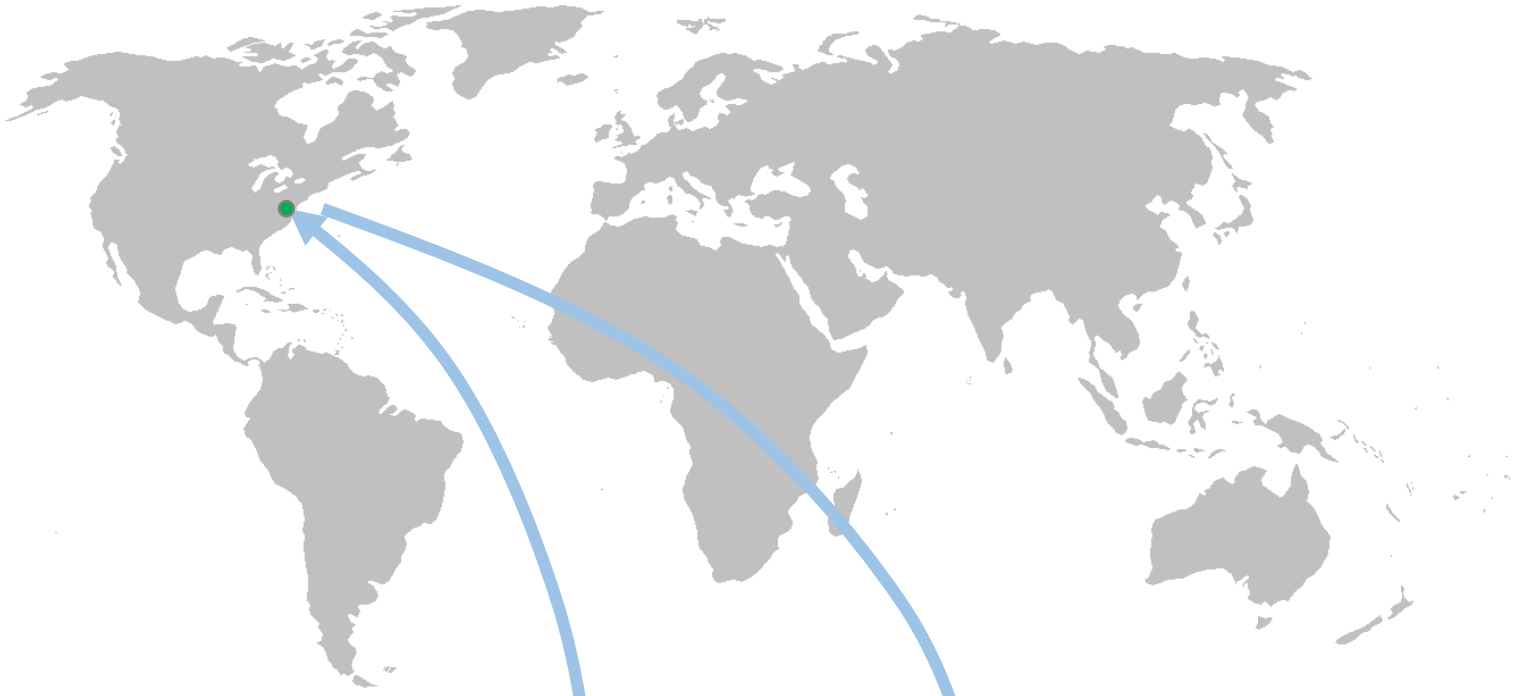
Proposing A National Infrastructure For Implementing Quantitative Imaging Quality Processes

Lung Cancer Workshop XIII

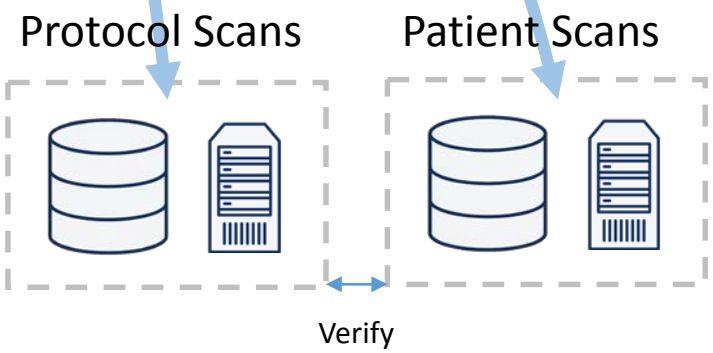
June 13, 2016

Long-Term Vision



Automated Data Transfer

- "Push" 3D Series
- Send back IQ Report with personalized feedback



Continuous Guidance

- Published Reports
- FAQs
- Web Calculators

National Image Quality Monitoring Proposal

- We have a highly efficient and scalable image quality monitoring infrastructure up and running
  - Ultra-low cost CT phantoms requiring <= 5 min to scan
  - Web-based Calculator(s)
  - Running on the Amazon Web Services (AWS) cloud

Phantom Cost < $50
AWS Cost < $0.05

SW Dev & Maintenance Will Be Largest Cost

Data Collection

All Metrics As a Function of Distance From Iso-Center

Fundamental Image Quality Metrics

- **CT Linearity**
  - Air, Acrylic, Delrin, Teflon
- **3D Gaussian PSF**
  - X, Y, Z Sigma
- **Sampling Rate**
  - X, Y, Z Distance
- **Image Noise**
  - Tape HU SD
  - Other Noise Measures
- **Edge Enhancement**
  - Max Mean Edge HU / Mean Tape HU

Estimated Clinical Task Metrics

- **Small Nodule Detection**
  - 3, 4, 6, 8 10 mm ellipsoids
- **Small Nodule Change Measurement**
  - 4, 6, 8, 10 mm ellipsoids
- **COPD Metrics**
  - Emphysema metrics
  - 1, 2, 3 mm airway wall
- **Cardiac Calcification**
  - 1, 2, 3 mm ellipsoidal calcifications
- …

Can Add Software Performance Testing As Well

Procedures

- Sites scan a calibration phantom each time they modify a quantitative imaging protocol
  - Each site receives personalized feedback on protocols including fundamental metrics, how well the protocol is performing for each relevant clinical task needed, and how well their scanner/protocol is performing with respect to similar equipment

- Sites also optionally send some percentage of de-identified scans corresponding to a certified protocol to collect additional data with a patient in the gantry.

Site Benefits

- Upon Joining Sites Will Be Able To Quickly Converge On Globally Verified Protocols For Specific Scanners
- The System Will Find Calibration Issues That Local Physicists Will Need To Investigate – Reducing # of Poorly Performing Patient Scans
- The Site Will Have Access To Many Online Guides, Resources, Datasets, and Calculators

Global Benefits

- For The First Time We Will Have A Detailed View of The Quality of Population Scanning And Be Able To Longitudinally Track Global Performance Trends
- Best Practices Will Take Hours To Days To Disseminate
- Researchers And Study Sponsors Will Be Able To Much More Carefully Control The Quality of Imaging Studies
- The Quality of All Imaging Research Publications (That Leverage These Resources) Will Increase