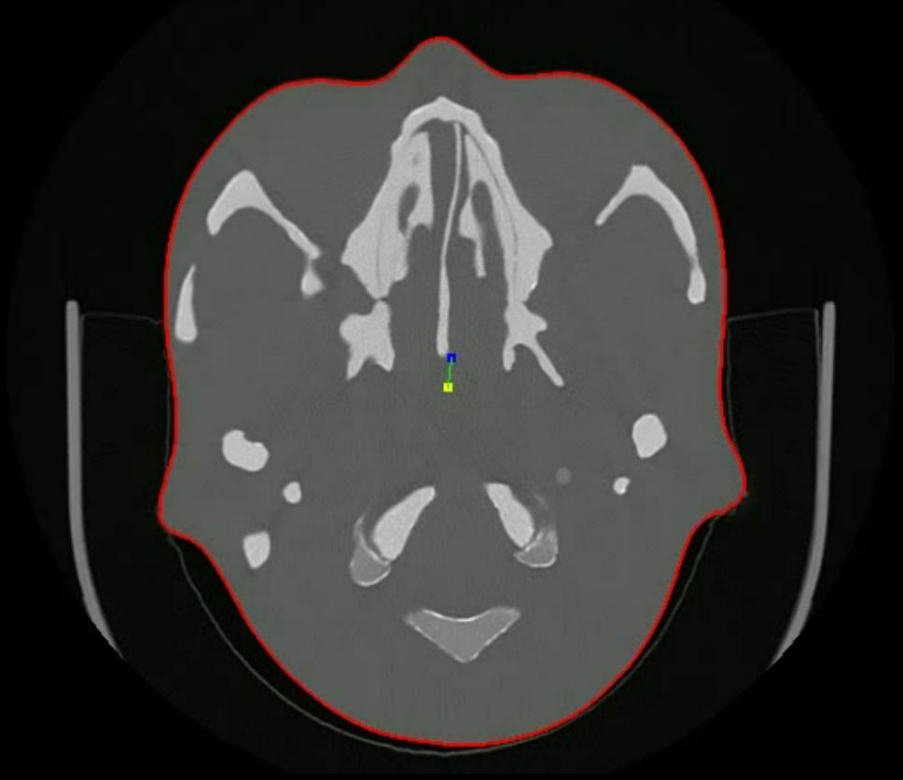
Service evaluation of Patient Positioning in CT Scans at Barts Health NHS Trust



E. Thomson [1], R. Fong [1], L. Bailey-Pioli [1], C. Ovenden [1], V. Mutanga [1], D. Dihanov [1], T. Faleye [1], A. Rose [1], Q. Munnee [1], K. Santhirababu [1], L. Tonks [1], D. Abbeyquaye [1], A. Palmer [1]

1. Barts Health Clinical Physics Department, Radiation Safety Section

Project Goals

- Collect a representative data set of patient positioning within the trust
- Assess whether patients are being positioned correctly across different sites and departments.
- Develop, record and share the process of this service evaluation to repeat or improve the method.

Motivation

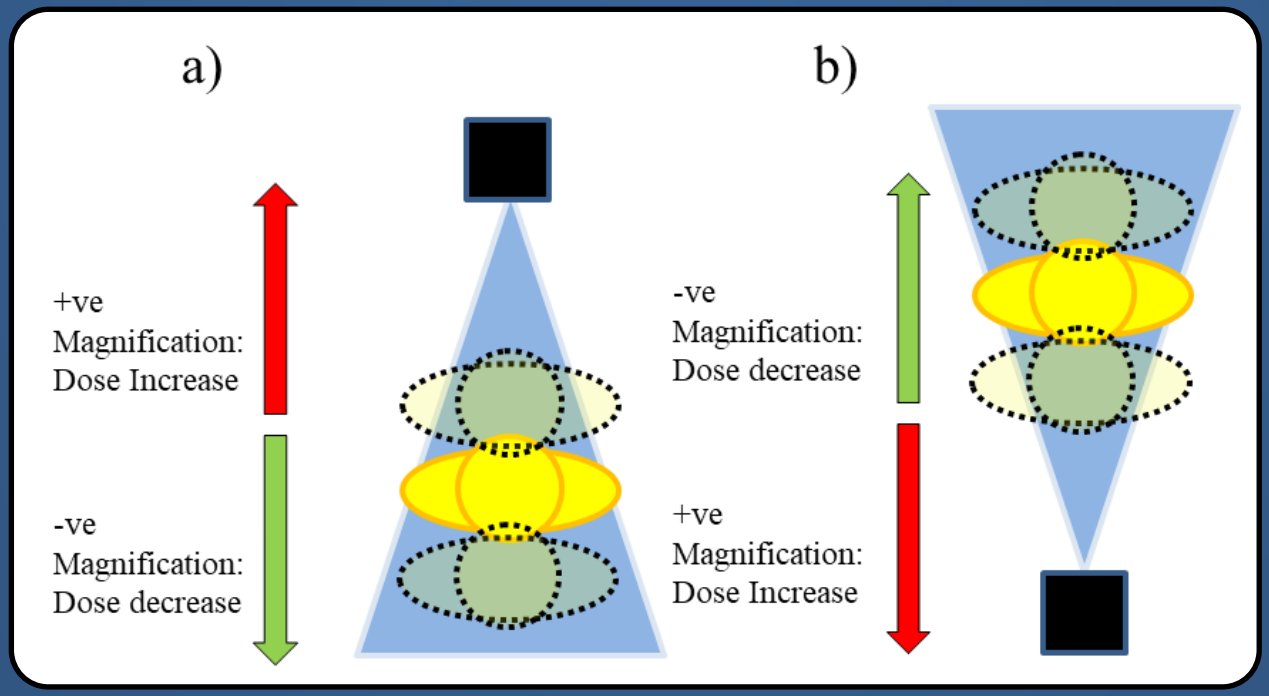
- The IR(ME)R (Amendment) Regulations 2024 references the need for successful training and experience in positioning of patients: Schedule 3 Table 2 [1].

Diagnostic radiology	
General	Principles of radiological techniques
	Production of X-rays
Specialised Techniques	Computed Tomography
	Interventional procedures
	Hybrid imaging
Practical aspects for diagnostic radiology	Patient positioning
	Equipment selection and use
	Protocol selection
	Optimisation of image quality and radiation dose
	Dose assessment and recording
	Image acquisition, artefacts, processing, display and storage

Motivation

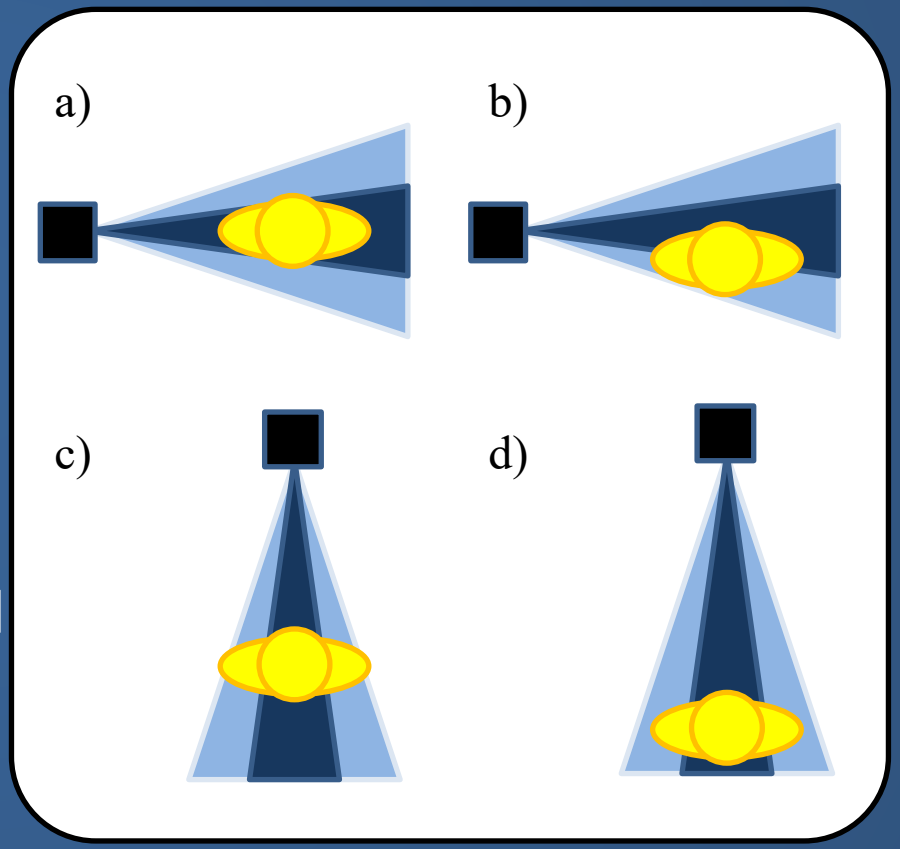
- AEC adjusts delivered dose based on topogram [2].

- Misalignment means:
  - Positive magnification and increase in dose
  - Negative magnification and increase in image noise



Motivation

- The bowtie filter shapes the radiation beam [2].
- Thickest region of the patient receives the highest intensity of X-Rays
- Misalignment means:
  - Higher surface dose delivered to thinner regions
  - Image noise is increased in thicker regions.



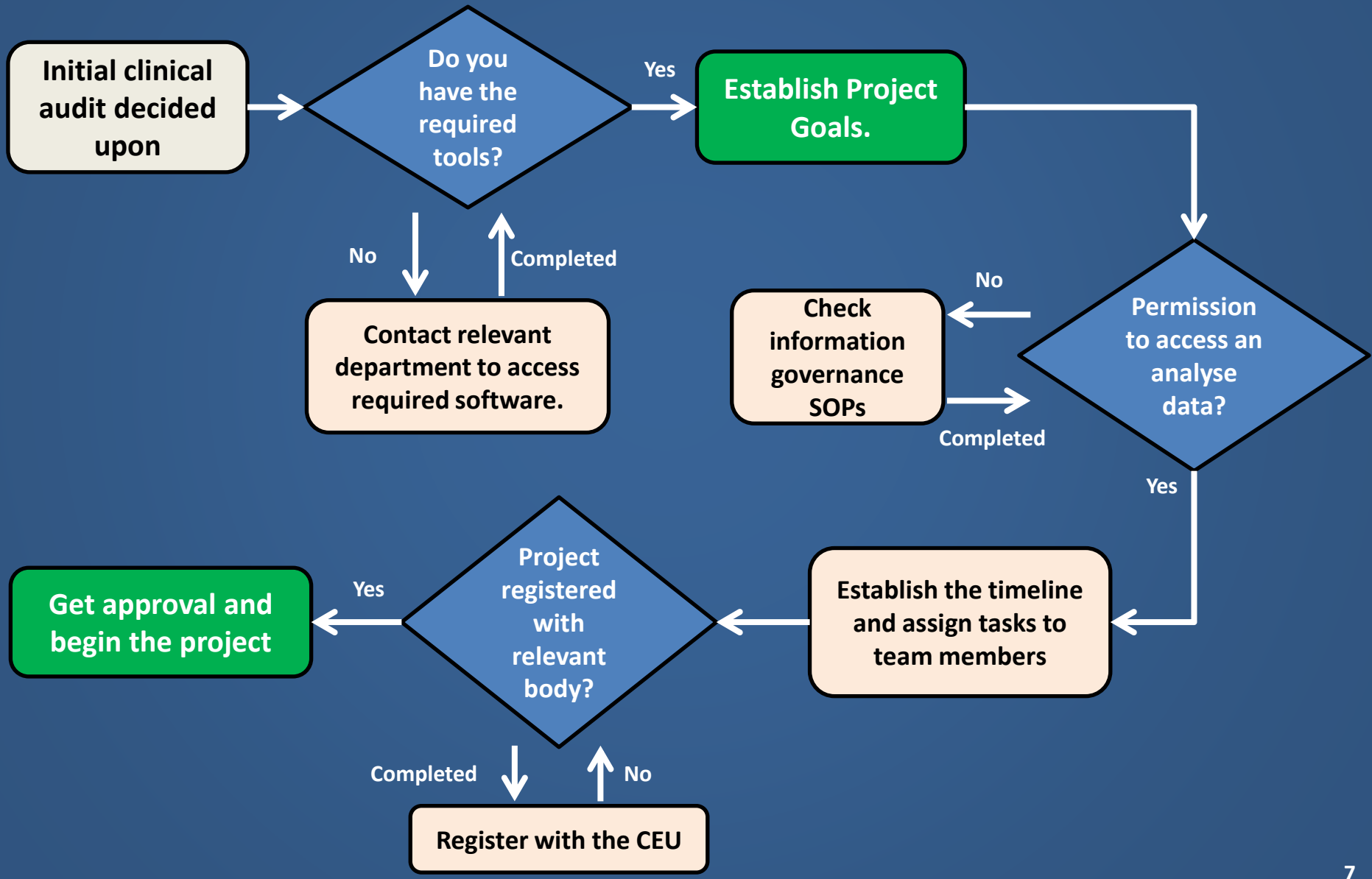
Method

- CT Head and Abdomen Scans collected between 01/01/2025 – 31/03/2025 for Hospitals A - E. Expanded to 30/04/2025 for Hospital B to increase Head data.

- Image centre was assumed to typically align with isocentre for these scan types.

- Misalignment for a CT scan defined as median difference between Image centre and Patient centroid in image.

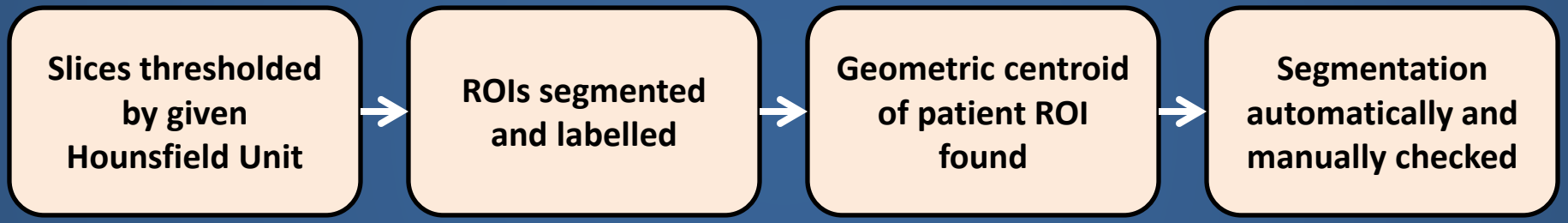
Method


Initial clinical audit decided upon
Do you have the required tools?
Yes
Establish Project Goals.
No
Completed
Contact relevant department to access required software.
No
Check information governance SOPs
Completed
Permission to access an analyse data?
Yes
Establish the timeline and assign tasks to team members
Project registered with relevant body?
Yes
Get approval and begin the project
Completed
No
Register with the CEU

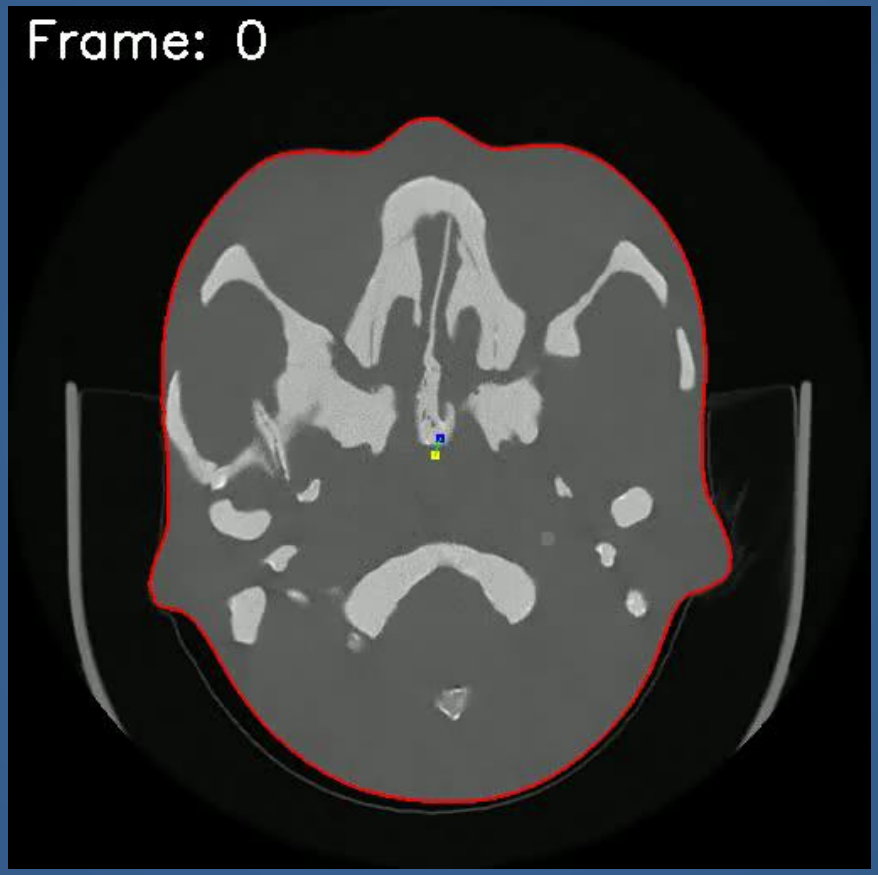
Method

Barts Health NHS Trust

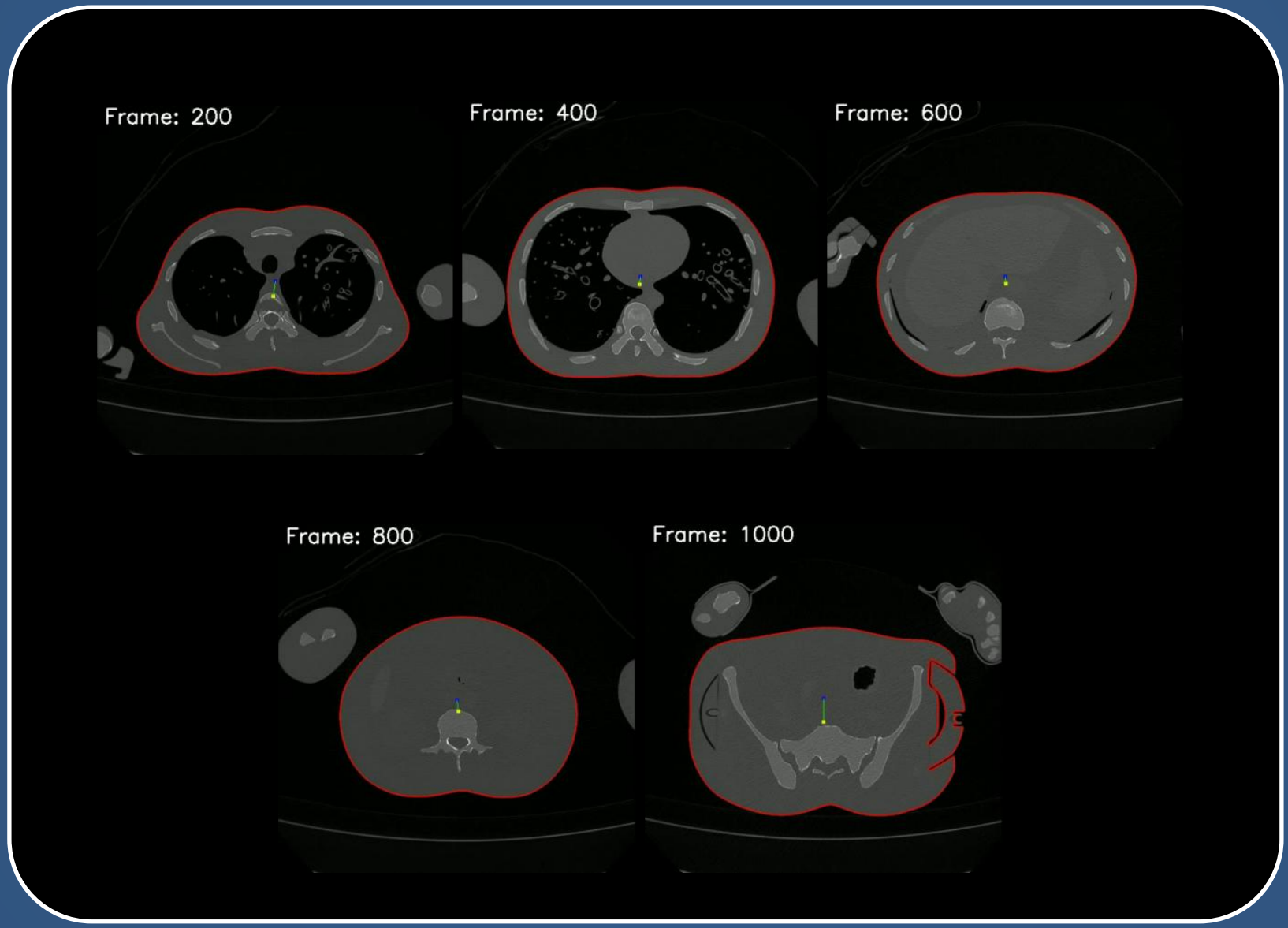
Misalignment found using custom python (v3.9.13) tool



Method

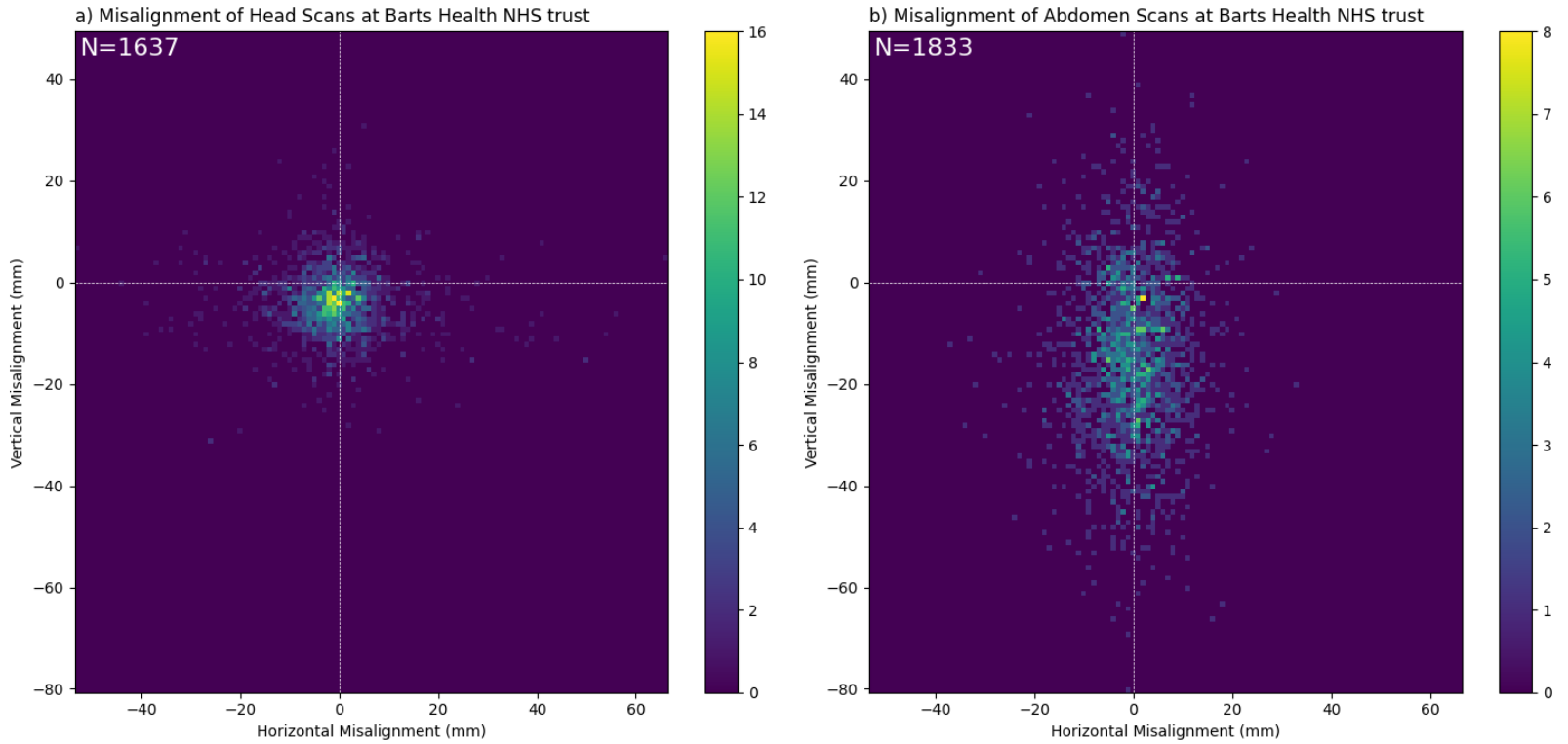


Method



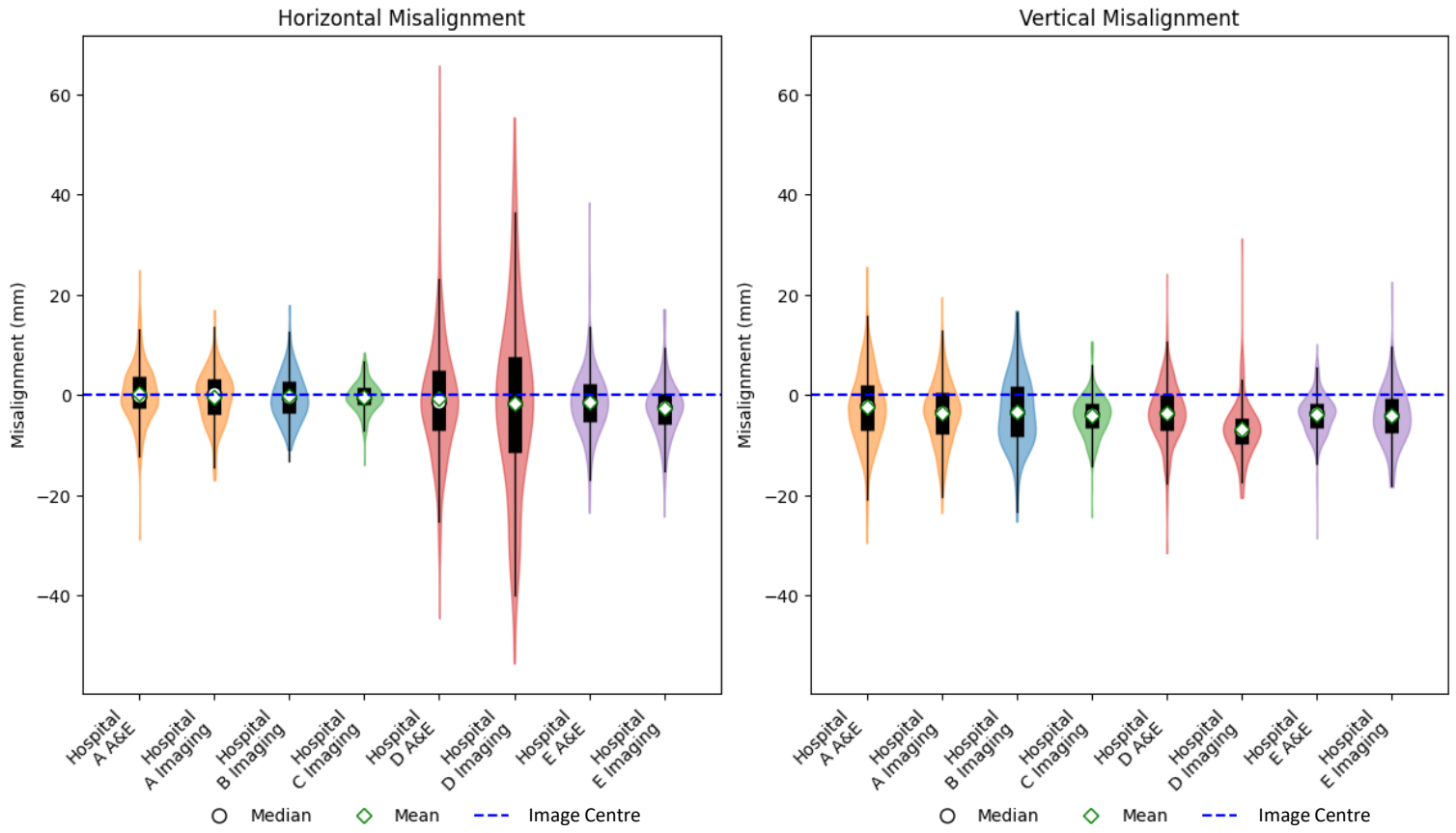
Results: Whole Trust

Barts Health NHS Trust



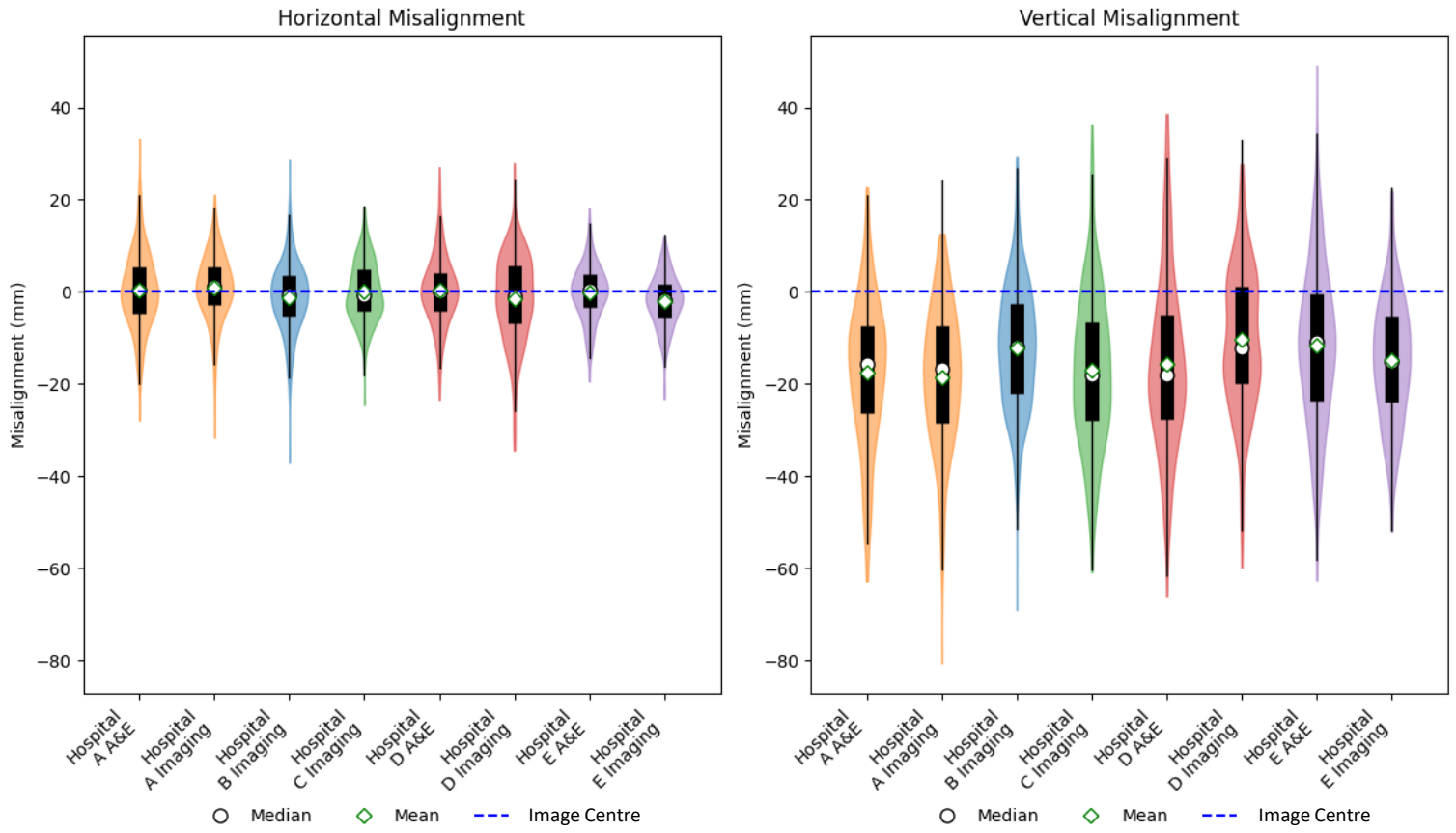
Misalignment	Mean (mm)	STD (mm)	N
Head Horizontal	-0.82 ± 0.23	9.15 ± 0.16	1637
Head Vertical	-3.85 ± 0.15	6.18 ± 0.11	1637
Abdomen Horizontal	-0.48 ± 0.18	7.61 ± 0.13	1833
Abdomen Vertical	-14.62 ± 0.38	16.14 ± 0.27	1833

Results: Head Scans

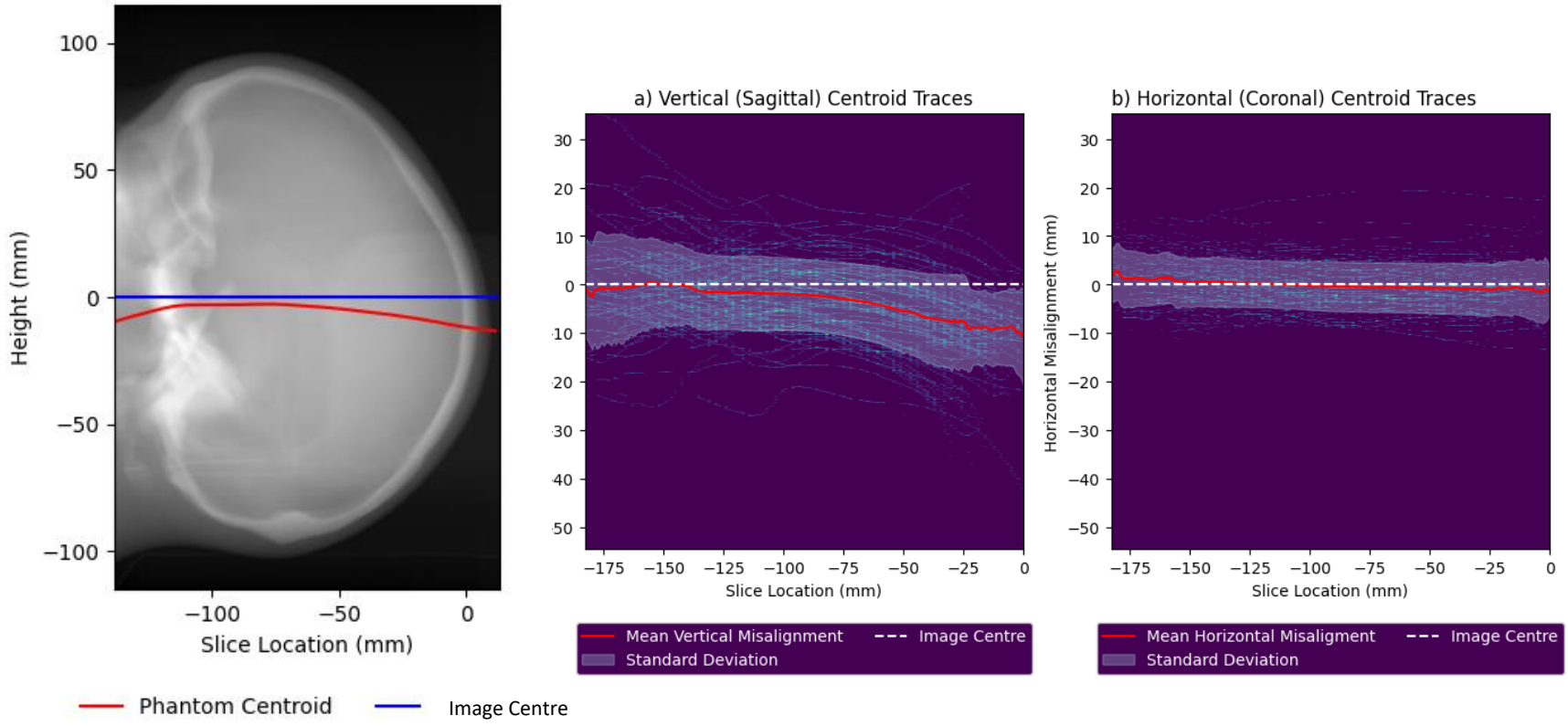


Results: Abdomen Scans

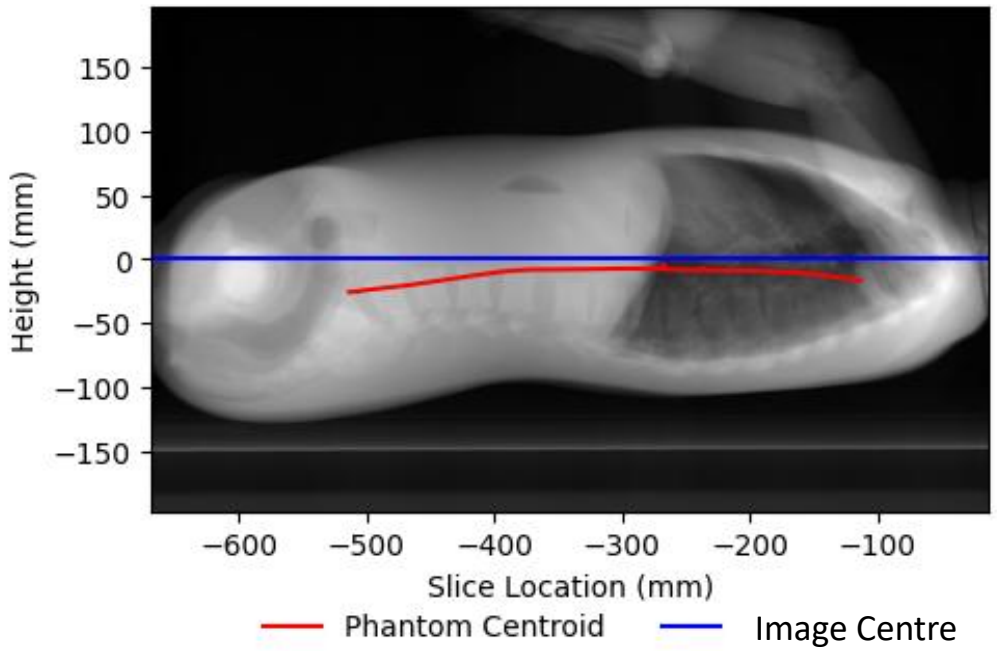
Barts Health NHS Trust

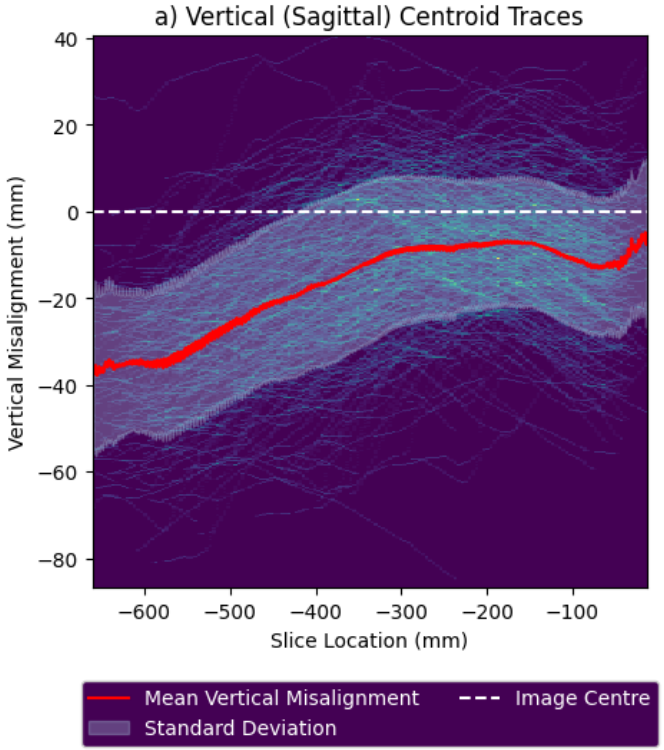


Results: Anatomical Effect



Results: Anatomical Effect





Discussion: Positioning

- Mean patient abdomen position is lower than image centre, this is consistent with literature [3].
- Patient anatomy does contribute to misalignment at the shoulder and pelvis. The central slice should be used to avoid this.
- Horizontal head positioning at Hospital D has a significant spread.

Discussion: Method

- The method relies on the assumption that image centre and isocentre align.
- No distinguishing between time of scan
- Unnecessary to analyse entire scans, focus only on the central scan to reduce download time.
- This method uses geometric patient centre instead of centre of attenuation

Future work

- Define a window of acceptable misalignment in which the impacts on dose and image quality are insignificant.

- Implement training sessions and talks on patient positioning via biological markers.

Conclusions

NHS
Barts Health
NHS Trust

- Patient abdomen and head positioning is acceptable at Hospitals A,B,C,E.
- Improvement in horizontal head positioning at Hospital D is required.
- The method may fail to detect poor positioning due to its assumptions.
- If poor positioning is identified it is likely present.

Acknowledgements

Thank you to the radiographers that instructed us on typical positioning and reconstruction methods, as well as the entire Barts Radiation safety department for helping collect the data.

I would also like to thank Barts Information governance and the clinical effectiveness unit for their help getting this project approved.

Questions?

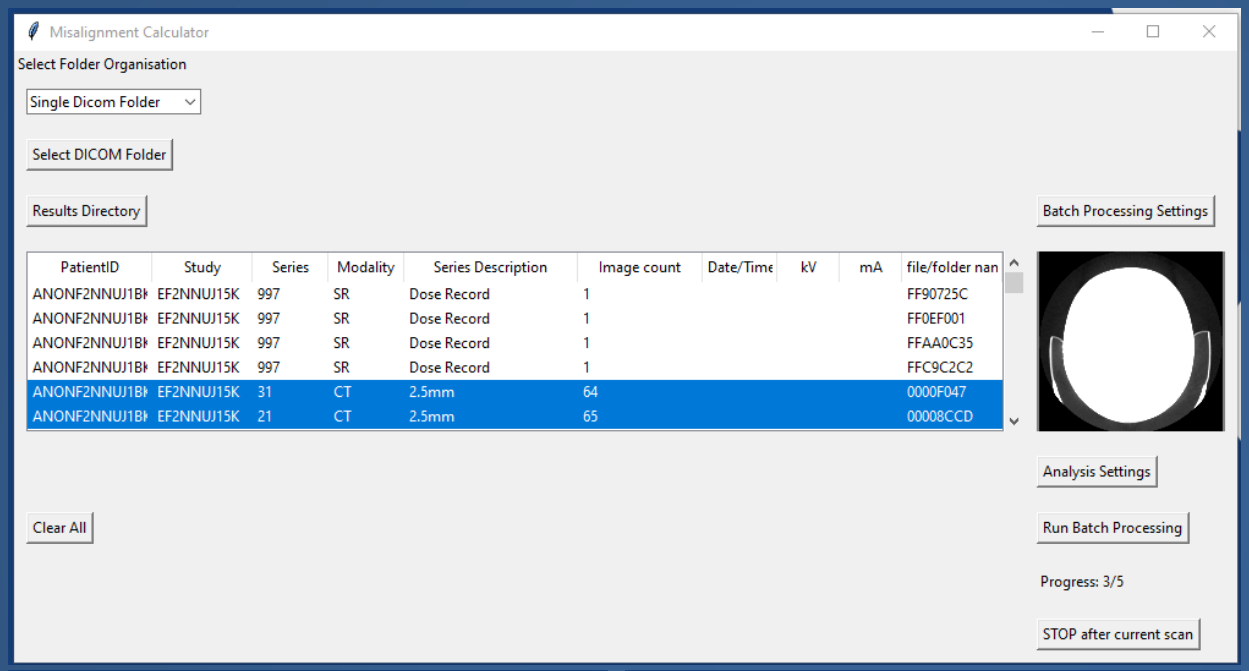
References

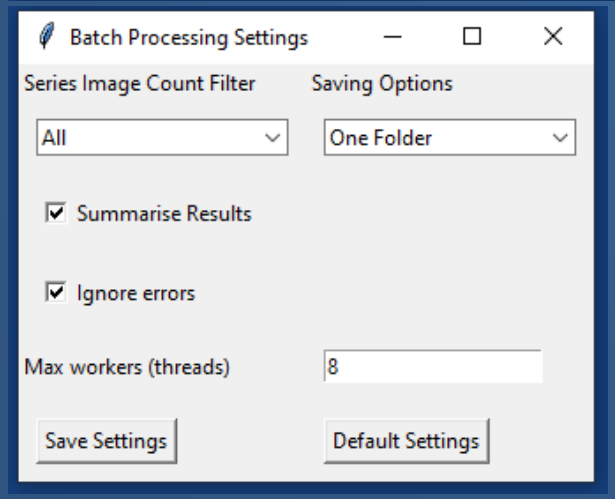
1. The Ionising Radiation (Medical Exposure) Regulations 2017 (Latest version), UK Government, 2024. Schedule 3, Table 2.

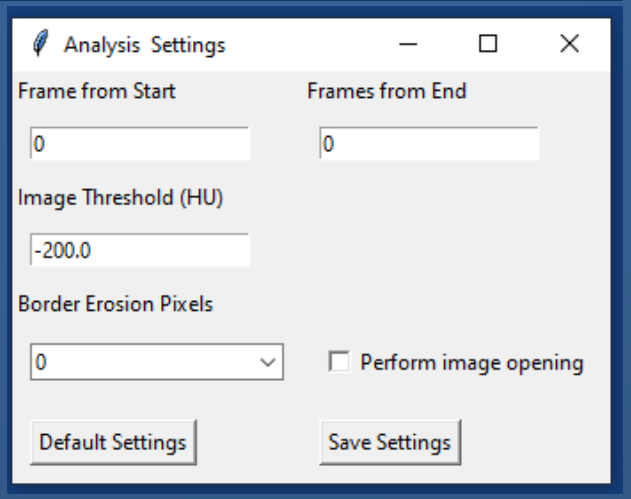
2. Y. Al-Hayek, X. Zheng, C. Hayre and K. Spuur, 2022, DOI: 10.1016/j.jmir.2022.09.027

3. O. Akin-Akintayo, L. F. Alexander, R. Neill, E. Krupinksi, X. Tang, P. Mittal, W. Small and C. Moreno, 2019, DOI: 10.1067/j.cpradiol.2018.02.007

Screenshots of the tool







Poor Positioning Examples