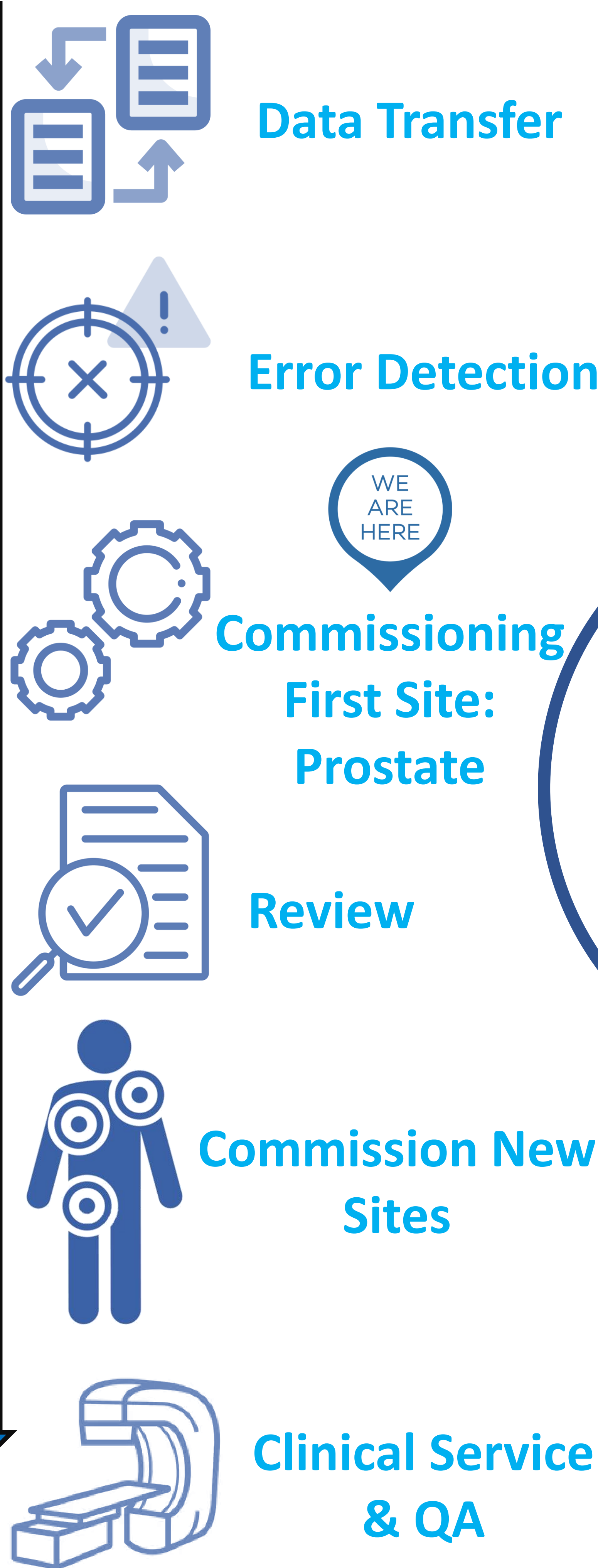


## Project Timeline



## Introduction

- Technological advancements have resulted in increasingly complex radiotherapy (RT) treatment plans.
- Advanced methods are required to provide verification of the entire treatment chain. [1]
- Numerous commercial solutions are available in the UK for Online Treatment Monitoring (OTM).
- Log-file analysis from the LINAC trajectory files is generally considered to be the optimal solution for OTM. [2]
  - At NHST, we have a project underway to commission and bring into service, MobiusFX (MFX, Varian Medical System, Palo Alto, CA, USA) for log-file based OTM.



## First Steps: Error Detection

- In-house software was developed (Python) to introduce known errors to plans generated using the treatment planning system (TPS) and test data transfer to the MFX system.
- Error detection performance was tested by delivering a standard plan *without* any errors, then delivering treatment with an *intentional error* (Fig. 1):
  - Jaw + 3, 5, 10mm
  - MLC + 3, 5, 10mm
  - MU ± 3, 5, 10, 15

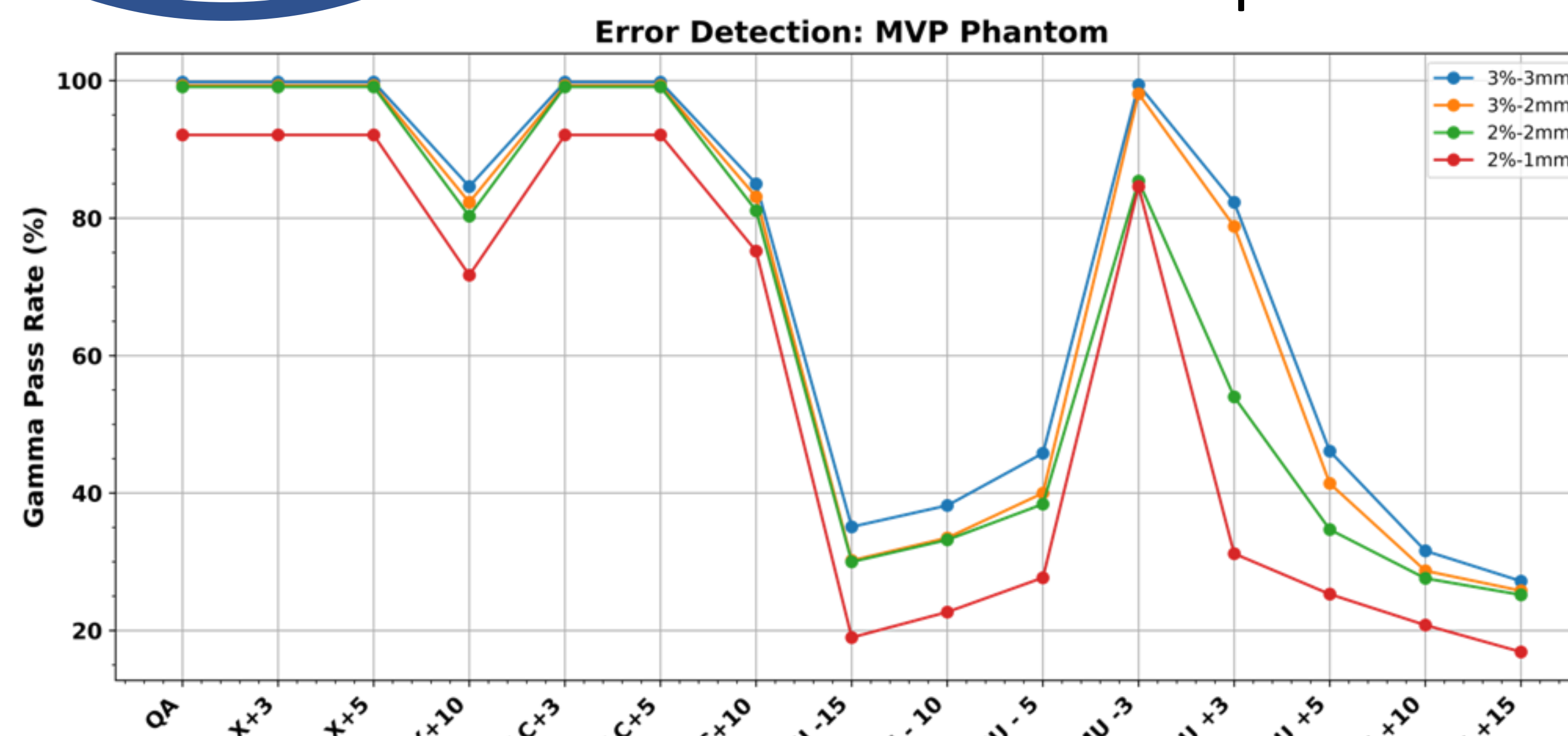


Figure 1: Gamma pass rates of plans analysed within the MFX, for standard (QA) and error plans

standard plan *without* any errors, then delivering treatment with an *intentional error* (Fig. 1):

- Jaw + 3, 5, 10mm
- MLC + 3, 5, 10mm
- MU ± 3, 5, 10, 15

## Future Work: Commissioning

- First clinical site will begin with prostate patients, allowing users to gain experience interpreting and investigating results (Fig. 2).

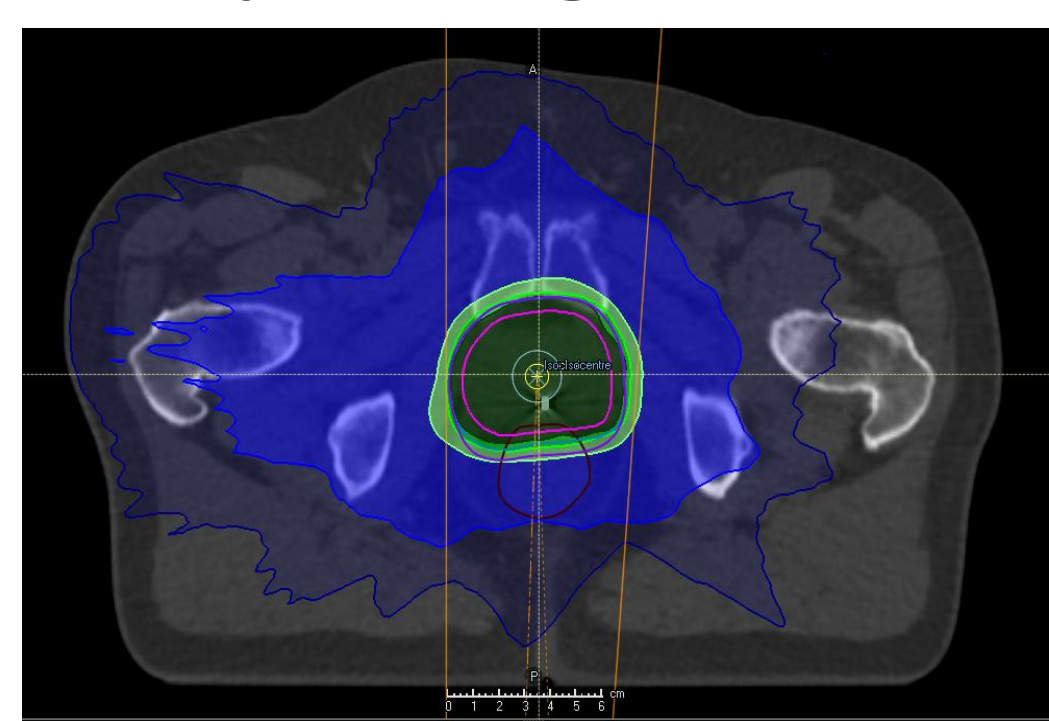


Figure 2: Prostate VMAT plan from the RayStation TPS

- Delta4 patient QA phantom can be compared to MFX and error detection tolerances, to set clinically acceptable baselines.
- Receiver Operating Characteristic (ROC) analysis will allow for tuning of OTM behaviour, yielding satisfactory compromises between detection & workload (Fig. 3).

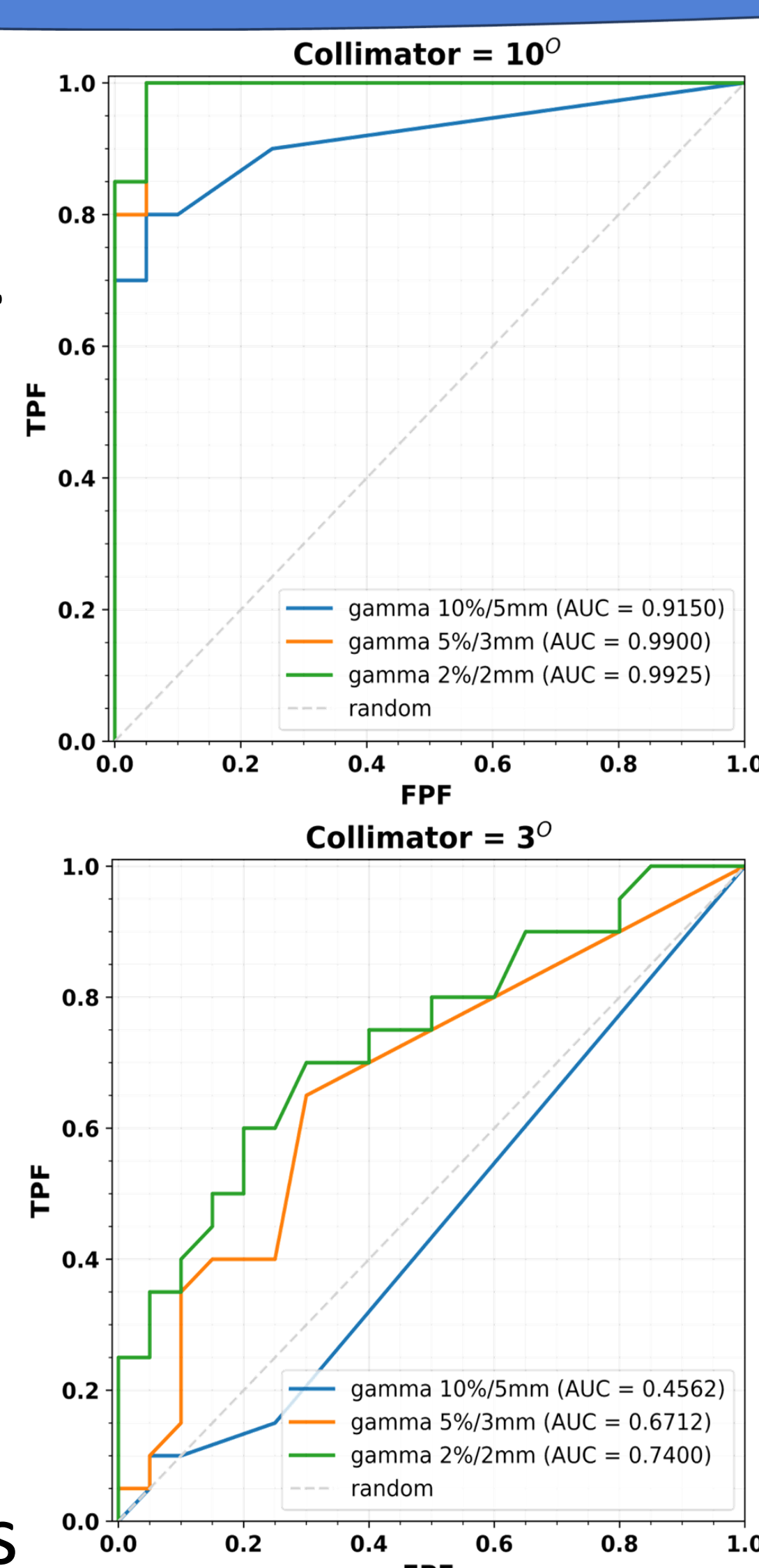


Figure 3: ROC of gamma tolerances for introduced errors

## Outlook

- OTM with MFX will allow for verification and dose assessment for *each treatment fraction*, but will require additional quality assurance.

- Release into clinical service requires the development of a regular QA protocol to trend and monitor the systems performance.
- Patient outcomes are improved by making treatment more sensitive and reactive to errors, allowing for it to be corrected during treatment.

- Time spent on patient specific QA can be dramatically reduced, reducing the burden to the service (Fig. 4).

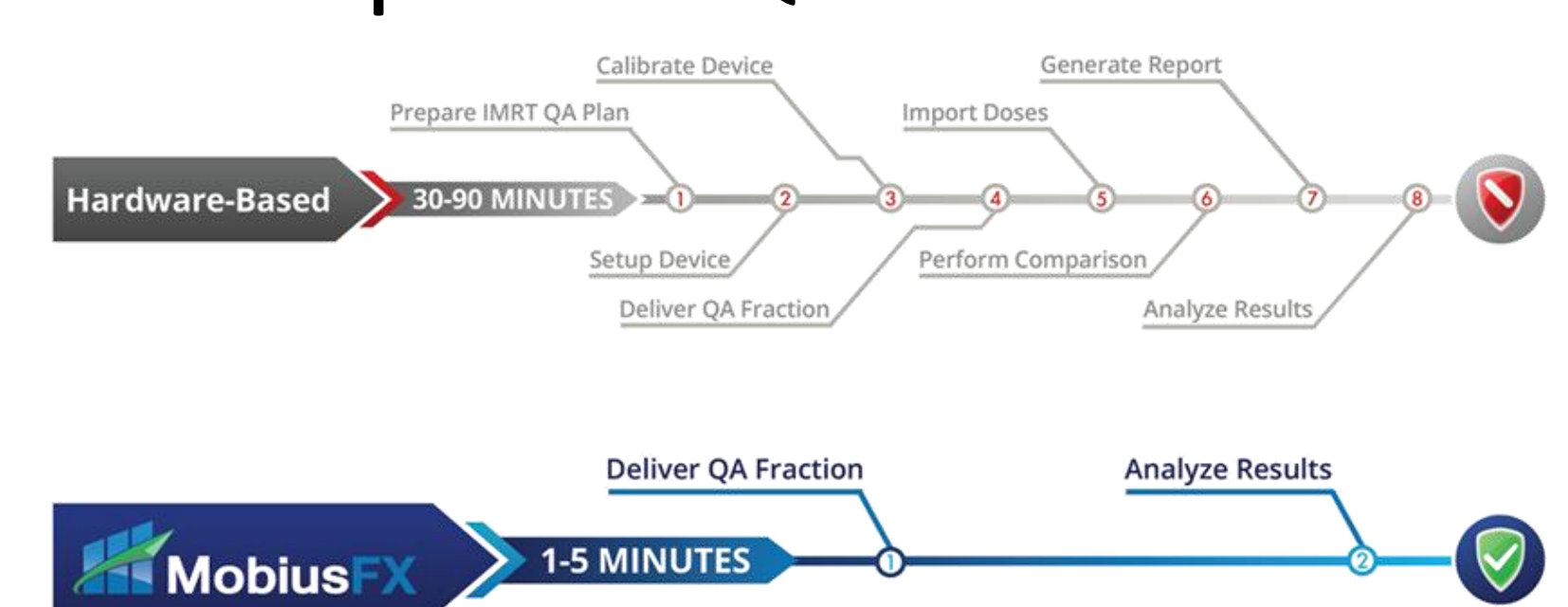


Figure 4: Advantages of MobiusFX OTM compared to standard patient QA practice

## References

1. Stevens, S., Moloney, S., Blackmore, A., Hart, C., Rixham, P., Bangiri, A., Pooler, A., & Doolan, P. (2023). IPEM topical report: guidance for the clinical implementation of online treatment monitoring solutions for IMRT/VMAT. *Physics Phys. Med. Biol.* 68  
 2. Stevens, S., Moloney, S., Bangiri, A., Blackmore, A., Hart, C., Holmes-Smith, W., Pooler, A., Rixham, P., & Doolan, P. (2021). IPEM topical report: results of a 2020 UK survey on the use of online treatment monitoring solutions for IMRT/VMAT. *Physics Phys. Med. Biol.* 66