Prevent Cancer Foundation

Lung Cancer Workshop IX
Application of Quantitative CT Imaging to Early Lung Cancer Management: Accelerating Progress

Integrating Quantitative Imaging into Lung Cancer Screening

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RSNA

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RSNA Radiological Society of North America Founded in 1915

Basic Premise For RSNA

- **Extracting objective, quantitative results from imaging studies will improve the value of imaging in clinical practice.**

RSNA Report:

“There are substantial barriers to the widespread use of quantitative measures in clinical radiology – including:

- **inherently large number of variables that impede validation of specific metrics,**
- **diversity of proprietary industry platforms, and**
- **lack of acceptance by radiologists**

QIBA

Quantitative Imaging Biomarkers Alliance

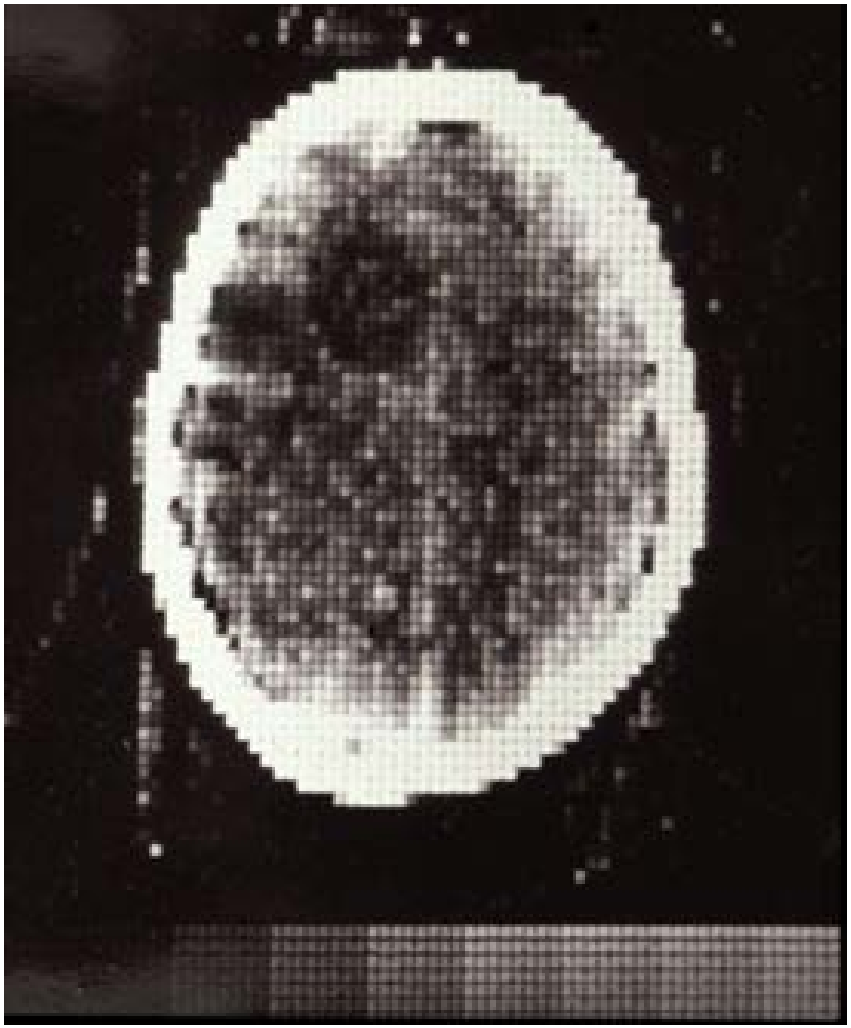
RSNA

- **Formally began May, 2007**
- **Mission: Improve value and practicality of quantitative imaging biomarkers by reducing variability across devices, patients, and time.**
  - **Build “measuring devices” rather than “imaging devices”.**

CT Scanner Variables That Affect Quantification

- kVp; mas
- Slice thickness, overlap
- Pitch
- Reconstruction kernel
- Field of view; matrix
- Collimation

The first clinical CT scan: Atkinson Morley's Hospital, October 1971



QIBA CT Volumetry Profile Claim:

Claim: Measure Change in Tumor Volume

- **Measured increases or decreases of more than 30% in the volume of a tumor are likely to be associated with a true change in the volume of the tumor.**

Reader Variability

- **Extracting numbers almost always requires an algorithm**
- **Algorithms almost always require radiologist input.**

Radiology 1983; 149(3):803-807

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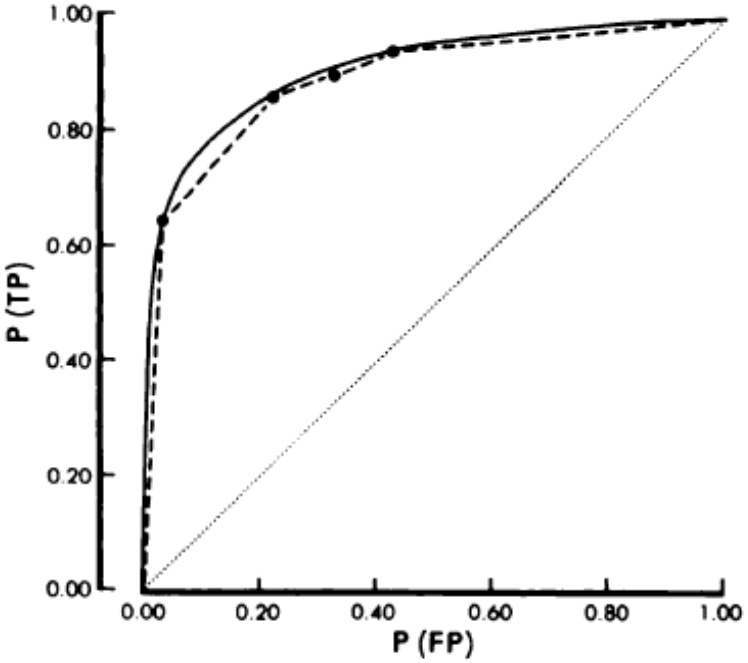
Lung Scan Interpretation: Effect of Different Observers and Different Criteria[1]

Many nuclear medicine physicians use criteria put forth by McNeil or Biello *et al.* to interpret lung scintigrams, while others use an integration of these and other reported or personal criteria. In-

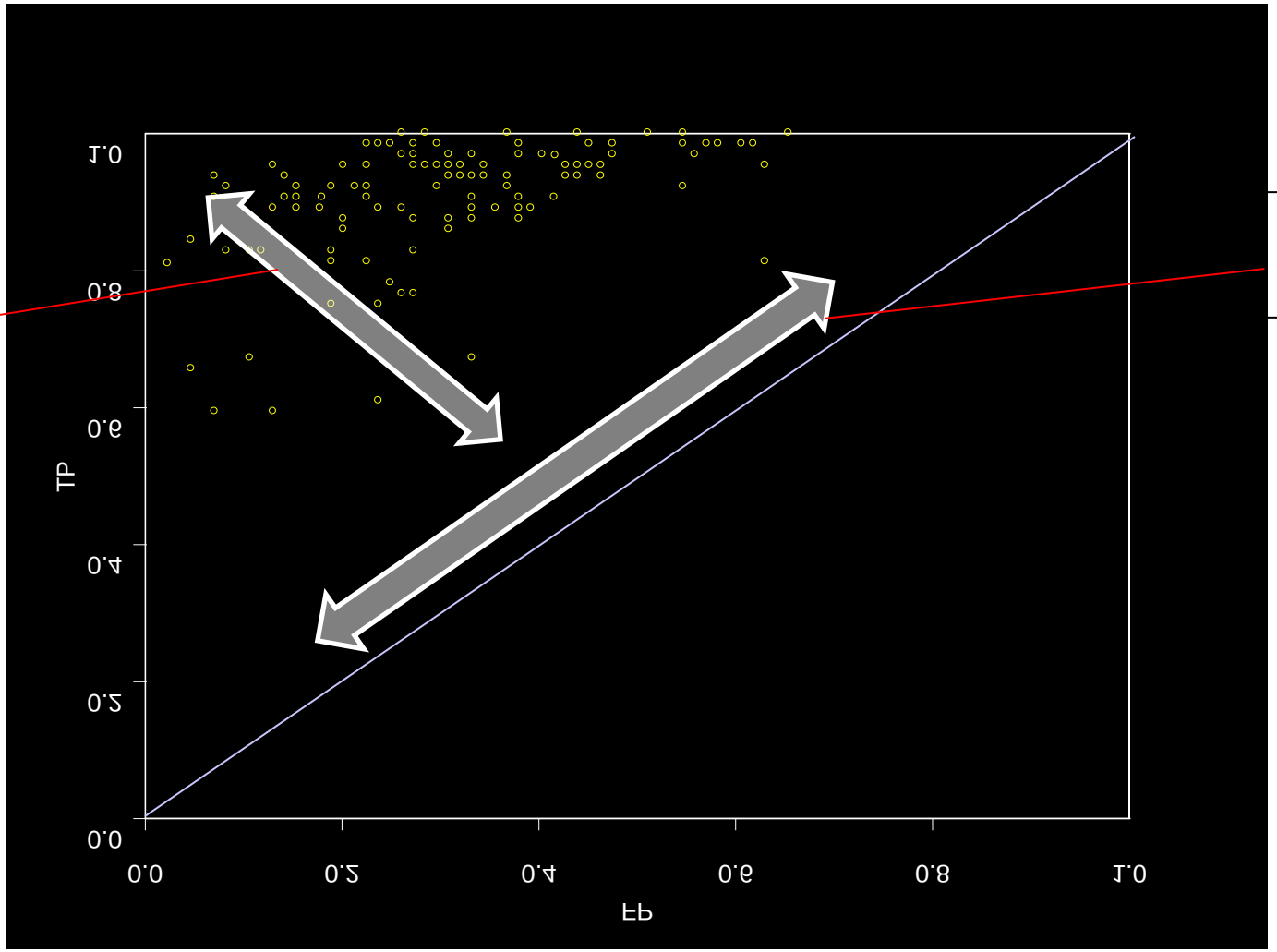
ROC Curves

Figure 1

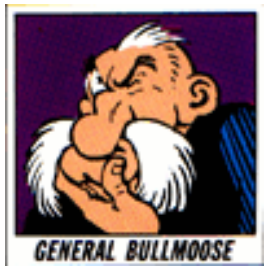


ROC curve for data in TABLE I. Dashed line = empirical curve; solid line = smoothed (Gaussian-based) curve; dotted diagonal line = no discrimination.

Operating points of 108 radiologists reading same mammograms



Beam, Layde, Sullivan Arch Intern Med 1996; 156:209-213



"What's good for General Bullmoose is good for the USA."

Al Capp

The Screening Wars …

- **“Individual patient focus” optimizes Sensitivity**
- **“Society focus” optimizes Specificity (“do no harm”)**
- **I believe these are irreconcilable differences.**

The Washington Post

Dec 2, 1993

- **FDA Seeks to Improve Quality of Mammography; Rules Set Mandatory Certification System**

- *Washington, D.C.*
- *Author: John Schwartz*
- **Agency officials said the new standards are similar to voluntary accreditation standards set by the American College of Radiology (ACR) in the late 1980s. Nearly 60 percent of all mammography facilities are accredited by the ACR, and [David A. Kessler] said "those facilities that are already ACR accredited - or that meet ACR requirements and are accredited by states - could receive the federal certificate in relatively short order."**

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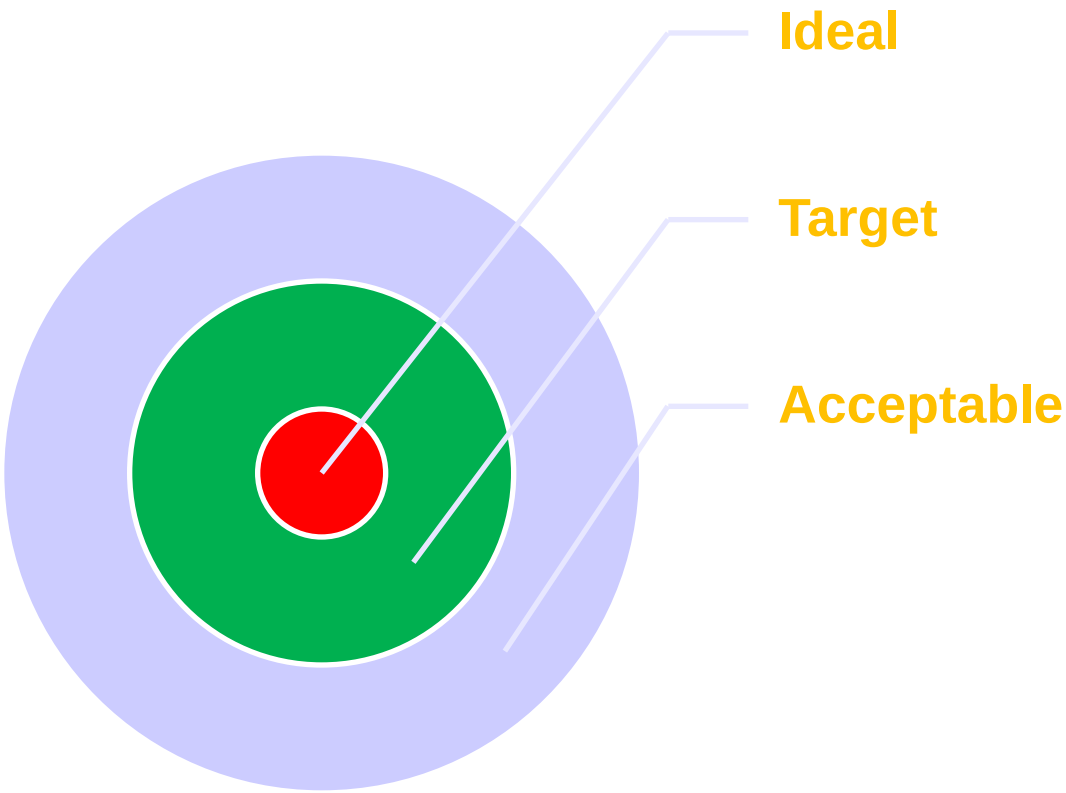
Tiered Approach To Performance Thresholds Supports Installed Base of Scanners & Guides Future Development



Levels correspond to specifications for parameters that affect measurement variability (e.g., slice thickness, recon algorithm, etc.)

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UK Lung Screen (UKLS) nodule management protocol: modelling of a single screen randomised controlled trial of low-dose CT screening for lung cancer. D R Baldwin, S W Duffy, N J Wald, R Page, D Hansell, J K Field *Thorax 2011;66:308-313*

Table 2 UK Lung Screen (UKLS) nodule categories

	Solid	Non-solid or part solid
Category 1	Nodules containing fat or with a benign pattern of calcification are considered benign. Nodules <15 mm^3 or if pleural or juxta pleural ≤3 mm	
Category 2	Intraparenchymal nodules with a volume of 15–49 mm^3. Pleural or juxtapleural nodules with a maximal diameter of 3.1–4.9 mm.	Nodules with a maximal non-solid component diameter <5 mm. Where there is a solid component, the component volume is <15 mm^3
Category 3	Intraparenchymal nodules with a volume of 50–500 mm^3. Pleural or juxtapleural nodules with a maximal diameter of 5–9.9 mm.	Nodules with a maximal non-solid component diameter of >5 mm. Where there is a solid component, the component volume is 15–500 mm^3
Category 4	Intraparenchymal nodules with a volume >500 mm^3. Pleural or juxtapleural nodules with a maximal diameter of ≥10 mm.	Nodules with a solid component with a volume >500 mm^3

Lung Cancer Screening Accreditation Program(s)

- International Guidelines (IASLC?)
- Oversight
  - Professional Organization (ACR? Other?)
  - FDA
- Ensuring high quality requires infrastructure to test algorithms and radiologists.

Algorithm Development

- **“Segmentation is the Mother of All Problems”.**
- **Need LARGE databases (images and associated clinical data).**
- **Need to disseminate appropriate Consent language for secondary use of clinical and research images.**

Reimbursement Issues

- **Keeping costs low requires:**
  - **Efficient throughput**
  - **Low false positive rate**

Thank you