QIN Moving Towards Validation For Clinical Utility

2018 Recipient of the Larry Clarke Young Investigator Award



Dr. Angela Jarrett of the University of Texas at Austin will be receiving the 2018 Larry P. Clarke Young Investigator Award. She will travel to the May Annual Meeting and make a presentation on her work in Tom Yankeelov's lab. Dr. Jarrett has worked on two major projects at the interface of

quantitative imaging and computational modeling of cancer. One has focused on using quantitative magnetic resonance imaging data to calibrate a family of models based on coupled partial differential equations which describe the spatiotemporal response of human breast cancer to neoadjuvant therapy. After calibration, she runs the model forward to predict the future growth or response of the tumor to compare it to what the actual outcome was for the individual patient. This is an extremely difficult problem and represents extremely novel work; there are no more than five groups in the country working at building mechanism based models of tumor growth and response that can be calibrated entirely with quantitative imaging data. Additionally, the importance of this problem is difficult to overstate; the need to develop mechanism-based models of tumor progression to optimally treat patients is paramount.

Her second project area is work at the interface of quantitative imaging, immunotherapy, and tumor modeling. More specifically, she is developing a mathematical model based on and coupled with quantitative MRI and PET data for HER2+ breast cancer in response to anti-HER2 therapy. The model incorporates temporal data describing tumor size, hypoxia, necrosis, and vasculature, and solves a system which includes the role of the immune system. The predicted immune response is compared to experimental results of immunofluorescent staining for immune infiltrates in tumor histology slices. Again, there is very little work on mathematically modeling these phenomena, yet they are recognized as of critical importance in cancer biology.

CONTENTS:

QIN Award: 2018 Recipient of the Larry Clarke Young Investigator Award

QIN Tools & Methods - QIN Bench Marking of Tools and Methods

QIBA - QIBA and QIN Next Steps

Informatics – TCIA and QIN

QIN Joint Effort -QIBA-QIN Next Steps

Collaboration Tool – QIN SharePoint Transitions to QIN -HUB

Communication – QIN New Public Website

Membership – Associate Member Project

Publications – JMI honors Larry Clarke

From the Director -

QIN Benchmarks for Tools and Methods

QIN sites are involved in a variety of Challenges and Collaborative Projects (CCPs) across the network. These activities produce valuable information about performance of software tools on reference data sets, utility of digital or physical phantoms in analysis of consistency in measurements and quality control of quantitative studies. The QIN Challenge Task Force, composed of representatives from QIN Working Groups, the Executive Committee, and NCI program staff, has developed a 5-tier benchmark system as a standard way to assess milestones in development of quantitative imaging products (i.e., tools, methods, devices, etc.) from concept to clinic. QIN Benchmarks will recognize objective performance of quantitative imaging products in CCPs, technical and clinical tests, requiring a peer-reviewed publication supporting each claim. A presentation on QIN Benchmarks process, application, and review will be presented at the QIN 2018 Annual Meeting by Keyvan Farahani, Program Director, and Deputy Director for Technology, QIN/NCI.

QIBA and QIN Next Steps

The Quantitative Imaging Biomarker Alliance (QIBA) and QIN will have the opportunity at the next QIN Annual Meeting in May to focus on collaborations intended to reduce barriers to clinical translation and community adoption of tools and biomarkers, and to advance ideas toward commercialization. The annual meeting will convene a panel to explore potential activities for collaborations between the two groups. The panel will discuss possible joint objectives and focus on methods to bring resources together to achieve them.

TCIA and QIN

The Cancer Imaging Archive (TCIA) continues to serve QIN data sharing needs. If you are managing a challenge or collaborative project you can submit an application to host the related data set(s) by visiting <u>http://www.cancerimagingarchive.net/primary-data/</u>. Leveraging TCIA's services lets users hand off the burden and risks associated with de-identification of patient data for HIPAA compliance; and expose their data set to over 9,000 active users every month. This drastically increases the visibility of projects within the cancer research community, and helps with meeting the requirements of a growing number of publishers that require data sharing.

TCIA is actively collecting other valuable data sets which may be of interest to QIN members. In the first quarter of 2018 new data from two major NIH-funded projects were posted. The first is the <u>Clinical Proteomic Tumor</u> <u>Analysis Consortium (CPTAC)</u>, which is designed to accelerate the understanding of the molecular basis of cancer through the application of large-scale proteome and genome analysis, or proteogenomics. The second is the <u>Applied Proteogenomics Organizational Learning</u> and <u>Outcomes</u> (<u>APOLLO</u>) network, which is a collaboration between NCI, the Department of Defense (DoD), and the Department of Veterans Affairs (VA) to incorporate proteogenomics into patient care as a way of looking beyond the genome. The emerging field of proteogenomics aims to better predict how patients will respond to therapy by screening their tumors for both genetic abnormalities and protein information, an approach that has been made possible in recent years due to advances in proteomic technology. Radiology and pathology images from both of these projects are being collected and made publicly available by The Cancer Imaging Archive to enable researchers to investigate cancer phenotypes which may correlate to corresponding proteomic, genomic and clinical data.

QIN SharePoint Transition to QIN-Hub

The QIN-Hub is in its final stage for transition to "Go Live". Keyvan Farahani (NCI) will be presenting an overview of the collaboration tool at the 2018 QIN Annual Meeting. This asset comes at a unique milestone time for the QIN where group collaborations will become more prominent among working groups and teams for challenges that will address bench marking of tools. The new interface with Google apps will provide a more flexible document sharing platform and access to Wikis currently utilized by team members will be readily available for use within the QIN-Hub (https://nciphub.org/groups/qinhub). This transition marks the end of life cycle application for the QIN SharePoint. QIN SharePoint will be maintained as an asset for QIN related electronic document storage for program use.

New Associate Member

Dr. Winfried Brenner, the Professor of Nuclear Medicine, Head, Department of Nuclear Medicine, Charité -Universitätsmedizin Berlin, and the group at the Core Facility Berlin Experimental Radionuclide Imaging Center (BERIC) have a longstanding interest in quantitative imaging. The physicists in the group are engaged in image analysis algorithm development with special emphasis on heterogeneity in disease processes, particularly cancer, and automated pattern recognition in neurodegenerative diseases. Additionally, the group is working on cancer specific problems in PET/MR cancer applications which include O-15 water kinetic modeling, flow-corrected tracer uptake values, attenuation and movement correction and image reconstruction which are also addressed in several PhD projects in the Charité Graduate School Biophysical Quantitative Imaging Towards Clinical Diagnosis (BIOQIC; https://bioqic.de) and in Berlin School of Integrative Oncology (BSIO; http://www.bsiocancerschool.de). Another area of interest is pre- and intra therapeutic dosimetry estimation. They have recently begun development of a wearable device for dosimetric thyroid radioiodine monitoring for outpatient services in radioiodine therapy. The group is particularly interested in image formats, reconstruction algorithms and tools, image segmentation tools, and techniques for quantifying PET radiotracer tissue concentration in PET/MR data. Dr. Brenner is specifically interested in cancer treatment response imaging quantitation, and imaging analyses for treatment planning, and wants to bring validated imaging tools to cancer clinical trials, in support of the extensive radionuclide therapy program and the cancer clinical trials conducted throughout the Charité University hospital system in Berlin and within the framework of the German Cancer Consortium (DKTK; https://dktk.dkfz.de/en/sites/berlin). The research engagement with QIN is highly complementary to the Charité system research goals in cancer effectiveness. As the largest research hospital system in Germany, the work at the Charité enables the physicians and investigators there to lead research efforts in the nation, and Dr Brenner and the group aims to use the QIN associate membership to help engage other imaging researchers in Germany in cancer quantitative imaging.

This group at Charité can bring to QIN a focus on clinically applicable imaging analysis tools for cancer therapy with radionuclides. There is a very large clinical practice at Charité with a number of clinical and experimental therapy trials ongoing, e.g. theranostic approaches in prostate cancer using PSMA and neuroendocrine tumors using DOTATOC. This provides a rich experience for design and testing for quantitative imaging analysis tools contributed by the computational expertise. Additionally, the new state-of the art PET/MR at the Charité Universitätsmedizin Berlin, is being explored for cancer imaging applications and these topic ideas can be brought to the QIN for research engagements.

QIN New Public Website

The QIN Website has been public since December 14, 2017. The goal of the QIN website is to educate the public about the QIN mission and research led by an organized network of imaging research teams supported by NCI's

Cancer Imaging Program. The latest updates on the QIN website to promote quantitative imaging methods include information on the following:

- o Background and Mission -on quantitative imaging analyses and techniques,
- o Announcements for cooperative agreement funding under the new PAR-18-248 and PAR-18-249,
- QIN activities and team involvement to advance quantitative imaging analyses, and improvements to the quantitative imaging process,
- o Tools development that standardize performance in imaging devices,
- o Selected QIN Publications that emphasis improvements in quantitative imaging and related processes, and
- o 2018 QIN Annual Face-to-Face Meeting Registration page/form.

We encourage all members to visit the website and provide us with helpful feedback for improvements. Please use the Website to register for the 2018 QIN Annual Face-to-Face Meeting:

QIN Website Link: https://imaging.cancer.gov/programs_resources/specialized_initiatives/qin/about/default.htm

QIN Publications

Medical Imaging



QIN and JMI will honor Dr. Larry Clarke in the upcoming special issue that will focus on quantitative imaging methods and translational development. There was a great turnout of submitted papers that are currently under review. Topics will include physics of medical, image processing, computer-aided diagnosis, image-guided procedures, robotic interventions, and modeling, image perception, observer performance, technology assessment, ultrasonic imaging and tomography.

JMI link: https://www.spiedigitallibrary.org/journals/journal-of-medical-imaging/volume-5/issue-01

From the QIN Director

The Program team in CIP is preparing for the upcoming annual meeting of the Quantitative Imaging Network. The registration through the web site seems to be going very well, and the agenda promises a full two days of interaction. The theme will focus on translation of tools from development to clinical trial utility. With a total of 62 clinical decision tools currently in the QIN catalog, it will be important to know the readiness of each tool for participation in clinical trials. Of course, the QIN tools will initially be used in a correlative fashion so as not to interfere with standard of care, but as time goes on, it is anticipated that the network will begin to engage industry and the FDA to move robust tools from correlative roles to mainstream clinical decision roles.

The Network has taken a strong first step in the translation toward clinical trial involvement. Meetings with specific National Clinical Trial Network (NCTN) members has garnered considerable enthusiasm for inclusion of QIN tools into certain trials. Interactions with ECOG-ACRIN, and Alliance groups have been encouraging, but more effort is needed to demonstrate the potential of the QIN tools. This means doing our homework before meaningfully engaging the cooperative groups. We must find those tools with greatest potential for success and match them to appropriate trial activities. To accomplish this, the QIN is initiating a process of benchmarking the cataloged tools. The benchmarks will indicate the degree of readiness for each tool to enter clinical trials in an integrated way. Our hope is to begin the process right after the annual meeting in May.

The next year promises to be very busy, but with the potential for also being very productive for the Network. With Dr. David Mankoff chairing the Executive Committee, emphasis on clinical trial utility for QIN tools will remain high.