QIBA 2017: Investigating New Profile Conformance Methods and Concepts

Quantitative Imaging Biomarkers Alliance RSNA

QIBA Profile Challenges & Opportunities

Introduction

The goal of every quantitative imaging biomarker is to enable a significantly improved standard of care that is widely adopted for a specific clinical task and ultimately is universally applied to the full patient population. To achieve this requires not only a comprehensive understanding of sources of quantitative measurement bias and variance and effective methods to control and ensure measurement performance in the academic medical center setting, but the new quantitative methods must also be effective and easily achievable in the community care setting. The use of new and innovative QIBA Profile conformance methods that leverage computational innovations provide new opportunities to improve the delivery and adoption of quantitative imaging biomarkers.

QIBA is exploring new conformance methods designed to help overcome many of the major challenges faced by all quantitative imaging biomarkers. Here, we review challenges and opportunities to improve the delivery and adoption of QIBA profiles with new conformance methods.

CT Quantitative Measurement Example
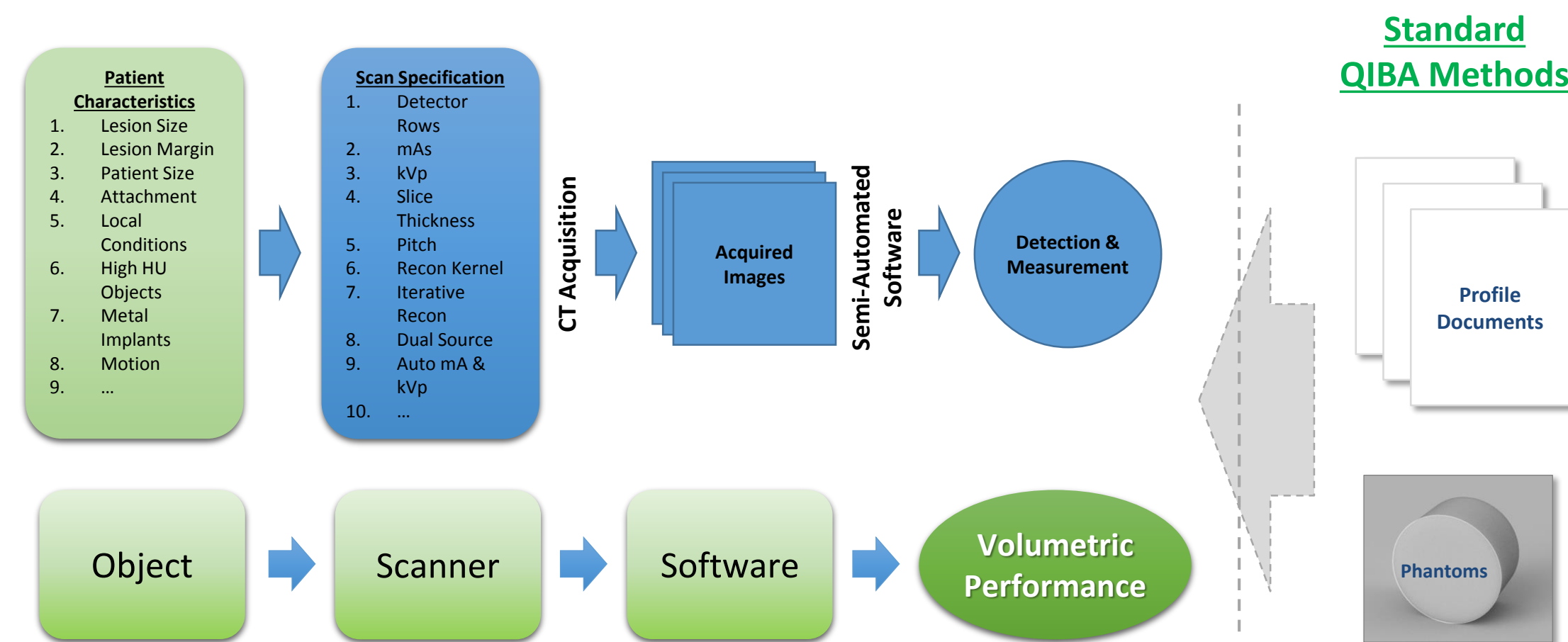

Real-World Complexity

1. Patients present with varying lesions and conditions. There is no way to account for all combinations.
2. Many CT scanner models exist, each with over a dozen parameters. Some of these are modified at patient scan time (mA, FOV).
3. Acquired image characteristics can vary significantly within a single image.
4. There are many software measurement systems with high levels of internal code complexity and no access to the code base.
5. All of the above are constantly changing with no requirements for notifying local personnel. Vendor system changes (e.g., reconstruction kernels) can potentially occur at any time.

New Profile Conformance Methods

Goal: To Use Novel Conformance Assessment Methods To Increase Adoption Of And Conformance With QIBA Profiles

Automated Phantom Analysis

- Automated Phantom Detection and Measurements
- Calculates Quantitative Metrics
- Thoroughly Checks DICOM Tags
- Produces Easy To Use Reports
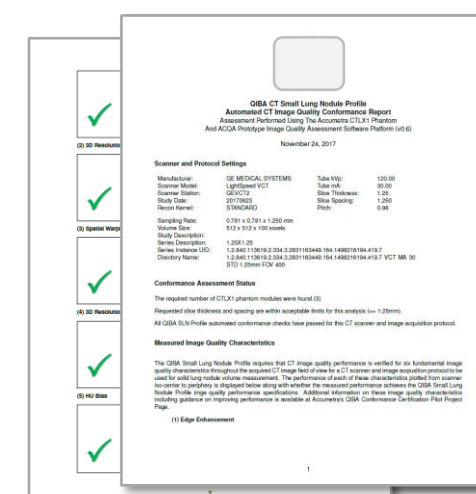
Cloud-Based Computing

- Leverages Fast & Efficient Computing Resources And Network
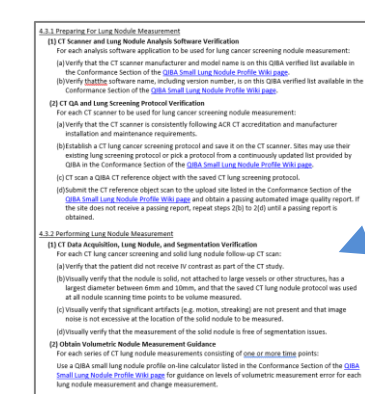- Easily Scales To Support Global Demand

Low-Cost Phantoms

- A Combination of Hardware and Software Innovations Can Keep Costs Down While Maintaining High Image Quality Measurement Performance
- Must Be Designed For Quick Scanning (<= 5min)

Crowd-Sourcing

- Enabled By Low-Cost Phantoms
- Provides Global View of Performance
- Captures Image Acquisition Diversity

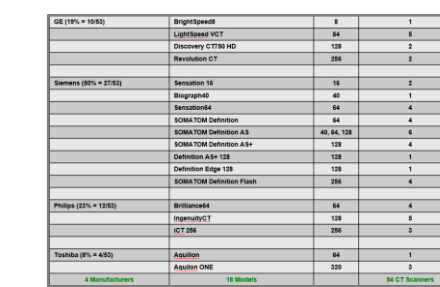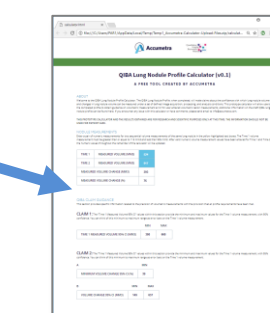Regularly Gather Data On Hundreds Of Scanners

Simple Checklists & Reports

- Automation Enables Short Checklists
- Some Manual Checks Still Needed

Goal Is To Have A <= 1 Page Clinical Check-List

Web Calculators

- Performs Complex Profile Calculations For Users
- Can Advise and Educate Users

Can Include Error Checking And Guidance

Modeling & Simulation

- Can Be Used To Translate Fundamental Image Properties Into Predictions of Task-Specific QI Biomarker Performance
- These Estimates Can Be Used For Model Validation & Support Profile Refinement.
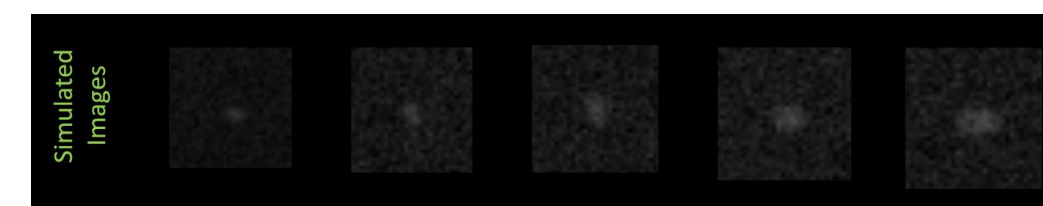
Design of Experiments

- Helps Prevent Issues In The Clinical Environment By Allowing Vendors To Define Parameter Operating Envelopes
- Focuses On High Performance Risk Parameters Such As mA and kVp

Single Operating Point | Wider Operating Envelope
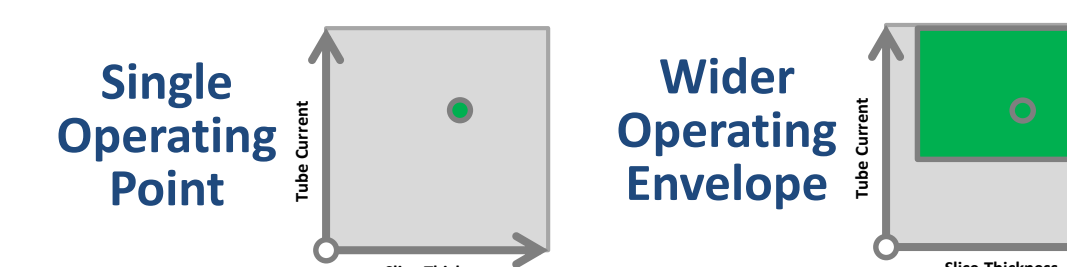
CT Small Lung Nodule Conformance Pilot Project

Simple Checklists and Reports
- Scanner, Software, and Protocol Checks
- Volumetric Analysis Checks
- Clinically-Focused and Easy To Use Reports

Fully Automated Phantom Analysis
- 3- To 6-Minute Phantom Analysis Time in Cloud
- Clear Pass/Fail Communication
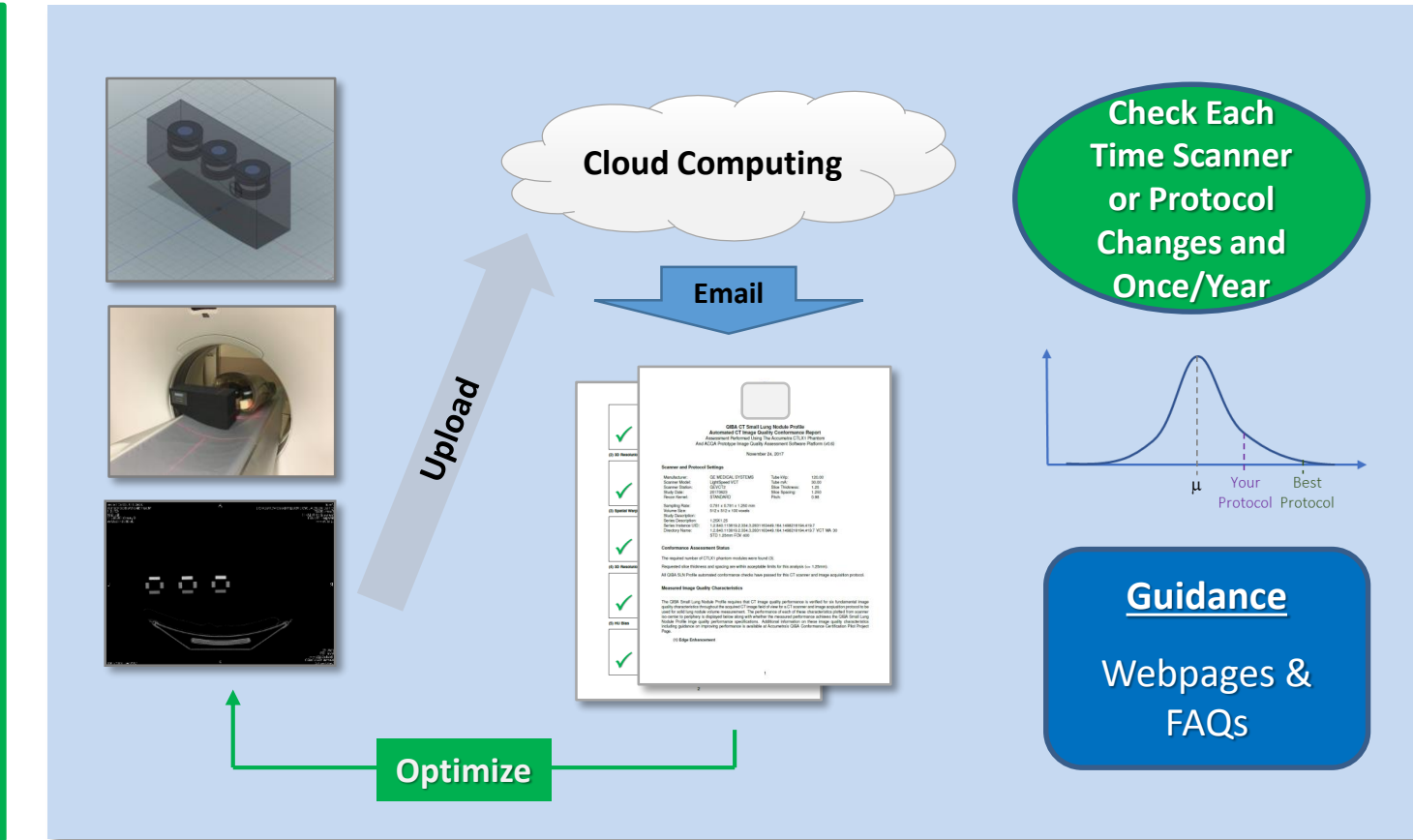- Suggestions and Guidance For Resolving Issues

Crowd-Sourcing
- 100 CTLX1 Phantoms To Be Shipped in 2017
- Protocol Optimization Guidance Will Be Provided Based On This Data
- Send Email To info@accumetra.com To Obtain A FREE CTLX1 Phantom And Support This Study

Low-Cost CTLX1 Phantom
- Low-Cost Design ($200)
- 5-Minute CT Scan Time
- 9 Have Shipped To U.S. Sites

Cloud Computing

Email

Upload / Optimize

Check Each Time Scanner or Protocol Changes and Once/Year

Guidance
Webpages & FAQs

Web Calculator
- Performs Profile Calculations
- Provides Guidance

Modeling & Simulation
- Leverage Fundamental Image Quality Characteristics
- Helps Establish Refined Tech Specs

Cloud-Based Computing
- Starting With 2 Amazon EC2 Instances, one in the U.S. and another in Germany.
- Easily Scalable To Support Global Clinical Sites

Design Of Experiments
- CT Scanner Vendor
- Exploring SW Vendor Opportunities

Future Profile Conformance Opportunities

Global Image Quality Optimization
- Strategies For Guiding Sites To Globally-Driven Optimized Imaging Protocols For a Specific Scanner Can Be Investigated
- CT Scanner Imaging Issues Can Potentially Be Identified In Real-Time And Acquisition Protocol Corrections For Quantitative Imaging Biomarker Scans Can Be Made and Verified Quickly

Rapid Global Studies
- Automation and Low Cost Phantoms Enable Large Global Studies To Be Conducted To Investigate Scanner and Algorithm Performance As Well As Inform Clinical Trials On Expected Variance With Quantitative Imaging Endpoints.

Link Image Quality Performance Report With Web Calculator
- Future QIBA Profiles Can Use Automated Phantom Analysis Results To Produce Scanner-, Protocol-, Patient-, and Lesion-Specific QI Measurement Guidance.

This Novel Profile Conformance Assessment Platform Can Support Other QIBA Profiles And Phantoms.