NCI and CR UK: Collaborative Agreement

Personalized Medicine:
Imaging as a Biomarker for Therapy Response
Clinical Decision Making

Larry Clarke, PhD: FAAPM, FISMRI

Branch Chief

Cancer Imaging Program (CIP)

**NCI-NCRI Informatics Initiative Joint Conference
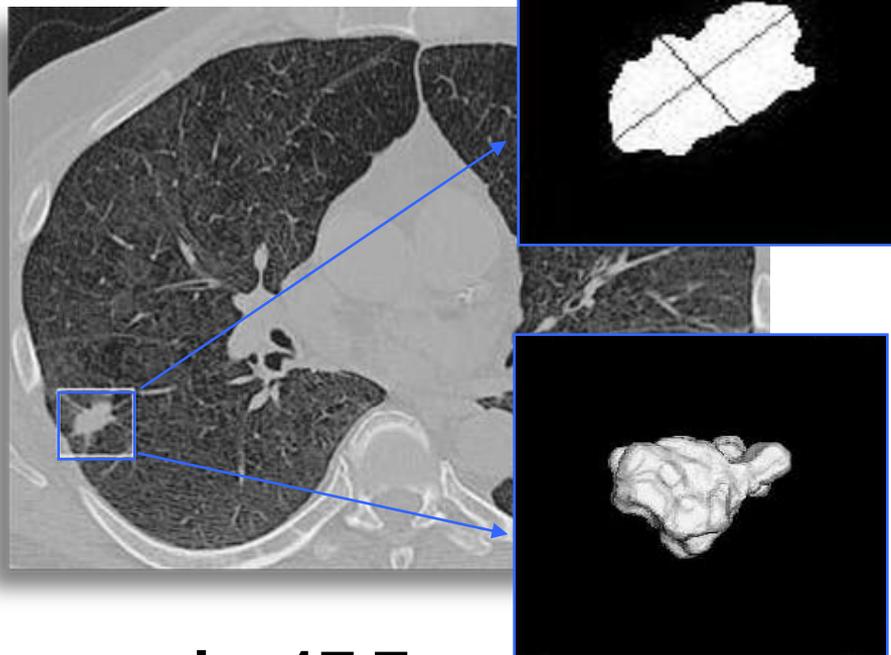in Bethesda Maryland June 21-22nd.**

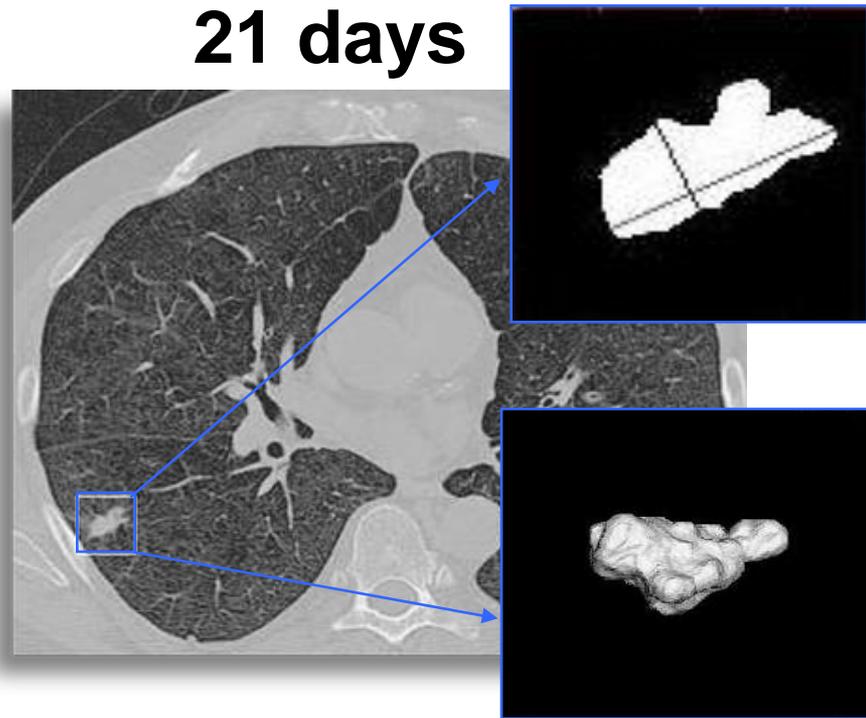# CIP-ITD Branch: Research Mission: 2006-

- **Mission:** An Open Science Model: Development and validation of current and next-generation of imaging platforms, methods, informatics and resources, as required for cancer research; to support future multi center clinical trials, <u>consistent with caBIG requirements since 2006.</u>

- **(U01)PAR: Quantitative Imaging Network (QIN) U01: (**2008-) Development and validation of QI methods as applied to therapy response using <u>current generation </u>of anatomical, functional and molecular imaging methods.

- **(U54) RFA: Network for Translational Research (NTR)(**2008-), Development and validation of <u>next generation </u>multi-modality imaging platforms.

- **PAR 01 169: Academic Industry Partnerships for Translational Research: Hub (U01, U54: R01 Model):** Development of public resources and research communities to encourage a broad consensus on QI methods

Response to Therapy: Post Gefitinib

pre-Therapy

post-Therapy
21 days

Long axis=17.7 mm
Short axis= 9.6 mm
Volume=886.2 mm³

Long axis=17.1 mm
Short axis= 7.4 mm
Volume=525.4 mm³

MSKCC

Change in Long axis 3% Change in Volume 41%

RIDER: NCI Web-Based Public Resources (2006-2010) Evaluation of Responses to Cancer Therapies

Mission and Goals

- **Quantitative Imaging (QI):**
  - Prospective data collection

- **Implementation Model:**
  - Phantom Data collection
  - Patient retrospective data
  - Measurement variance-bias

- Compare relative performance
  - Clinical decision tools

  Commercial Platform Example: PET CT

Scope

- **Phantom Design**
  - Simulated CT, PET CT, DCE MRI and DI MRI

- **Longitudinal Repeat Studies**
  - CT, PET CT, DCE DI MRI
  - DWI MRI: Phantom
  - Platform Harmonization study

- **Stakeholders and Agencies**
  - RSNA, SNM, AAPM, ISMRM)
  - NCI caBIG, NIH NIBIB, FDA, NIST,

- **Trans Oncology 2009 : Results**

NCI U01: Quantitative Imaging Network 2010 Evaluation of Responses to Cancer Therapies
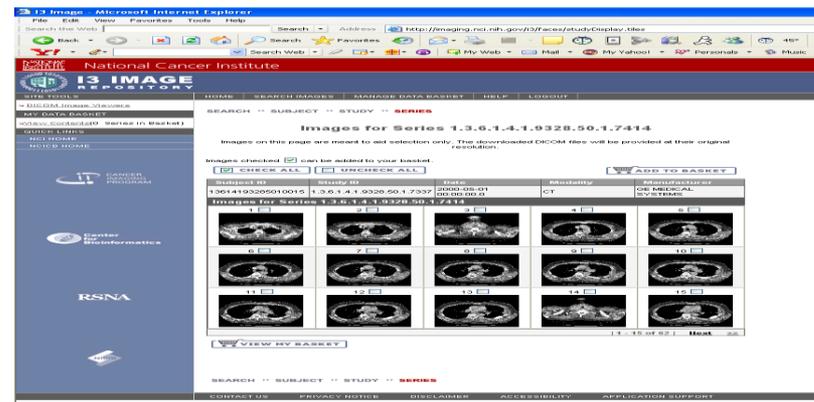
Mission

- **Quantitative Imaging (QI)**
  - Data collection and quantitative clinical decision tools to measure response to therapy.

- **Implementation Model:**
  - On- going clinical trials
  - Support adding imaging

- **Prospective data collection:**
  - De-identification
  - Case mixing
  - Avoid IP issues

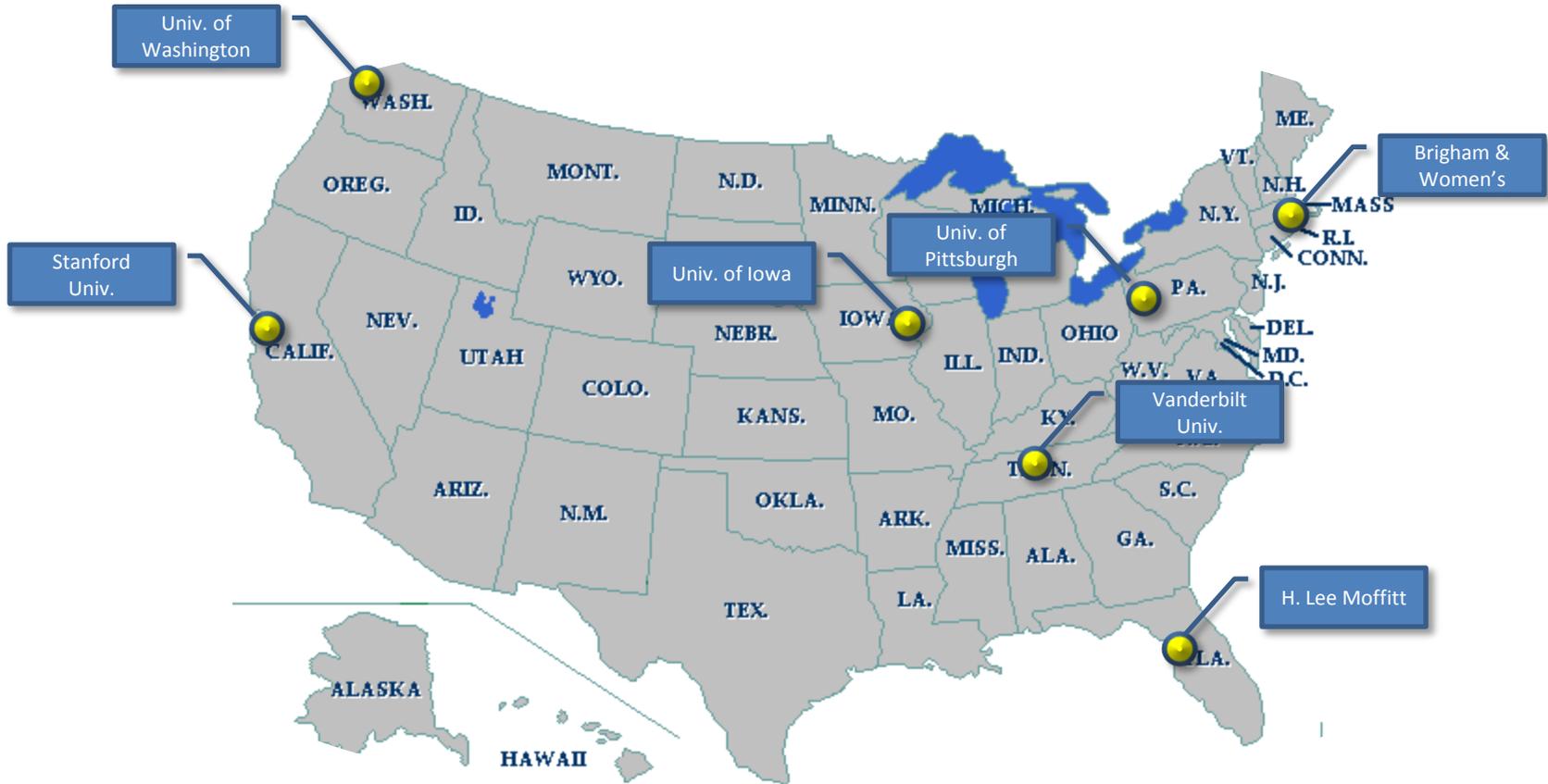**Commercial Platform Example: PET CT**

Goals

- **Broad Consensus for QI**
  - 15-20 Centers by Sept 2011
  - Associate Members: CC's
  - International: CR UK
  - EU Framework (Discussions)

- **Stakeholders and agencies**
  - RSNA MOU (SNM, AAPM, ISMRM)
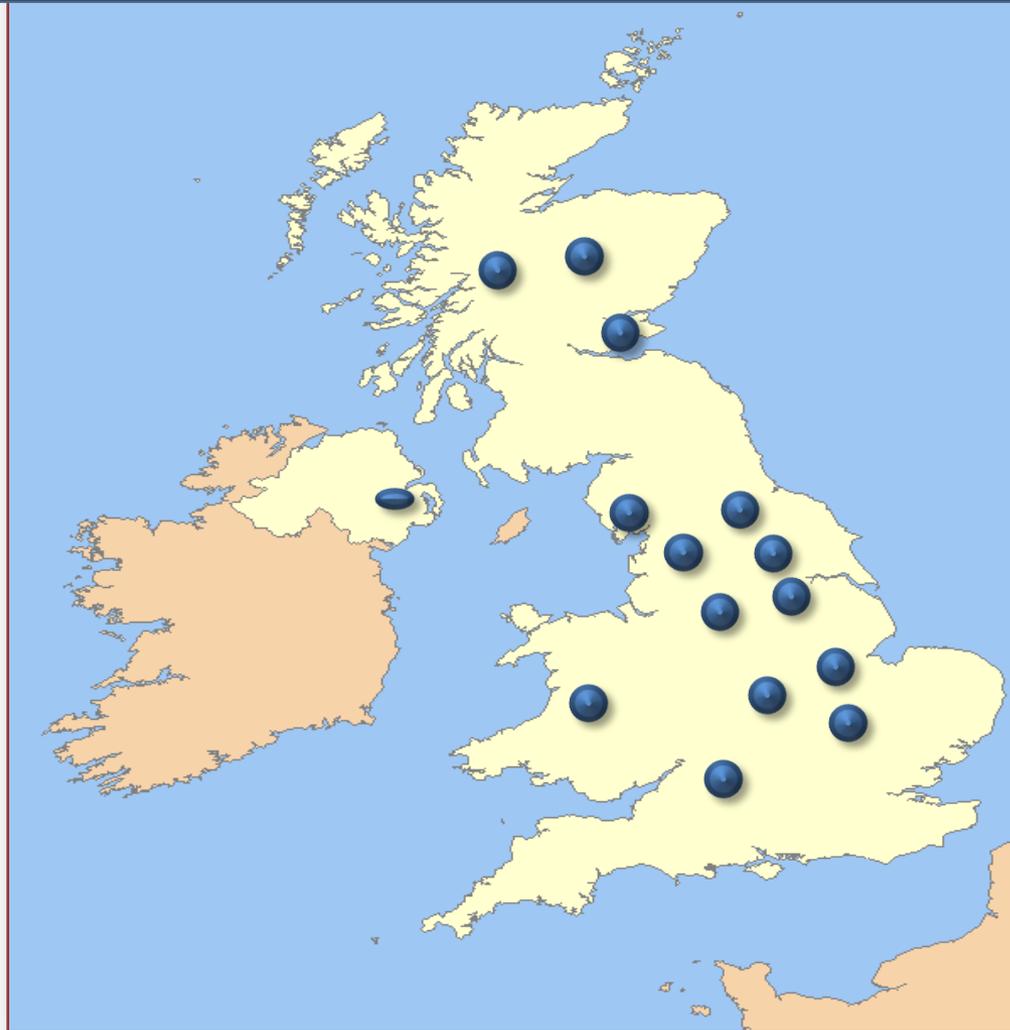 - NCI caBIG,
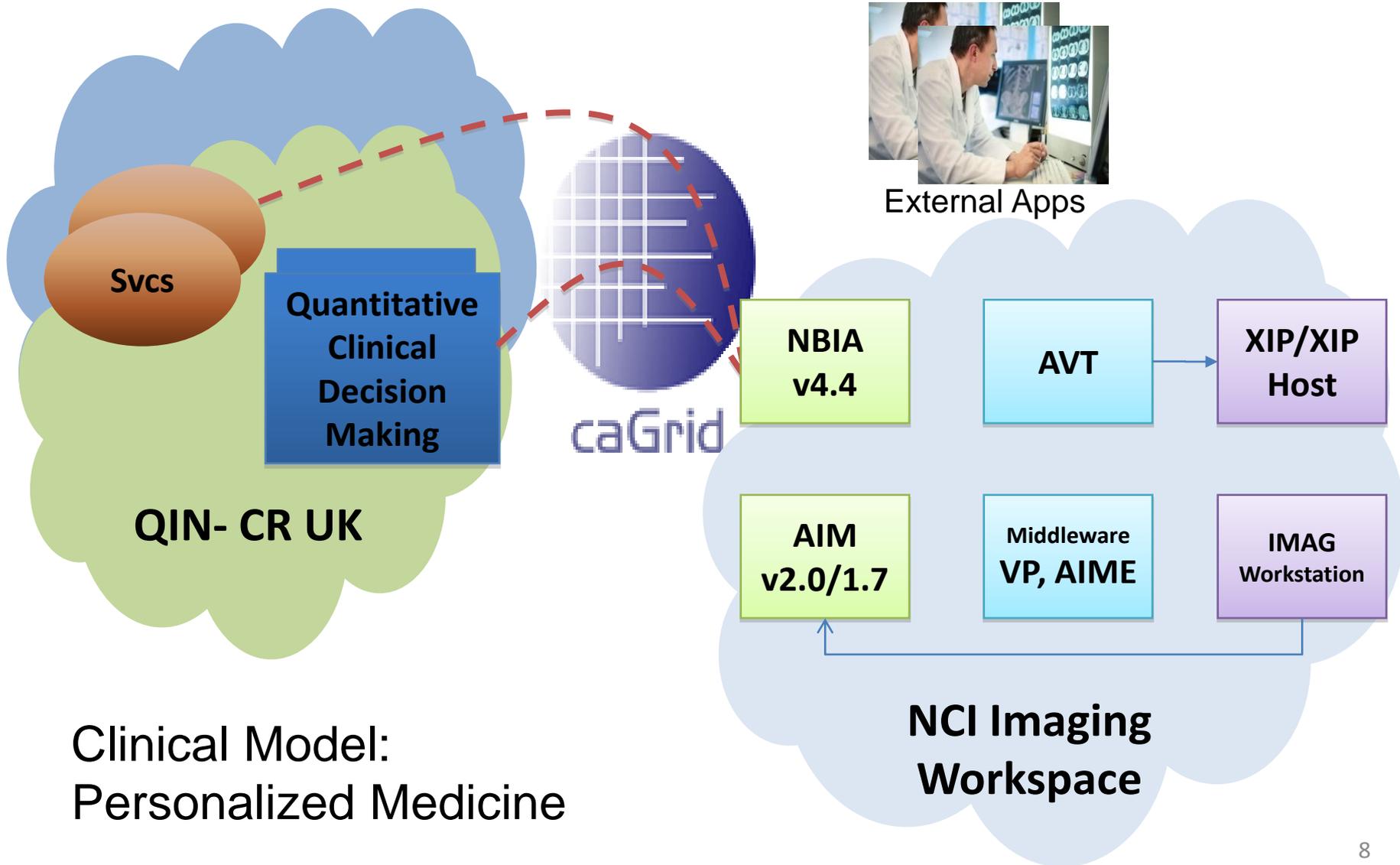 - NIH NIBIB, FDA, NIST

QIN: Seven Sites Funded

Retrospective Database Resource: NCI NBIA

Cancer Research UK: 19 Experimental Cancer Medicine Center Network (ECMC's) , 4 Molecular Imaging Centers ICR, KCL-UCL, ICL, Oxford
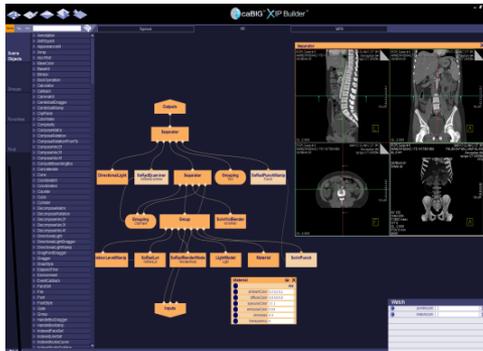
CR UK, NCRI, QIN, and NCI Imaging Workspace

External Apps

Svcs

Quantitative Clinical Decision Making

QIN- CR UK

caGrid

NBIA v4.4

AVT

XIP/XIP Host

AIM v2.0/1.7

Middleware VP, AIME

IMAG Workstation

NCI Imaging Workspace

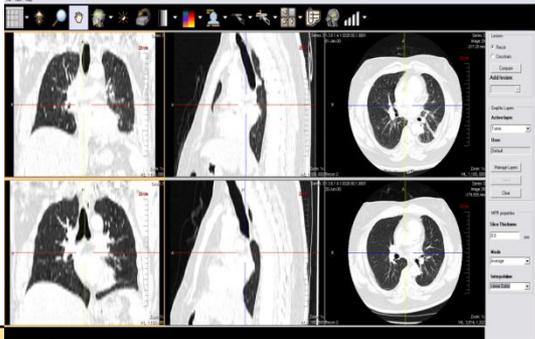Clinical Model: Personalized Medicine

The caBIG® Imaging Product Line

Key Free and Open Source Components in the Management and Integration of Imaging Clinical Trials and Research
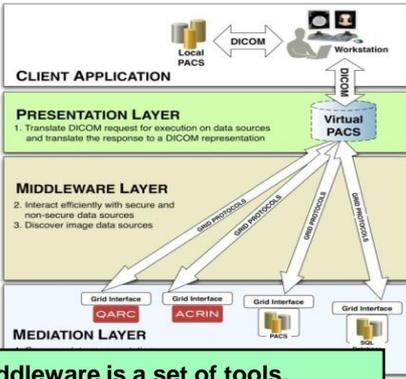
Visualization

eXtensible Imaging Platform (XIP): an easily extensible open source platform that provides development and implementation support to allow multiple algorithms to run on proprietary or generic workstations.

Archive

The National Biomedical Imaging Repository (NBIA): searchable repository of in vivo cancer images
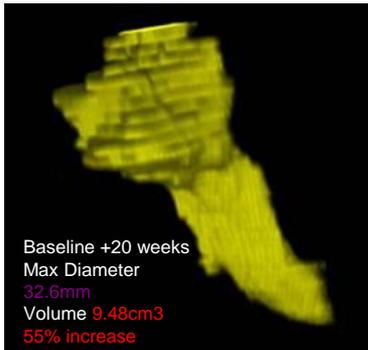
Transfer

Imaging Core Middleware is a set of tools, libraries and applications designed to create a bridge between the unique medical model of DICOM, caGrid and other non-specific radiology software and systems.

Standards

Annotations and Imaging Markup Developer (AIM): XML standard for medical image annotation and markup
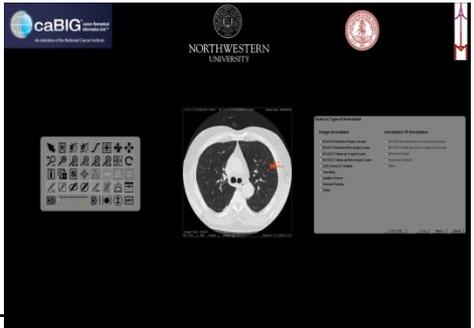
Adjudication

Algorithm Validation Tools (AVT): allow determination of the consistency of any measurement method for detecting change. AVT can also serve to do an analysis of variability of multiple readers of imaging studies and/or variability of multiple algorithms
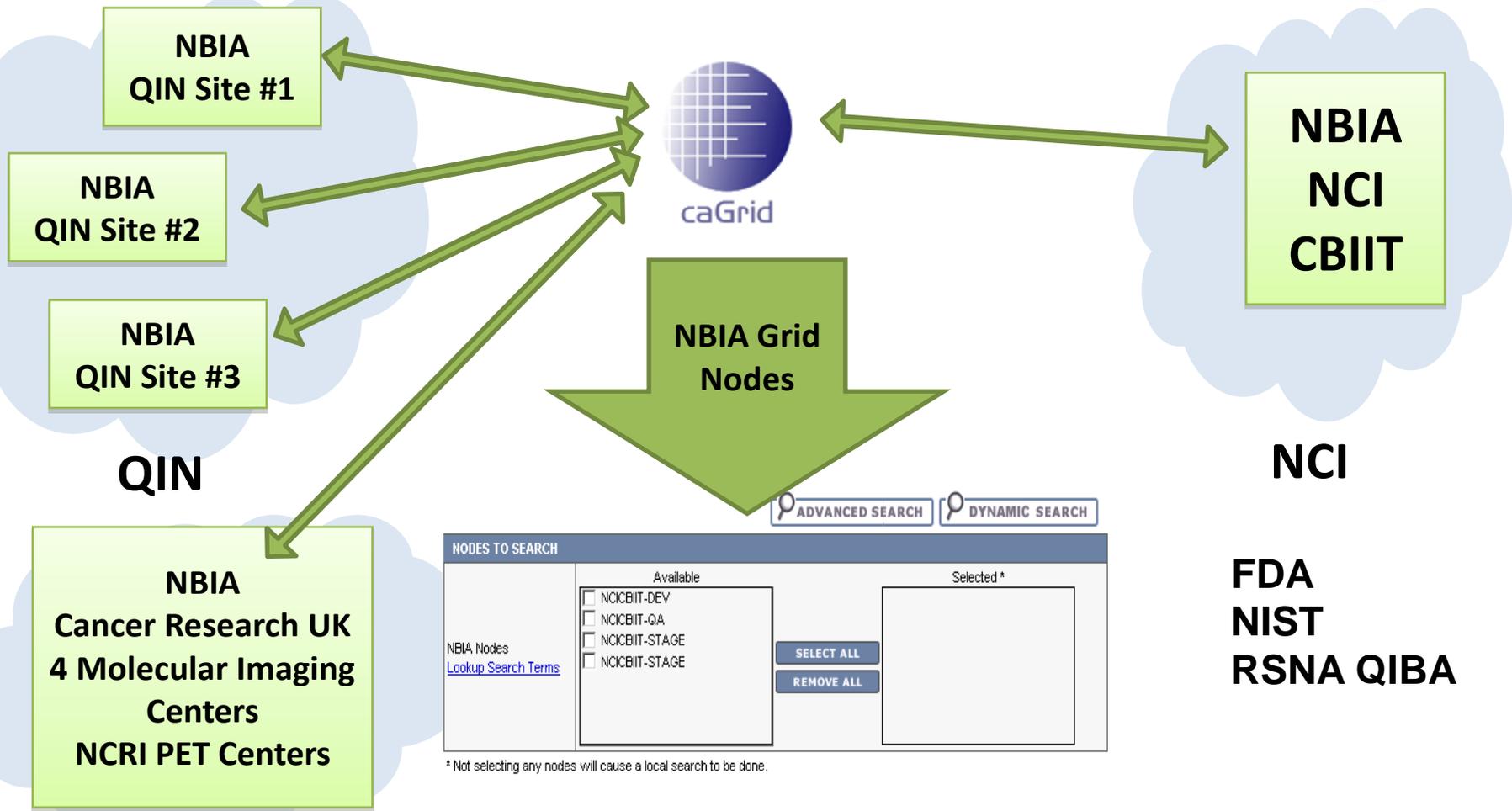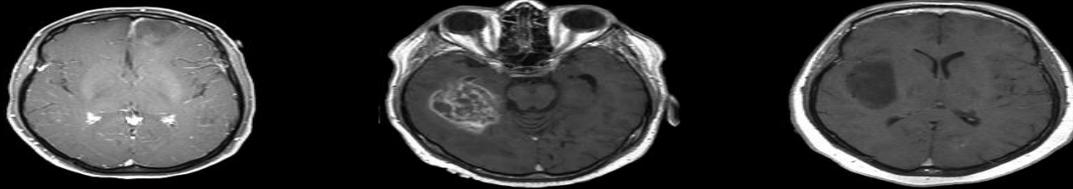
Baseline +20 weeks
Max Diameter
32.6mm
Volume 9.48cm3
55% increase

DICOM
Digital Imaging and Communications in Medicine
ONTOLOGY

RadLex®

UNIFORM PROTOCOLS
FOR IMAGING IN CLINICAL TRIALS
UPICT

SNOMED INTERNATIONAL

Query Federated Imaging Data Services: Clinical Decision Making

NBIA
QIN Site #1

NBIA
QIN Site #2

NBIA
QIN Site #3

QIN

NBIA
Cancer Research UK
4 Molecular Imaging
Centers
NCRI PET Centers

caGrid

NBIA Grid
Nodes

**NBIA
NCI
CBIIT**

NCI

**FDA
NIST
RSNA QIBA**

ADVANCED SEARCH   DYNAMIC SEARCH

NODES TO SEARCH

Available

☐ NCICBIIT-DEV
☐ NCICBIIT-QA
☐ NCICBIIT-STAGE
☐ NCICBIIT-STAGE

NBIA Nodes
Lookup Search Terms

SELECT ALL

REMOVE ALL

Selected *

* Not selecting any nodes will cause a local search to be done.

CR UK -NCRI

Augmenting TCGA data with clinical imaging to enable genotype-to-phenotype research.....

New Goal: Engage Researchers in Quantitative Correlations

GBM Feature Characterizations on MR Images	Collection and Archiving of MR Images of TCGA Cases	Scoring the images	Data analyzed for Discovery

Conclusions

- Example of the importance of the NCI Cross Program Council Initiative

- This initiative deploys a reusable model for deployment and adoption of caBIG imaging tools by the US and International research and industry community. It is a "comprehensive use case" for caBIG

- This model supports the global effort towards providing personalized medicine. There is a critical need for <u>standards for both interoperability of data and tools and clinical decision tools for imaging as a biomarker.</u>

- Set the foundation for quantitative correlation for imaging and genomics within the context of clinical decision making.

Opportunity: Leveraging IT Research Resources

caBIG-GRID NCRI..other IT?

Networks- Centers: Directed at development of consensus/standards for both informatics and clinical decision making for <u>longitudinal imaging and genomics studies</u>

NCI Research Networks

CR UK Research Centers

Discussions

Wellcome Trust UK Biobank
NIH OD Biobank Project?

DOD Brain Trauma Project?

Imaging Workspace

NIH NIST FDA Societies Industry

URL's for reference

- NCI CIP Program: http://imaging.cancer.gov/

- caBIG™ Website: https://cabig.nci.nih.gov

- FDA Critical pathways report: Drug Response:
- http://www.fda.gov/oc/initiatives/criticalpath/

- FNIH Biomarkers Consortium
  http://www.biomarkersconsortium.org

- Network for Translational Research (NTR):
  http://grants.nih.gov/grants/guide/rfa-files/RFA-CA-08-002.html

- Quantitative Imaging Network (QIN)
  http://grants.nih.gov/grants/guide/pa-files/PAR-08-225.html

  Translational Oncology Publications (2009)
  http://www.transonc.com/pdf/manuscript/v02i04/neo09217.pdf

- RSNA Quantitative Imaging Biomarker Alliance
  http://www.rsna.org/Research/qiba.cfm

- NIST: Interagency Workshop on Biomarkers 2006: (NCI, NIH, FDA, NIST)
  http://usms.nist.gov/workshops/bioimaging.htm