



PHYSICS

2022 ESTRO Physics Workshop: Science in Development

Re-irradiation: improving dose summation for plan optimisation, evaluation, and outcome analysis

7 - 8 October 2022, Lisbon, Portugal

Chairs: Ane Appelt, Eliana Vásquez Osorio, Charles Mayo, Andrew Jackson

Re-irradiation poses considerable challenges in clinical practice, and the need to overcome these is becoming increasingly important as rising numbers of patients are offered multiple courses of radiotherapy. There is heterogeneous, poor-quality data in the literature, a lack of a standard approach to dose assessment and reporting, and a lack of dedicated technical solutions from commercial vendors. This European Society for Radiotherapy and Oncology (ESTRO) workshop, endorsed by the Canadian Organization of Medical Physicists and the American Association of Physicists in Medicine (AAPM), brought together 32 professionals (Figure 1) with various backgrounds and at all career levels to brainstorm on these challenges and to work on potential outputs.



Figure 1: Re-irradiation workshop participants

Our engagement started with a pre-workshop online meeting, where participants introduced themselves. Two presentations on the clinical opportunities and challenges of re-irradiation by Louise Murray (clinical oncologist, University of Leeds and Leeds Cancer Centre, UK) and the technical management of re-irradiations by Pauline Dupuis (medical physicist, Centre Léon Bérard, France) helped to set the scene. Nick Hardcastle (medical physicist, Peter MacCallum Cancer Centre, Australia) introduced a pre-meeting benchmark challenge and survey that aimed to gather information about the different clinical practices for re-irradiation assessment and to evaluate the inter-observer variation in the assessment of cumulative doses. Two patient cases, representing common re-irradiation scenarios, were shared with the participants. DICOM files for original and re-irradiation treatments were

included. From the 22 responses to the survey and 20 responses to the benchmark challenge, it was apparent that there is a large variation in the re-irradiation clinical workflow, the assessment method and the results over the same cases, which confirmed the need for standardisation.

During the first day in Lisbon, 12 presentations were made by the chairs, participants, and vendors (Brainlab, MIM Software, RaySearch Laboratories, and Varian Medical Systems), which formed the basis of heated, thought-provoking discussions (Figure 2) that took up most of the second day. During both days, participants had the opportunity to contribute to the workshop by not only giving flash talks on various topics related to re-irradiation, but also by participating in online polls and by posting on a “mural” their suggestions on discussion points during the meeting, potential outcomes and post-workshop working themes (Figure 3).



Figure 2 Group discussions and brainstorming during the workshop with Lone Hoffmann (medical physicist, Aarhus University & Aarhus University Hospital, Denmark) on the left and Andrew Jackson (medical physicist, Memorial Sloan Kettering Cancer Centre, USA) on the right

Two invited speakers, Nicolaus Andratschke (radiation oncologist, Department of Radiation Oncology, Zurich University, and University Hospital of Zurich, Switzerland), the only clinician in our group, and Coen Hurkmans (clinical physicist, Catharine Hospital Eindhoven, The Netherlands) talked about how to define and report re-irradiation and opportunities for large-scale radiotherapy data collection, respectively. Our very effective chairs, Ane Appelt (medical physicist, University of Leeds / Leeds Teaching Hospitals NHS Trust, UK) and Eliana Vásquez Osorio (computer scientist, University of Manchester, UK) touched on the challenges of image registration for dose accumulation in re-irradiation and summation of equivalent doses in 2Gy fractions, while Charles Mayo (physicist, University of Michigan, USA) and Andrew Jackson (physicist, Memorial Sloan Kettering Cancer Centre, USA) talked about the AAPM and American Society for Radiation Oncology ontology and standards for data sharing as well as strategies for modelling dose tolerances for re-irradiation.

All the great talks triggered group discussions on many re-irradiation challenges that we face, including the uncertainties in image registration for dose summation, wish lists for vendors, standardisation of data reporting for individual patients, the collection and reporting of data on doses to organs at risk for outcome/toxicity modelling, how to get the right data on re-irradiation studies, and so on. By the end of the meeting, it was clear that there is a lot of work to be done; thus a post-workshop meeting is underway with the intention of creating working groups to tackle some of these challenges. Potential outcomes include the publication of the benchmark re-irradiation challenge (an abstract has already been submitted for the ESTRO congress 2023), the development of resources for the scientific community (e.g., cohort with clinical cases), guidelines on technical aspects of re-irradiation, recommendations for vendors, recommendations to journals for data requirements, and of course future online/in-person workshops and sessions on re-irradiation to support standardisation in clinical practice. Anybody interested in contributing to these working groups is very welcome to contact the chairs via Ane Appelt or Eliana Vásquez Osorio (see email addresses below).



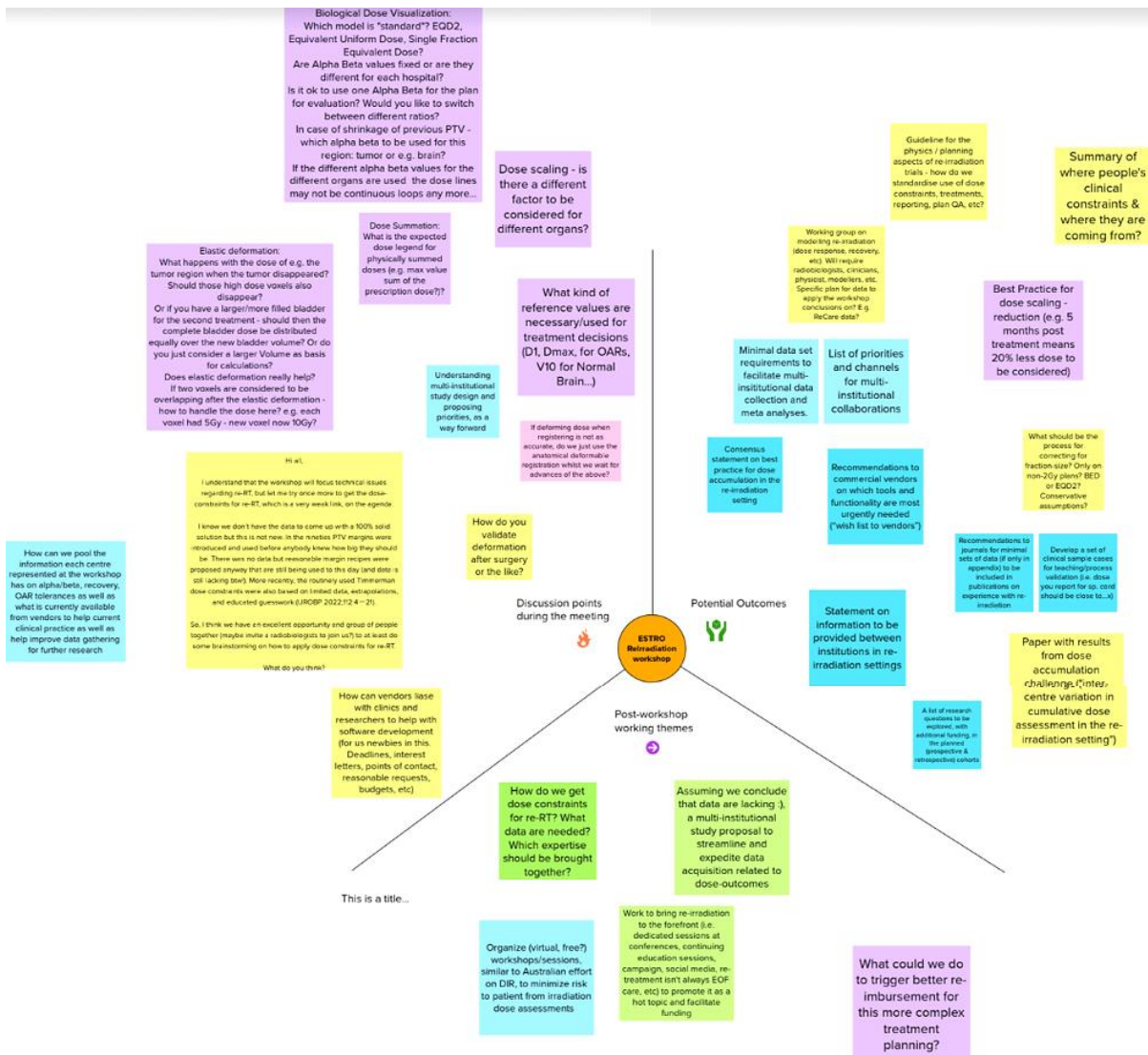


Figure 3 Online “mural” with participant suggestions on topics for discussion on the right, potential outcomes on the left and post-workshop working themes at the bottom

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