

# Topic 1: Personalised Medicine & Adaptive Therapy for Medical Physicists

This document provides a framework and guidance for the Expert Working Group on Personalised Medicine & Adaptive Therapy, with a specific focus on the roles and responsibilities of medical physicists and their sub-specialties in advancing this area. The goal is to identify research needs, gaps in professional education, university foundation knowledge, and CPD requirements, ensuring that medical physicists are equipped to contribute to the evolving field of personalised medicine and adaptive therapy in clinical practice.



## :: 1.1: Adaptive Therapy Principles ::

### POTENTIAL KEY AREAS TO EXPLORE

#### • Concepts and Clinical Rationale:

- How do adaptive therapy principles apply specifically to medical physicists? What are the unique roles of medical physicists in adaptive therapy compared to traditional radiation therapy approaches?
- What is the role of medical physicists in planning, monitoring, and adapting treatment based on real-time patient data (such as tumor response and motion)?
- What clinical evidence supports the effectiveness of adaptive therapy in specific cancer types (e.g., head & neck, lung, prostate) and how should medical physicists incorporate these findings into their clinical practices?

#### • Case Studies:

- How can medical physicists contribute to the planning and delivery of adaptive therapies in these specific cancer sites? What are the clinical challenges and opportunities unique to each?

#### • Limitations and Future Directions:

- What limitations currently exist in adaptive therapy (e.g., technology limitations, resource limitations) that impact the role of medical physicists in its implementation?
- How can medical physicists contribute to overcoming these challenges? What emerging technologies or techniques are medical physicists involved with to address these limitations?

### POTENTIAL EVALUATION QUESTIONS AND APPROACHES

- **Research Needs:** What are the current gaps in evidence and technology that hinder the application of adaptive therapy? How can research help overcome these obstacles from the perspective of medical physicists?
- **Future Education Courses:** Should adaptive therapy principles and technologies be embedded in medical physics education programs? How can medical physicists be better prepared to implement adaptive therapy in clinical practice?
- **University Foundation Knowledge:** What foundational knowledge in radiation therapy planning, tumour biology, and clinical decision-making should be incorporated into the curriculum to prepare future medical physicists for personalised and adaptive therapy practices?
- **CPD Requirements:** What specific CPD modules should be designed to ensure practicing medical physicists are able to apply adaptive therapy principles in a clinical setting?

## :: 1.2: Enabling Technologies ::

### POTENTIAL KEY AREAS TO EXPLORE

#### • Cone Beam CT (CBCT): Physics, Artefacts, and Correction:

- How do medical physicists use Cone Beam CT to improve the accuracy of radiation therapy, particularly in adaptive therapy scenarios? What specific physics principles must be understood to use CBCT effectively in treatment planning and delivery?
- What common artefacts occur in CBCT, and how can medical physicists mitigate these issues to ensure accurate imaging?

#### • 4D Motion Tracking: Respiratory Gating and Tumour Tracking:

- How does 4D motion tracking and respiratory gating impact radiation delivery? What role do medical physicists play in monitoring and managing these techniques, particularly in lung cancer or head and neck cancers where tumour motion is significant?

#### • MR-Guided RT: System Comparison and QA Requirements:

- How do MR-guided radiation therapy (RT) systems compare to traditional imaging techniques (e.g., CT-based RT), and what unique challenges do these systems present for medical physicists, particularly in QA and system calibration?

#### • AI in Contouring & Registration: Tools, Validation, and Pitfalls:

- **What role do medical physicists play in implementing and validating AI tools for contouring and image registration in personalised medicine? What are the challenges in validating these AI tools to ensure they are clinically effective and safe?**

### POTENTIAL EVALUATION QUESTIONS AND APPROACHES

- **Research Needs:** What further advancements are needed to improve adaptive therapy practices? What role do medical physicists have in advancing these technologies?
- **Future Education Courses:** How should medical physics programs incorporate training in the advanced technologies that enable personalised and adaptive therapies?
- **University Foundation Knowledge:** What core principles in imaging physics, radiation therapy, and AI need to be embedded in university-level courses to prepare medical physicists to use these technologies?
- **CPD Requirements:** What training or certification programs are necessary to ensure that practicing medical physicists can effectively use and validate AI tools and advanced imaging techniques in clinical practice?

## :: 1.3: Patient-Specific Treatment Design ::

### POTENTIAL KEY AREAS TO EXPLORE

#### • MRI Sequences for Pathology Characterisation:

- What MRI sequences are essential for accurately characterising tumours and other pathologies in personalised radiation therapy? How do these sequences help medical physicists optimise treatment planning?

#### • Functional Imaging Integration (e.g., DWI, Perfusion):

- How can functional imaging such as diffusion-weighted imaging (DWI) and perfusion imaging be integrated into radiation therapy planning? What role do medical physicists play in incorporating these advanced imaging modalities?

#### • Tumour Heterogeneity and Implications for Planning:

- How does tumour heterogeneity affect treatment planning, and how can medical physicists contribute to developing strategies for personalised treatment based on this heterogeneity?

### POTENTIAL EVALUATION QUESTIONS AND APPROACHES

- **Research Needs:** What further research is needed to better understand tumour heterogeneity and its impact on treatment planning? How can imaging technologies be optimised to improve personalised treatment design?
- **Future Education Courses:** Should medical physics education programs place more emphasis on functional imaging and tumour heterogeneity in the context of personalised radiation therapy?
- **University Foundation Knowledge:** What core knowledge in advanced imaging and tumour biology should be incorporated into medical physics programs to prepare students for personalised treatment design?
- **CPD Requirements:** What CPD modules are needed to help practicing medical physicists integrate advanced imaging modalities and tumour heterogeneity considerations into clinical practice?

## :: 1.4: Clinical Decision Support & Data Science ::

### POTENTIAL KEY AREAS TO EXPLORE

#### • Tumour Response Assessment During Therapy:

- How do medical physicists contribute to assessing tumour response during radiation therapy, particularly in the context of adaptive therapy? What imaging or measurement tools are involved?

#### • Basics of Radiomics and Delta-Radiomics:

- What is radiomics, and how does it contribute to personalised medicine in radiation oncology? How can delta-radiomics (changes in radiomics features over time) predict therapy response?

#### • Integration of Genomic and Biomarker Data:

- How can genomic and biomarker data be incorporated into radiation therapy planning to better tailor treatments to the patient's specific needs?

#### • Machine Learning Models for Outcome Prediction:

- How can machine learning be used to predict treatment outcomes in personalised medicine? What are the roles and responsibilities of medical physicists in developing or using these models?

#### • Use of Wearable Sensors in Radiation Oncology:

- How can wearable sensors be integrated into clinical practice to monitor patient responses to radiation therapy in real time? What challenges do medical physicists face in utilising these devices?

### POTENTIAL EVALUATION QUESTIONS AND APPROACHES

- **Research Needs:** What research is required to better integrate radiomics, biomarkers, and machine learning into personalised radiation therapy planning? What role do medical physicists play in this integration?
- **Future Education Courses:** How should medical physics education incorporate data science and machine learning to prepare students for the future of personalised therapy?
- **University Foundation Knowledge:** What foundational knowledge in data analysis, genomics, and clinical decision support should be included in medical physics curricula to equip students for the future?
- **CPD Requirements:** What specific CPD programs can be developed to help practicing medical physicists stay current with data-driven approaches, AI tools, and wearable technologies in clinical settings?