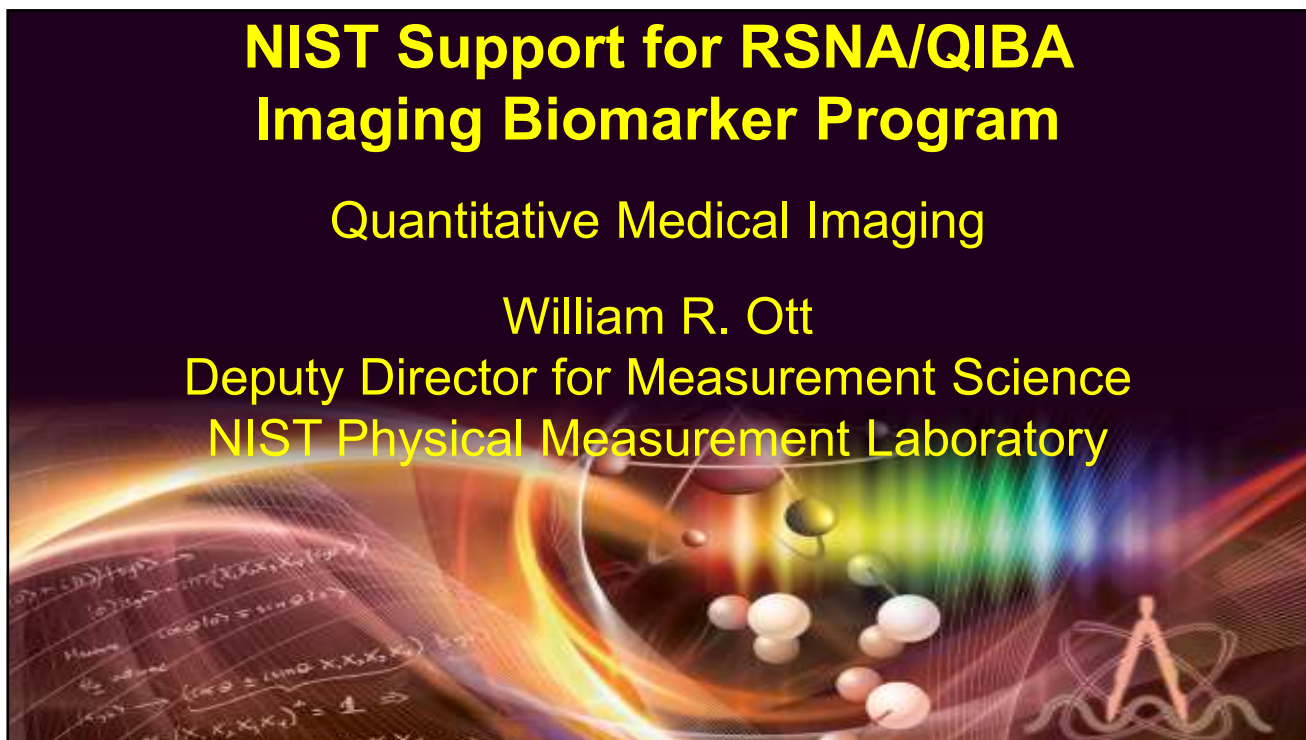


NIST Support for RSNA/QIBA Imaging Biomarker Program

Quantitative Medical Imaging

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NIST Physical Measurement Laboratory



NIST Mission

Promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology to enhance economic security and improve our quality of life

NIST Vision

Be the world's leader
Create critical measurement solutions
Promote equitable standards

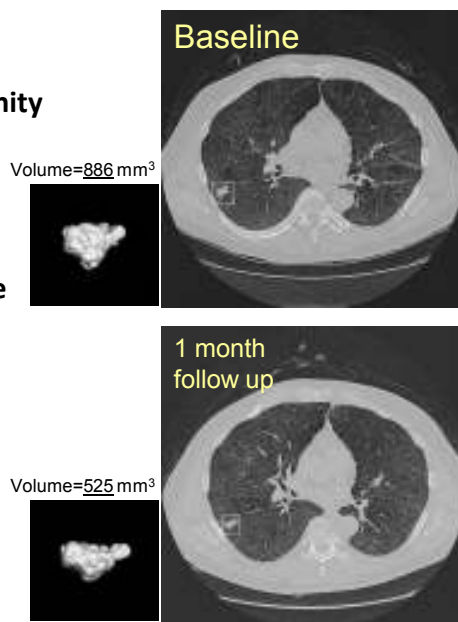
Core Competencies

Measurement Science
Traceability
Measurement Standards and Services



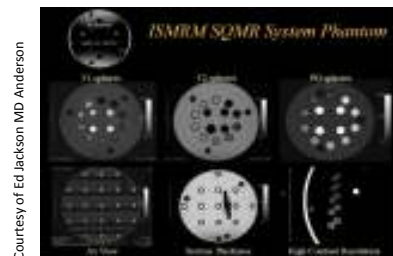
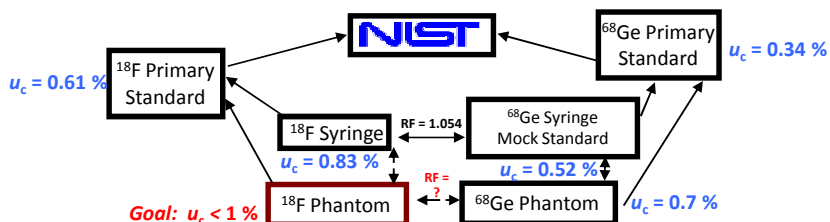
Goal of NIST Activities Quantitative Medical Imaging

- Respond to measurement needs of the biomarker community
 - develop measurement methods and standards
 - provide and evaluate critical data
 - establish traceability
- Revolutionize the use of medical imaging in the health care enterprise
- Transform medical imaging
 - from a qualitative technology (what's there?)
 - to a quantitative one
 - how much is there
 - how much has it changed
 - how much is healthy
 - and how much is diseased tissue



Progress with CT, PET, MRI

- **CT:** Recognized need for length standard
 - NIST-designed “pocket-phantoms”
 - Tumor definition and size
 - Inexpensive, robust, portable, good contrast
- **PET:** Ge-68 ($t_{1/2}$ 271 d)
 - National standard
 - Calibration for different geometries (syringe, phantoms)
 - Calibrated ^{68}Ge phantoms (same tech—epoxy as mock syringes)
- **MRI:** NIST/ISMRM MRI system phantom prototypes at Mass General and MD Anderson for protocol development before US round robin
- Planning initial fabrication run of 50 phantoms for US scanner survey
- Working on SI-traceable diffusion phantom with Peter Bassler NIH



Courtesy of Ed Jackson MD Anderson

Medical Imaging: Standards and Software Validation


Imaging as a Biomarker Sept '06

What will NIST Deliver?

- Measurement infrastructure for evaluating image processing and analysis
BIOCHANGE 2008 and **BIOCHANGE CHALLENGE 2010**
<http://www.nist.gov/itl/iad/dmg/biochangechallenge.cfm>
- Contribute to standards for exchanging experimental and diagnostic information
- Develop/validate standards for integrating images with other sources

NIST PET-CT Imaging Laboratory and Testbed

- PET-CT scanner will be calibrated for *absolute* activity (Bq) and serve as a national reference for
 - Phantom characterization and calibration
 - Phantom measurement performance testing
 - Site qualification for clinical trials (similar to ACR)
 - On-going clinical QA
 - Comparison of performance between scanners
 - Testbed for imaging physics studies
 - Studies of factors influence image quantification
- Will facilitate image-based dosimetry studies through availability of NIST radioactivity and dosimetry standards
- Data acquired can be used as data reference for software validation



NIST Small Bore MRI Facility

MRI scanner ordered:

Varian/Agilent 7T-310 mm bore, actively shielded, recondensing cryostat

Variable field capability: will operate at clinical field values 1.5T, 3 T, & 7 T

Fitted with fiber optic thermometers, optical interferometers, shielded room, temperature stability < 1 C.



Delivery date Sept. 2011; for new Precision Measurement Lab in bioengineering corridor

Initial uses:

Validate/monitor NMR/dimensional properties of NIST/ISMRM system phantom components

Develop SI-traceable flow/diffusion phantoms

Develop and image microfabricated MRI agents for use in cell tracking

Thermal absorption/ B1 mapping studies

Validate quantitative imaging protocols.