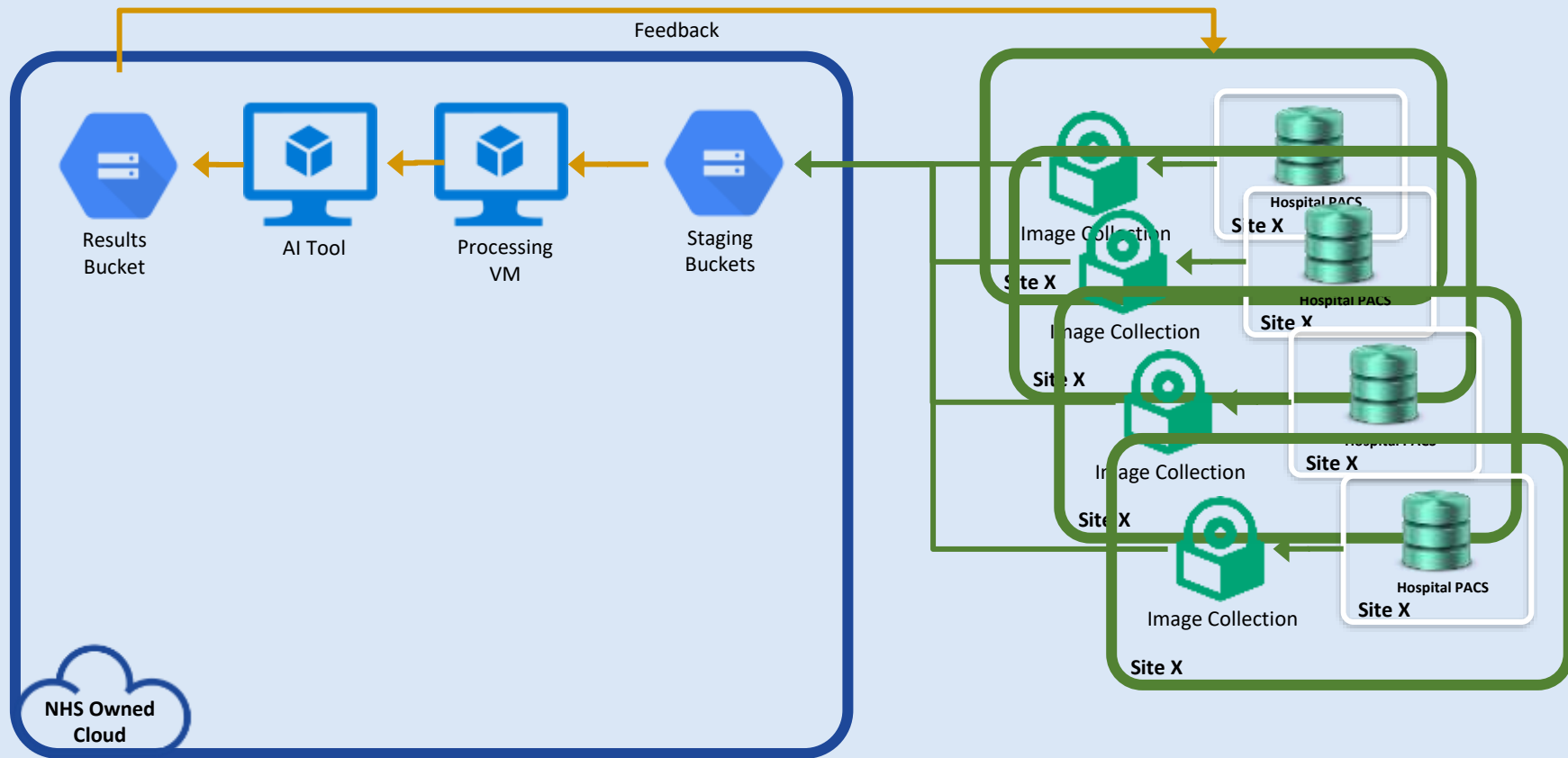
Monitoring link to Deployments

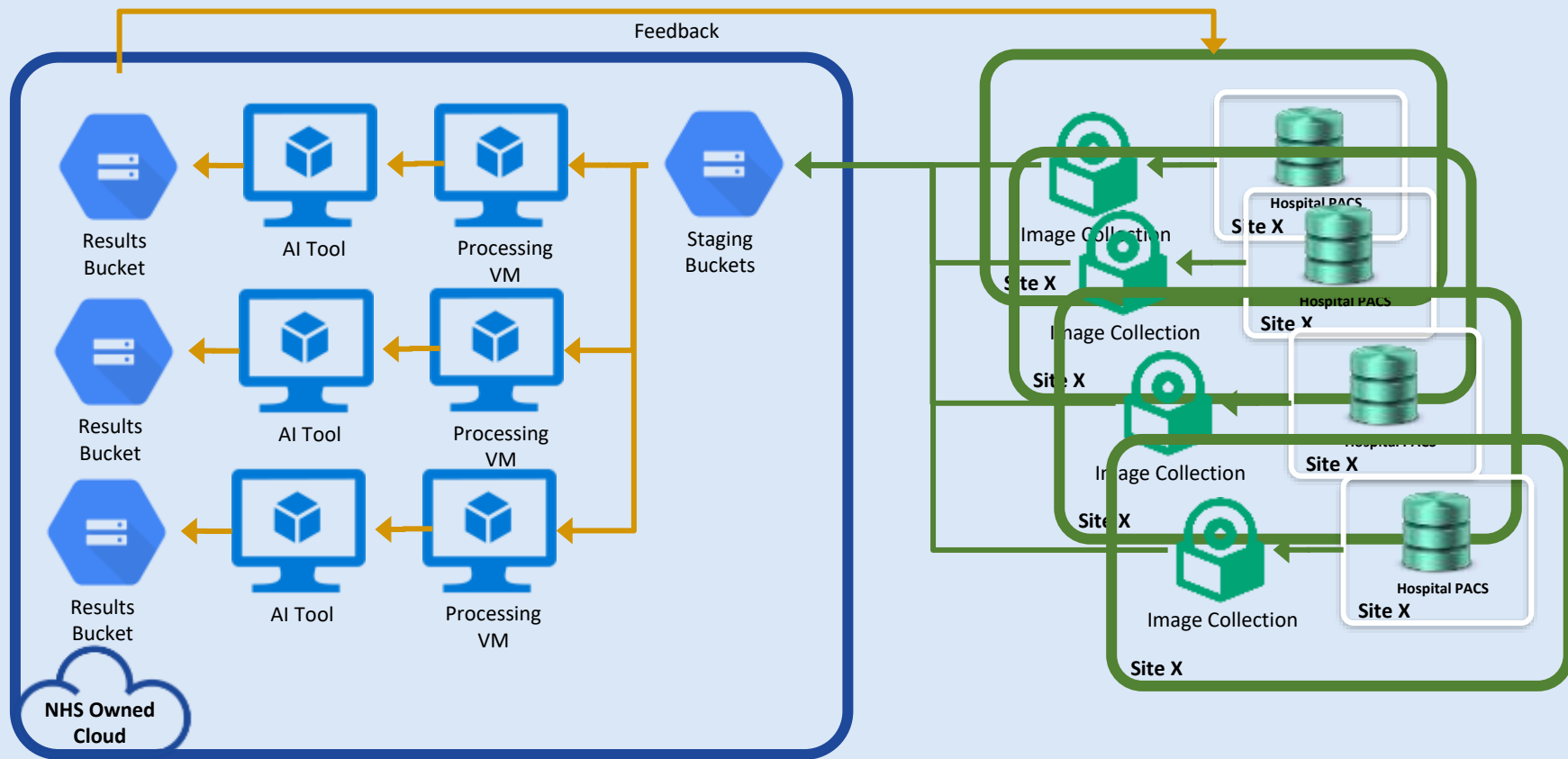
- Is monitoring required?

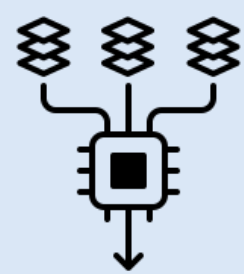
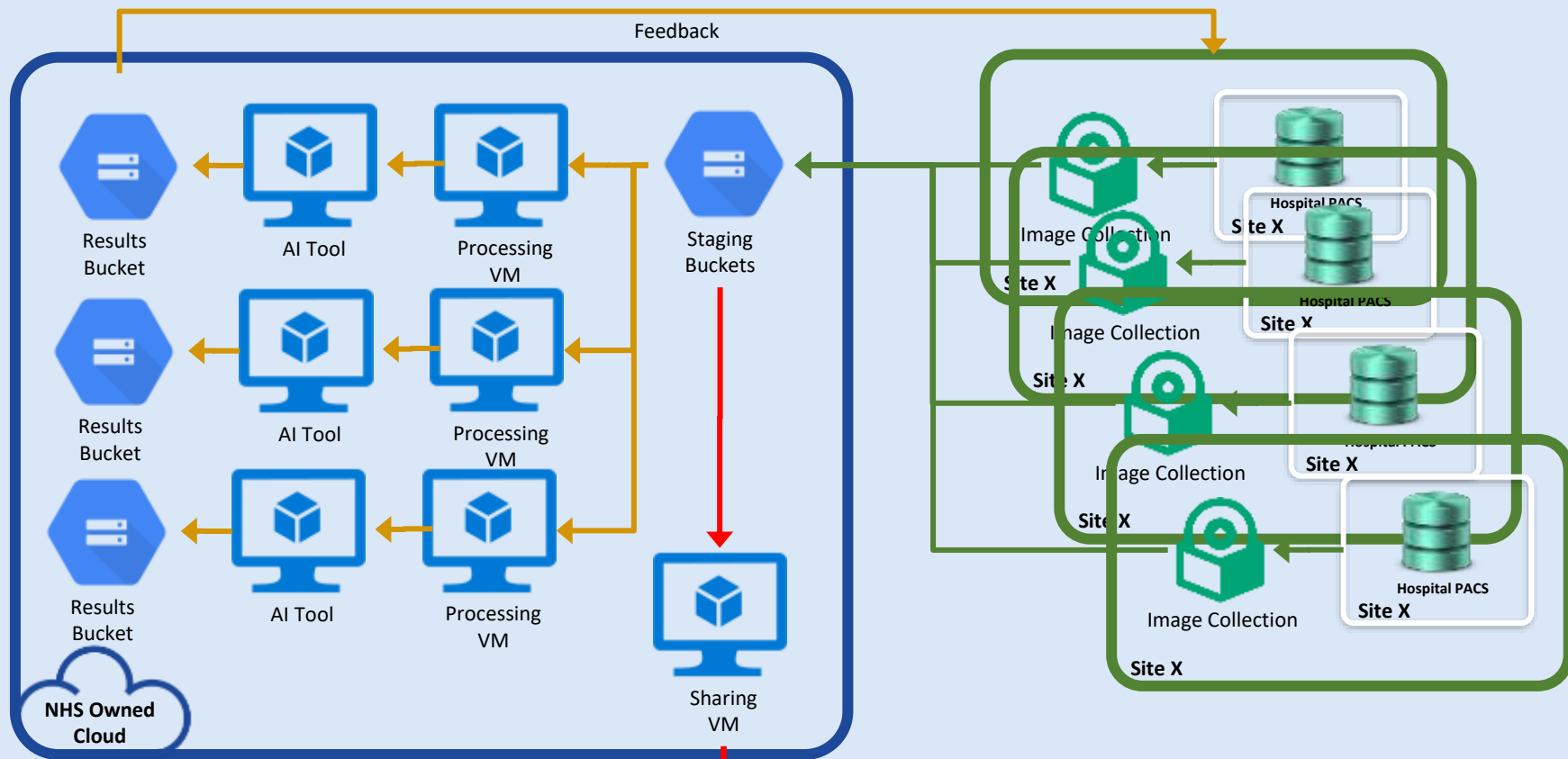
Monitoring link to Deployments

- Is monitoring required?
- Implementing meaningful monitoring at each individual institute will be difficult
- Monitoring could be enabled by centralized method of deployment









Training Datasets



Validation Datasets



Monitoring Datasets