

QIN CHALLENGES AND COLLABORATIVE PROJECTS

Setting the Stage for Research Translation

QUANTITATIVE IMAGING NETWORK (QIN)

Newsletter 4, Issue 3

QIN-NCTN Meet in Philadelphia

The QIN and the National Clinical Trials Network (NCTN) convened a planning meeting in Philadelphia to determine next steps for what needs to be done to translate QIN tools and methods into the clinical trial environment. A framework for understanding the clinical trials environment and applicable standards to position appropriate assets to achieve the goal were presented by a team of experts spanning IROC, system therapy, target therapy, cancer immunotherapy, precision oncology, QIN, QIBA, ECOG-ACRIN, and the Alliance with SWOG. Breakout sessions were conducted to discuss challenges and goals for quantitative response assessment, quantitative biomarkers, informatics and precision metrics, image accrual, and curation for analysis. The evaluation audit listed a dozen QIN tools involved in prospective clinical trials was provided to bring context to the discussion. A report will be drafted and disseminated to the QIN membership for future planning at the 2017 QIN Annual Meeting.

QIN Challenges and Collaborative Projects to Support QIN

Members of the network are involved in examining various imaging and image assessment parameters through network-wide cooperative projects. The QIN Challenge Task Force devised a policy to more effectively use the cooperative power of the network for conducting computational challenges in benchmarking tools and methods, and collaborative projects in analytical assessment of imaging technologies. Consensus on policy generated the formulation of Challenges and Collaborative Projects (CCPs) into technical and clinical CCPs as follows:

QIN Computational Challenge. A multisite test of computational algorithms designed to perform quantitative image processing and/or analysis for a given task, with direct technical or clinical relevance to QIN projects, using designated training and test data sets, relevant physical or clinical reference standards, and evaluation metrics. QIN challenges may be further divided into the following subcategories:

(1) *Technical Challenge:* Testing performance characteristics of algorithms based on physical standards and metrics (e.g., image markup, spatial or functional accuracy, and repeatability). A technical challenge may test the performance of a tool or a method deployed in a specific technical task (e.g., tumor segmentation). The immediate outcome of a technical challenge would be a set of tools, or a class of methods, for technical assessment, and resulting annotations or other processed data.

CONTENTS:

Challenges: How challenges and collaborative projects will support the QIN in translation

Clinical Trials Design & Development Working Group: At Center Stage

QIN Associate Memberships: Highlights of recent activities.

Informatics Tools: NCI Cloud Pilots and TCIA at RSNA

Announcement: Larry Clarke QIN Young Investigator Travel Award

Collaborations: CBIIT and QIN plans to improve NCIP-Hub

Publications: QIN TOMOGRAPHY Special Issue

(2) *Clinical Challenge*: Testing performance characteristics of algorithms based on clinical standards or criteria for clinical decision support in evaluation of response to therapy. A clinical challenge may test performance of a tool or a method, such as evaluation of an imaging biomarker, having a direct connection with the clinical decision making process. The immediate outcome of a clinical challenge would be a set of benchmarked algorithms, software tools, or imaging biomarkers for quantitative imaging in predicting or evaluating response to therapy.

QIN Collaborative Project. An analytical study of tools, techniques, scientific and clinical parameters, and protocols, or otherwise, an opinion survey of members sharing similar goals. As the QIN moves towards translational activities, the use of CCPs will become important in that effort.

At Center Stage—Clinical Trials Design & Development Working Group

Recently an audit was undertaken to ascertain QIN tools involved in prospective clinical trials. This information was shared at the QIN-NCTN planning meeting held in Philadelphia, Pennsylvania on December 13th, 2016. The goal was to begin an assessment on how many QIN tools would be viable candidates for validation as the network prepares to move forward in its translational efforts towards clinical utility. This assessment was a preliminary step for the Clinical Trials Design & Development Working Group (CTDD-WG) and QIN program management to deliberate and build consensus on what value a tool must have to move forward and how the oncology community could play a role in this process. Currently, QIN program management and the CTDD-WG are exploring on ways to build a coalition with the quantitative imaging community, NCTN, and IROC and to put in place an infrastructure framework to take next steps for validation and explore what appropriate mechanisms would be required to succeed. The CTDD-WG will play a critical role for galvanizing QIN participation and applying the appropriate process to engaged the NCTN on how best to approach and execute readiness for the clinical trial setting and workflow.

One main emphasis of the 2017 Face-to-Face Meeting is on how QIN will build a consensus on a value structure for tools to be considered for validation advancement; and how the clinical oncology community can play a role in determining appropriate clinical utility within the context of preliminary steps to enhance translation. The CTDD-WG will play a central role in constructing and placing the necessary infrastructure to execute assessments for preliminary clinical validation of tools. If successful, a pipeline activity for preliminary vetting of tools could be established and applied to manage the activity where key performance indicators can be established that will meet clinical trial concept development requirements. Productive interface process intervals in the pipeline activity could be streamlined and aligned to achieve clinical trial process goals that could further enhance adoption objectives for the clinical trial oncology community.

One of the key challenges associated with the CTDD-WG activity will be how to address certain performance evaluation challenges and what infrastructure is needed to achieve the desired deliverable without introducing bias. Eventually, industry input will need to be factored into the process and how competing issues of the pipeline validation approach can be managed for positive attribute inclusion towards the QIN objectives for decision support. The CTDD-WG would have to consider how clinical challenges could be formulated and executed with QIN team members to evaluate tools to meet certain performance criteria associated with the validation process before it is considered for the clinical trial environment. One opportunity maybe leveraging clinical challenges to determine what aspect of the validation process could isolate qualities that would optimize clinical trial utility where information could be utilized to formulate pre-concept requirement framework for tool performance. The CTDD-WG has their work cut out for them but their commitment to achieving the promise of the QIN is unwavering and they are certainly up for the tasks; and have the full support of the QIN.

QIN Associate Memberships

Highlights on associate members at the Annual QIN meeting in 2016 demonstrated a concerted effort for outreach with the international research community to expand opportunities for quantitative imaging research and collaborations. The QIN has recently received increasing visibility with special issue publications in journals and international meetings that has contributed to significant enrollment of international associate members.

Dr. Jagannathan, from All India Institute of Medical Sciences, has invited Dr. Tandon, QIN Program Director for Associate Members, to highlight QIN at the “Conference on Recent Advances in MRI and MRS” to be held in conjunction with the ISMRM Indian Chapter and the Molecular Imaging Society of India in March of 2017. The increasing amount of interest provides broader opportunity for the network to expand international outreach efforts. Recent recruitment efforts have resulted in 4 new associate members in 2016. QIN now has 12 Associate Members from countries such as Sweden, Denmark, South Korea, and Bulgaria, India, and the United States. The associate members will have access to the QIN SharePoint site. A list of QIN Associate Members can be viewed on the QIN SharePoint landing page. We hope that access to this information by the broader membership will increase collaborative opportunities and additional participation for QIN challenges and collaborative projects.

Informatics Tools—NCI Cloud Pilots and TCIA at RSNA

NCI Cloud Pilots

The size of genomic data sets has exploded in recent years. Downloading petabytes of data in order to analyze it locally within different institutions is no longer scalable so [NCI has funded three “cloud pilots”](#) in order to help address this problem. The NIH’s Cancer Genome Atlas data sets are being used to drive development of these new systems. Researchers can log in to one of the three competing pilot systems and analyze the TCGA data directly without having to download it. Each pilot is being designed by different teams in order to assess and compare the effectiveness of various cloud implementation approaches. In previous years the teams were solely focused on TCGA’s genomics, but in 2017 they will begin integration with radiology imaging data that is stored in The Cancer Imaging Archive. All 3 pilot teams are interested in engaging QIN investigators about potential use cases for performing radiogenomics research with TCGA data on their platforms.

TCIA at RSNA

This year at RSNA there were two refresher courses focused on The Cancer Imaging Archive as well as numerous scientific presentations based on TCIA data: <https://wiki.cancerimagingarchive.net/x/TIJyAQ>. One of the refresher courses was a hands-on session that taught attendees everything they need to know to get the most out of TCIA. The session included an overview of how the site is organized, a summary of available data sets, tips for searching/filtering across data sets, and how to publish your data on TCIA. The other course focused on precision medicine research activities leveraging TCIA with a focus on The Cancer Genome Atlas data. A group of imaging-omic experts presented on various aspects of this cross-disciplinary research including radiologist assessments, quantitative analyses, radiomics pipelines, and imaging proteomics. The session ended with a half hour panel discussion on the challenges of integrating imaging into precision medicine and considerations for how NCI and TCIA could best enable the next generation of this kind of work.

Larry Clarke QIN Young Investigator Travel Award

The Cancer Imaging Program plans to make a travel award to a young investigator to attend the annual QIN meeting held at NCI every April. The purpose of the award is to recognize the contributions made by the awardee in the field of quantitative imaging as a method to measure or predict response to therapy in cancer clinical trials. The award will cover the travel and per diem expenses for the duration of the meeting. This will be an annual award for the duration of the Quantitative Imaging Program.

Nominations will be received by the QIN Director, Robert Nordstrom, during the month of January in the year of the award (close of nominations will be January 31). Eligible individuals are young scientists, engineers, clinical staff or any technical contributor to the advancement of quantitative imaging as a tool or method for measuring or predicting response to cancer therapies. The research efforts of the candidate need not be associated with a past or current QIN team member. The individual must have at least an undergraduate degree and be working in the field of quantitative imaging for no more than 5 years.

A review committee consisting of three members of the Cancer Imaging Program, the chair of the QIN Executive Committee and the chairs of each of the QIN Working Groups will review all applications and select the finalist by majority vote. The selected finalist will be notified by the end of February.

Nominations will consist of a CV on the candidate and a brief (approximately 2 pages) write-up of reference material and colleague impressions about the candidate's participation in quantitative imaging research. Publications and presentations from the candidate (if not a part of the CV) can be submitted separately.

The award will be announced at the annual QIN meeting and the individual will be given a plaque and will be invited to make a presentation of his/her work.

CBIIT and QIN Collaborate on NCIP-Hub

The QIN SharePoint Subcommittee is currently engaged with the NCI Center for Bioinformatics and Information Technology (NCI-CBIIT) to improve the NCIP-Hub interface with SharePoint. NCI-Hub utilization by QIN Working Groups has increased as a collaborative portal to share interest and information related to specific projects. The QIN SharePoint Subcommittee would like to facilitate more user activity by making the interface more user friendly via improved navigation. The group will perform a gap analysis to determine how best to target enhancements. With the recent QIN SharePoint addition of challenges and collaborative projects electronic bulletin board and the listing for QIN Associate Members, exposure to NCI-Hub via SharePoint could further compliment future participation in projects. The QIN SharePoint Subcommittee is very interested in promoting active views on the landing page for "one-stop-shop" viewing of information related to QIN activities. Currently, individuals visiting the site can access NCI-Hub by clicking on the tab titled "Participate in a Collaboration Project". Below this tab is the QIN Library and plans are being made to expand its content to support for clinical translation information as an access point. In terms of navigation on the landing page, information related to ongoing translational research activities, tools, and methods for validation could enhance usability (see image).

Challenges and Collaborative Projects (CCPs)			
☐ Challenge/Collaborative Project (CCP) Title	C/CP	Status	Challenge URL
QIN BMMR - Breast Metrics for Measuring Response	Challenge	Open	http://qinlabs.cloudapp.net/com
Breast DCE-MRI	Collaborative Project	Closed	
QIN Apparent Diffusion Coefficient	Collaborative Project	Closed	
DCE-MRI Arterial Input Function	Collaborative Project	Closed	
Interval Change using NLST Chest CT Scans	Collaborative Project	Closed	
Dynamic PET-MISO	Collaborative Project	Closed	
CT Image Feature	Collaborative Project	Closed	
DICOM Storage - Parameter Map Storage	Collaborative Project	Closed	
Dynamic Susceptibility Contrast MRI	Collaborative Project	Closed	
Validation of Gradient non-Linearity Bias Correction	Collaborative Project	Closed	
Lung CT Segmentation	Challenge	Closed	
PET Segmentation	Challenge	Closed	
DSC-MRI DRO Challenge	Challenge	Closed	
Propose a CCP Participate in a Challenge Participate in a Collaboration Project CCP Guidelines			
QIN Library About QIN Policy Documents QIN Activities QIN Documents Publications Clinical Translation			

QIN Publications

The QIN was honored recently with its third special issue publication. TOMOGRAPHY, a journal for imaging research, featured a special issue on the QIN. The publication is a unique imaging journal, publishing peer-reviewed articles spanning all aspects of imaging science research in basic research to clinical trials. Tomography publishes studies involving development and evaluation of novel imaging probes including optical, nuclear, ultrasound, MR-contrast and hyperpolarized agents along with image-based feedback of interventions. Advances in hardware, software, imaging informatics and chemical and molecular probe advances have also been featured in the publication. The QIN is very pleased with the opportunity to market the network's productivity.



Funding Opportunities

The QIN FOAs are publically available! PAR-17-128 is the UG3/UH3 announcement for new teams. PAR-17-129 is for current QIN members to continue their efforts with a renewal. It is a standard U01 with the exception that there will be a set aside of funds for doing joint projects.

PAR-17-093, Academic-Industrial Partnership to Translate and Validate in-vivo Cancer Imaging Systems (R01), was recently published on December 21, 2016. The purpose of this Funding Opportunity Announcement (FOA) is to stimulate translation of scientific discoveries and engineering developments in imaging or spectroscopic technologies into methods or tools that address problems in cancer biology, risk of cancer development, diagnosis, treatment, and/or disease status. A distinguishing feature of this FOA is the formation of an academic-industrial partnership, which is a strategic alliance of investigators in academic, industrial, and any other entities who work together as partners to identify and translate a technological solution or mitigate a cancer-related problem. The goals for proposed technologies are imaging applications in clinical trials, clinical research, non-clinical research, and/or patient care. Among other possibilities, participant's may include pre-clinical imaging investigations or investigations that combine patient specimens and pre-clinical methods, or optimizations of methods across different commercial platforms, sites, or time.

Data Science Bowl Launched to Improve Lung Cancer Screening

The third annual **Data Science Bowl** [🔗](#) opened on January 12, 2017 with the goal of improving the detection accuracy of low-dose computed tomography (LDCT) lung cancer screening using data curated by NCI's **Cancer Imaging Program (CIP)**, **Division of Cancer Treatment and Diagnosis (DCTD)** and the **Division of Cancer Prevention (DCP)**. Emphasis throughout the competition is being placed on solutions that meet the needs of real world applications. This year's competition encourages data scientists to develop machine learning algorithms to more accurately diagnose the presence of lung cancer at lower false positive rates than are currently encountered. The Data Science Bowl is being presented by Booz Allen Hamilton and Kaggle and is based on a project designed by CIP. NCI staff in DCTD and DCP collaborated with Booz Allen and Kaggle by building alliances, providing guidance on the scientific design of the competition, and facilitating data and image curation.

The Data Science Bowl naturally follows the National Lung Screening Trial (NLST), which was sponsored by NCI and launched in 2002. The **NLST results** demonstrated that LDCT screening reduced lung cancer mortality rates by 15-20% compared to standard chest X-ray; however, LDCT has historically resulted in high false positive rates (around 25%) that increase patient anxiety, promote unnecessary diagnostic follow-up testing and associated costs, and prevent its wider utility. An NCI workshop sponsored by CIP in 2012 explored ways to approach reducing the false positive rates of LDCT lung cancer screening, and an algorithm challenge was recommended. The goal of the Data Science Bowl is to develop diagnostic algorithms that can reduce false positive rates, which would ultimately lead to much more effective use of LDCT for lung cancer screening to the benefit of those eligible for screening.

Data Science Bowl competitors will have access to training and test data sets derived from various sources. The competition will run from January 12, 2017 to April 12, 2017, and the winners will be announced shortly thereafter. The competition will award winners with \$1 million in prizes, the funds for which will be provided by the Laura and John Arnold Foundation.

From the QIN Director

There are several important items of note for this issue of the QIN Newsletter. First, and perhaps foremost, the annual QIN meeting will take place April 10th – 11th here in our Shady Grove facility. The program team is working to put the finishing touches on the agenda. The theme will be “Pursuit of Translation to Clinical Function”, and the agenda will attempt to guide thinking in that direction. With a successful QIN – NCTN meeting behind us, we are looking forward to discussing how tool translation can be implemented.

Also, worthy of a few lines here is the fact that NCI has reissued the program announcement for the QIN program. It is published in two separate announcements, PAR-17-128 and PAR-17-129. The first is specifically created for first-time entrants into the network, and highlights a two-phased approach to tool development and validation. A UG3 mechanism covers the first phase, where applicants must develop and optimize clinical decision tools of their choice. At the end of that phase, the project is reviewed by program staff to determine if sufficient progress has been made to warrant progressing to the second phase (a UH3 mechanism). Here the investigators must validate their tool(s) in a multisite clinical trial to demonstrate integration into clinical workflow.

The second program announcement is a U01 mechanism and is intended for investigators who have a well-developed and optimized tool (or tools) ready for immediate validation in single-site or multisite trials. This is intended to be the avenue for current QIN members to continue validation efforts beyond the first U01 program. Demonstration in a multi-site trial is required by the end of the program. More will be said about these programs at the annual meeting.

