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Opportunities and Challenges of learning from Medical Imaging Data

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Medical Imaging data provides a wealth of information to the health care pathway including diagnosis, understanding disease extent, prognosis, outcome and follow-up. Medical image data can capture anatomical, biological and physiological information through computed tomography, positron emission tomography, magnetic resonance imaging and other approaches. To use this data effectively for an individual patient we need to understand uncertainties related to generating the imaging data as well as uncertainties related to the use of the imaging data. Understanding similarities of imaging data from a particular patient compared to others in a patient cohort is also key in being able to diagnose and predict outcomes effectively.

Although the principles behind medical image generation are consistent there are implementation differences between different scanner versions and different scan settings. These differences can result in differences in quantitative image information. Use of these images will also be different between clinicians, for instance the inter-observer variation for defining radiation oncology treatment volumes. Automated approaches can provide a pathway for presenting the estimated variation to clinicians to ensure this variation is understood when making clinical decisions.

Considering differences in images (and other medical data) across patient cohorts requires access to large datasets. This can be challenging as medical data is often stored in local institution silos. Combining this data can be challenging both from a governance and a data transfer perspective. Federated learning where data remains at local institutions but can be learnt from in a combined iterative manner can provide a solution to this challenge but requires significant support from local centres and a strong collaborative approach.

Addressing these challenges is important to ensure that medical imaging data can be used most effectively in all areas of medicine.

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