*Title*

Developments and Applications of Quantitative Imaging Biomarkers

*Abstract*

 The development and applications of quantitative imaging biomarkers are essential goals for modern biomedical imaging science. Imaging biomarkers are growing in their diversity and impact, and are increasingly being used for applications of imaging beyond traditional radiological practice, such as the evaluation of novel drugs and treatments. In cancer, molecular imaging using PET and optical methods report directly on cellular events and characteristics, and are complemented by MRI, CT and US methods that measure downstream effects such as changes in tumor volume, cell density, tissue vascular properties and blood flow. These are being applied in developing new drugs and in clinical trials and are proving useful in cancer management, especially to evaluate treatment response. Integrating multiple data sets from different modalities such as PET and MRI can provide a more comprehensive view of tumor metabolic and physiologic state. In neuroscience, quantitative brain morphometry is used to characterize and distinguish subject groups and identify structural variants in individuals which correlate with behavior and function. PET studies of neurotransmitters and their transporters are well established and provide direct evidence of whether drugs hit specific targets, along with their *in vivo* binding properties. Functional MRI based on BOLD (blood oxygen level dependent) signals provides unique insights into neural circuits and inter-regional functional connectivities, which may be quantified to assess changes with treatment, development, degeneration or as an index of severity of disease. Pharmaceutical MRI uses similar measurements to evaluate the actions of drugs and signaling pathways in the brain. In diabetes and metabolic disorders, measures of tissue composition, physiology and metabolism provide quantitative indices of disease risk and progression. Overall, there are numerous such biomarkers under development in many different areas of application in each modality, and these activities define much of the research in current imaging science.