Dear readers and colleagues,

Cancer care has been transformed by the development of three-dimensional imaging techniques since their emergence into clinical care in the 1970s and 80s. Early computed tomography (CT) and magnetic resonance (MR) imaging systems provided soft-tissue visualization of both tumor and normal anatomy to provide oncologists with insights of the distribution and overall burden of disease that have advanced our ability to stage and prognosticate cancer since the first American Joint Committee Manual for Staging of Cancer in 1977 [1]. In those early days, imaging studies provided insights that were largely treated as qualitative, adjunctive information, which when combined with the clinical exam, would enhance clinical decision-making.

The role of imaging data in oncological clinical care has evolved dramatically in recent years where imaging has transitioned from its adjunctive role to become a clinician-directed measurement tool for prognostication and response assessment, as well as a tool for directly guiding intervention. MR imaging, in particular, has advanced at an astounding pace with improvements in image quality and new capabilities to interrogate tissue microstructure, physiology and metabolism, generating more mechanism-oriented measures that could be integrated into clinical decision-making for precision medicine approaches. However, while the imaging systems have advanced, the persistent qualitative nature in the use and interpretation of medical imaging has to-date prohibited utilizing the full potential of the rich multiparametric and multimodal imaging data in the guidance of cancer care.

Complementary to the advances in imaging technology itself, the rapidly growing computing power and prevalence of artificial intelligence (AI) in the world around us has certainly introduced new opportunities.
and challenges in medicine and particularly in the field of radiology. There are promising strides in utilizing AI to improve image quality, accelerate image acquisition and reconstruction, as well as assist with image interpretation. One question that has arisen amidst the enthusiasm for AI applications in medical imaging is whether the requirements of imaging data are different in the adjunctive paradigm used by humans than numerical algorithms and whether the qualitative approach to imaging information in current practice will suffice in the era of human-machine hybrid medical care.

In order to fully address these evolving requirements and applications of imaging data, the community needs to make a conscious pivot from treating MR imaging data as a qualitative assessment tool when in actuality clinicians and the evolving technology around us are pushing its use as a quantitative measurement tool. This pivot requires critical steps that address the consistency and quality of imaging data at the time of imaging acquisition, post-processing and analysis, as well as changes in human behavior.

A dedicated effort is being led by groups including the Radiological Society of North America Quantitative Imaging Biomarker Alliance, which has broadly engaged institutions globally and partnered with industry to facilitate this transition of imaging from pictures to quantitative measurement. Through growing knowledge dissemination, clinical trial investigators have come to appreciate the impact of variable image acquisition on robust response assessment. Recently, members of collaborative clinical trial groups with the endorsement of the U.S. Food and Drug Administration (FDA) and National Cancer Institution (NCI) have established standardized MR acquisition protocols for primary and secondary brain tumors [2–4]. While establishing consensus for standardized image acquisition protocols are a first step, clinical adoption of these standardized protocols remains a challenge and along with this, the quality assessment metrics of MR imaging data need to be established for truly impactful implementation of quantitative MR imaging. Beyond the image acquisition, quantitative image interpretation also relies on standardized and transparent post-processing and analysis of imaging data with a quantitative approach, as fostered by groups such as the Quantitative Imaging Network [5–7]. Ideally, these academic collaborative efforts will include close industry engagement that will lead to the development of tools that enable broad deployment of quantitative MR implementation across varying clinical environments from large academic centers to community-based settings.

As highlighted in this edition of MReadings, the clinical research community is working aggressively to make the pivot and learn how to utilize the full and immense power of MR to quantitatively characterize and target tumors and tissues to improve radiotherapy delivery, as well as assess and adapt to early response to treatment. This transition will not only maximize the benefit of the ever-improving MR information to clinical decision-making, it will release the full power of multiparametric MR to characterize tissues for its use in biological targeting of tumor and biologically relevant radiation dosing of tumor subregions while limiting radiation-associated toxicity to the surrounding normal tissues – realizing personalized MR-guided radiotherapy.

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References


