NCI’s Quantitative Imaging Network (QIN): Progress and Impact on Clinical Trials

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The Current QIN Teams
Quantitative Imaging Network

- A cooperative agreement (U01) grant
- Develop, test, and validate quantitative methods of evaluating imaging response to therapies
- Managed as a network
  - Trans-institution working groups
  - Some data sharing between groups required
- All data and algorithms will be public eventually
- 21 sites now funded

QIN PAR-14-116

- Enhance the value of quantitative imaging in clinical trials to predict or measure response to therapy.
  - Develop, optimize & validate quantitative imaging methods and software tools for a single clinical trial site
  - Address the challenge of integrating existing or new methods and tools into multi-site multi-platform clinical trials.
Impact on Trial Sample Size

- True Effect Size (%)
- Sample size increases as error increases
- Power = 80%
- Significance = 0.05
- Sample size increases as error increases

QIN “Open Science’ Network: 21 Teams (U01)
Development and Performance Assessment of Quantitative Imaging Methods for Prediction or Response to Therapy

Link to a Clinical Trial
TCIA Imaging Archive: Annotated image databases with metadata
Development
Clinical trial
Tool Validation
Goal: Standardized Imaging Tools Consensus on data collection/analysis

A QIN Member
QIN Network Organization

21 Technical Teams (U01's)

Executive Committee
PI's and Program Staff

Coordinating Committee deals with WG issues.

Working Groups (WGs) and sub-WGs

QIN: Cross Team Working Groups

- Data Acquisition
- Image Analysis & Performance Metrics
- Bioinformatics/IT & Data Sharing
- Clinical Trial Design & Development

Overlap and coordination by joint committee
Several WGs have sub groups
DCE-MRI Pilot Challenge

- Goal: Multi-QIN sites DCE-MRI Data Analysis Challenge to evaluate the ability of DCE analysis software packages/models to distinguish pathologic responders from non-responders after 1 cycle of chemotherapy
  - Dataset: 20 studies (10 patients at baseline and after 1 cycle of chemotherapy)
  - Participants: Members of QIN
  - Evaluations: ability of models to predict response seen in pathology based on changes in Ktrans

DCE-Challenge Results (Preliminary)
QIN-ACRIN Collaboration
Harmonization of Data Collection

MR-DWI
Calibration standard for measuring ADC

PET CT
NIST-traceable Ge-68 standard for absolute PET scanner calibration

Early results
Performance Evaluation of Lung Lesion Segmentation Algorithms

• Clinical & Phantom Datasets:
  – Clinical: 52 lesions from 5 collections
  – Phantom Dataset: known volume
  – LIDC, RIDER, Moffitt, Stanford, Columbia

• Three QIN sites submitted 3 runs for each lesion

• Evaluations: bias and reproducibility of volumes, overlap metrics

• Scale up planned: RSNA QIBA-International

Lung: Sample Results (4 algorithms)

- Single Click
- Seed Circle
- Watershed Active Contour
- Level Set
QIN Pilot: Example results:

Wide range of lesion volumes

Intra-algorithm volume overlap higher than inter-algorithm

Dice Coefficient

Map displaying areas of high (light purple) and low agreement (brown) between algorithms

Pairwise dice coefficients (overlap between results of different algorithms)

QIN-ACRIN: Informatics Tools

- Tools to quantify tumor burden and data exchange using AIM
- AIM/ePAD adoption and formal evaluation in clinical trials
- AIM adoption in 3D Slicer, image metadata sharing in ISPY..
QIN Advanced Tools: Image-Derived Heat Maps

- CT images of lung cancer
- Unsupervised (automatic) feature clustering
- Clustering shows three patterns
- Visualization similar to genomic array analysis
- Sep/Oct 2014: 3rd radiogenomics workshop – Joint with AAPM FOREM meeting

Data from H. Lee Moffitt Cancer Center

QIN is an early user of the archive, public and private.

http://cancerimagingarchive.net
Making The Move To The Cloud

Now

Moving the data to the tools and algorithms

Moving the tools and algorithms to the data

Collaborations

• RSNA QIBA
  • Collaboration on imaging phantoms
  • Physical measurement uncertainty problem
  • Metrology tool sharing for algorithm comparison

• ECOG-ACRIN ; SWOG -ALLIANCE
  • Collaboration on imaging phantoms and QI methods
  • Development of Quantitative Imaging Protocols

• International Collaboration: Canadian CIHR

• CBIIT Imaging Informatics Workspace
  • Leveraging IT and informatics support for cloud computing
  • HubZero Collaborative Tools Sharing
International Imaging Workshop
Canada CIHR, CR UK, NCI, London July 2011

• Quantitative Imaging Workshop Goals:
  – Science: Linking ‘omics’ to patient care
  – Scope: Screening, Diagnosis, Therapy and IGDD
  – Funders: Leveraging Resources/Networks/ Open Science Strategies.

• Deliverables: NCI -CIHR Funding Plan
  – Support for Two QIN Teams from Canada (2014-2015)
  – Active Dialogue with CR UK: Data and Tool Sharing (2014)
  – Exploring other Countries: EU Framework, India, China

QIN Reference Documents
Reports: 2012, 2013

Potential Resource for:
• NCI Clinical Trial Networks
• Imaging Companies: Advanced Tools/Methods
• FDA: Guidance Documents in quantitative imaging
• International Collaboration
• RSNA: QIBA
NCI Funding Opportunities

- QIN U01: PAR 11-14-116
- Academic Industry Partnership (R01)
- NCI Informatics (U01, U24, etc)

Thank you for your attention

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