Quantitative Imaging

Quantitative imaging is the extraction of quantifiable (measurable) features from medical images for the assessment of normal or the severity, degree of change, or status of a disease, injury, or chronic condition relative to normal.

The Goal: Create the condition where all imaging scanners perform as measuring instruments.

Two Parts to Quantitative Imaging

Clinical Workflow
Adaptation into clinical trials as a correlative tool.

Data Collection
Protocols for standardization to minimize variance & bias.

Data Analysis
Algorithms and tools to support clinical decision making.

Regulatory and commercial hurdles conquered.
Quantitative Imaging Levels of Performance

Growth in Quantitative Imaging

QIN: Joining Imaging, Analytics, and Informatics

Measuring or predicting response to cancer therapies in clinical trials.

Supporting clinical decision making
Accomplishments of the Network

- Over 450 peer reviewed publications on methods, standards, and decision support tools for clinical workflow.
- 4 separate journal issues dedicated to QIN efforts
  - Magnetic Resonance Imaging 30(9) Nov 2012
  - Translational Oncology 7(1) February 2014
  - Tomography 24(4) December 2016
  - Journal of Medical Imaging to be published Dec 2017 – January 2018
- More than 67 analytical tools under development and validation
- Benchmarking taking place in addition to increased validation studies
- Data-sharing, consensus-driven environment
- National and international recognition of the value of quantitative imaging.

The Tool Catalog

Tool View

<table>
<thead>
<tr>
<th>Tool type</th>
<th>Tool name</th>
<th>Image modality</th>
<th>General description</th>
<th>Capabilities</th>
</tr>
</thead>
</table>

The Tool Catalog
The Tool Catalog & Benchmarking

1. Pre-Benchmark
2. Basic Benchmark
3. Technical Test Benchmark
4. Clinical Trial Benchmark
5. Clinical Use Benchmark

From Dr. Lowy

A Modified Definition of Precision Medicine

Interventions to prevent, diagnose, or treat a disease (e.g., cancer), based on a molecular and/or mechanistic understanding of the causes, pathogenesis, and/or pathology of the disease.

Where the individual characteristics of the patient are sufficiently distinct, interventions can be concentrated on those who will benefit, sparing expense and side effects for those who will not.

Quantitative imaging can be an important player in stratifying patient characteristics for appropriate interventions.

But this can only have value if quantitative imaging takes a place as a reliable tool in clinical workflow.
The Great Divide

QIN tools are working in clinical trials

- NCT01564699 Long-MAP: Biomarker-Directed Second Line Therapy in Treating Patients With Recurrent Stage IV Squamous Cell Lung Cancer
  - Radiomics tools to assess response to therapy
- A031704 PD-inhibitor (Dovitinib) and Imatinib followed by axitinib vs. VEGF TKI cabozantinib with axitinib in metastatic renal cell cancer (SWOG NCI A00011414)
  - Volumetric / Texture / Radiomics tools to assess predictive and prognostic imaging biomarkers of response and progression
- ALLIANCE A021602 Randomized, Double Blinded Phase III Study of Cabozantinib versus Placebo in Patients with Advanced Neuroendocrine Tumors after Progression on Everolimus (CABINET)
  - Volumetric / Texture / Radiomics tools to assess predictive and prognostic imaging biomarkers of response and progression
- A Randomized Phase 2 Study of Peptide Receptor Radionuclide Immune Therapy (PRRIT) in Gastro-Entero-Pancreatic Tumors, with Somatostatin Receptor Expression, and have progressed on Somatostatin Analog Therapy
  - Auto PERCIST tool
QIN does not operate alone...

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