3rd ESTRO Physics Workshop: Science in Development

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Multi-source data fusion for decision support systems in radiation oncology: opportunities, methodologies, standardisations and clinical translation track

Chairs:

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"Data is the new oil, but each car needs its own fuel." This sentence summarises the outcomes from this physics workshop very well. The central theme of the workshop was to discuss the role of big data and its analysis in radiation oncology.
Recent hardware developments in radiation oncology, as well as the availability of multi-source data and metadata (imaging, clinical records, -omics in general) have brought challenges to the radiotherapy medical physics community. It has become evident that different professionals (physicists, clinicians, engineers, industrial partners) are needed to fuse together different data sources and extract valuable information in the form of decision support systems.

The goal of this workshop was to bring together professionals who were working with one or multiple forms of multi-source data, as well as clinicians to form a community that could:
1) incentivise the role of data science in radiation oncology;
2) share tools and best practices for multi-source data mining;
3) display ways to speed up the production of reproducible and transparent science;
4) bind closely with clinicians to use all of the above to solve clinically relevant research questions.

To achieve these goals, we structured our workshop into three tracks:
a) imaging and radiomics;
b) (big) data infrastructure; and
c) clinical applications.

In the first track, Dr Alex Zwanenburg (quantitative imaging, Germany) led pitches from the participants to show the upcoming challenges for imaging data and radiomics, and the ongoing effort of the Image Biomarker Standardisation Initiative (IBSI), the independent international collaboration that is working towards standardising the extraction of image biomarkers from acquired imaging for the purpose of high-throughput quantitative image analysis (radiomics). After group discussion, the participants agreed that radiomics was a "measurement" and that it was important to identify systematic and statistical uncertainties that needed to be reduced as much as possible through benchmarking of radiomics computations, usage of dedicated phantoms and focusing on raw data (synograms in the future).

In the second track Professor Andre Dekker (clinical data science, The Netherlands) and other pitches from participants introduced the Findable Accessible Interoperable Reusable (FAIR) principles and how these could be linked to multi-source data infrastructure for knowledge discovery. After group discussion, the participants agreed that FAIR principles enabled reproducible and transparent science, but more was required: there was a need to link together FAIR and concrete examples in radiation oncology; a data management plan for radiation oncology needed to be defined that also considered other initiatives such as those drawn up by the American Association of Physicists in Medicine (AAPM); and companies were required to help to apply FAIR principles to products they brought to the market or the clinic.
In the third track, Dr Joanna Kazmierska (radiation oncologist, Poland) and other participants opened our eyes to the gap between research and translation to the clinic. After group discussion we agreed that it was fundamental to involve clinicians in data collections as well as during each phase of prediction-model development and study design.

Simple models (e.g. Bayesian networks) should be preferred for use in the first instance, since they were easier to understand and validate than complicated models. Models should be made FAIR, and should be shared in a dedicated repository. Finally, models should be translated in the clinic for informed, shared decision-making using a clear and agreed workflow.
We had much fun (see pictures) but also left with a concrete follow-up plan that included a position paper to establish a clinical data-science community within ESTRO, and sub-working groups for each of the listed tracks, to be led by young investigators.

Track Participants

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