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# Scanner Validation via the SNM Clinical Trials Network Phantom Program

Paul E. Christian
Associate Director - Operations
Molecular Imaging Program
Huntsman Cancer Institute
University of Utah

Chairman, SNM Quality Assurance Committee
Chairman, SNM, CTN Sub-Committee

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# Phantom Program (CAP, ACNP, SNM)

## 1973-2010

| | |
|---|---|
| 1973A | Geometric |
| 1973BA | Liver |
| 1974A | Brain |
| 1974B | AP Liver |
| 1975A | AP Thyroid |
| 1975B | Thorax |
| 1976A | Geometric |
| 1976B | Brain |
| 1977A | Liver |
| 1977B | AP Pelvis |
| 1978A | AP Liver |
| 1978B | AP Thyroid |
| 1979A | Liver |
| 1979B | Brain |
| 1980A | Liver |
| 1980B | Brain |
| 1981A | Liver |
| 1981B | Brain |
| 1982A | Thyroid |
| 1982B | Myocardium |
| 1983A | Liver |
| 1983B | Myocardium |

| | |
|---|---|
| 1984A | Head and Neck |
| 1984B | Myocardium |
| 1985A | Gallium |
| 1985B | Gated Ejection Fraction |
| 1986A | Geometric ROC Study |
| 1986B | Gated Ejection Fraction |
| 1987A | Liver ROC Study |
| 1987B | Gated Cardiac Arrhythmia |
| 1988A | Feet AP + Lat. ROC Study |
| 1988B | Gated Cardiac Cardiomyop. |
| 1989A | Gated Cardiac Tachycardia |
| 1989B | Renal Dynamic |
| 1990A | Gated Cardiac(akinesis) |
| 1990B | Renal Dynamic |
| 1991A | Pelvis |
| 1991B | Hepatobiliary |
| 1992A | Gated Cardiac Arrhythmia |
| 1992B | Geometric SPECT |
| 1993A | Lung V/P Study |
| 1993B | Brain SPECT Coronal |
| 1994A | Geometric ROC Study |
| 1994B | Cardiac SPECT Quant. |

| | |
|---|---|
| 1995A | SPECT QC |
| 1995B | Spinal SPECT/Planar |
| 1996A | Rest/Stress myocardial |
| 1996B | SPECT/Planar Renal |
| 1997A | Skeletal Study |
| 1997B | Medium Energy SPECT |
| 1998A | Cardiac SPECT |
| 1998B | Breast Planar |
| 1999A | Lung Perfusion SPECT |
| 1999B | Dual Isotope Cardiac |
| 2000 | Cardiac SPECT |
| 2001 | SPECT Lumbar Spine |
| 2002 | SPECT Chest |
| 2003 | SPECT Cardiac |
| 2004 | Gated SPECT Cardiac |
| 2005 | SPECT Spine |
| 2006 | SPECT Test Phantom |
| 2007 | Lung Perfusion |
| 2008 | Thyroid |
| 2009 | Cardiac TID |
| 2010 | Gastric Emptying |
| 2011 | PET/CT |
| 2012 | SPECT Cardiac |

# SNM Quality Assurance Committee

Clinical Simulation Phantoms

Evaluate: Image performance

- -Acquisition
- -Processing
- -Interpretation

Purpose of PET phantom

- -Resolution
- -Contrast
- -Noise
- -Quantitative accuracy
- -PET/CT alignment
- -Attenuation correction

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# Benefits to VA Medical Centers

- Objective review of imaging
- Global assessment of procedure accuracy
- Evaluate equipment performance
- Evaluate imaging protocols
- Review accuracy of quantitative measurements
- Identify poorly performing equipment
- Identify staff that needs education
- Ensure quality services to patients

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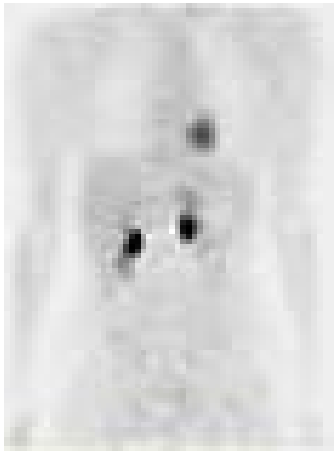
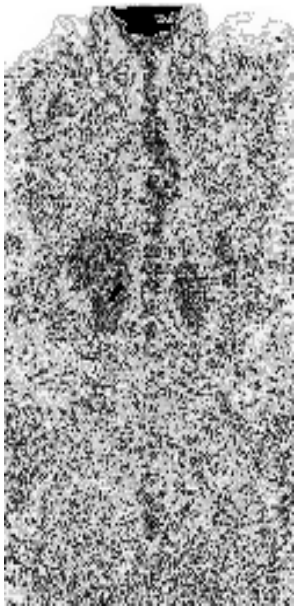
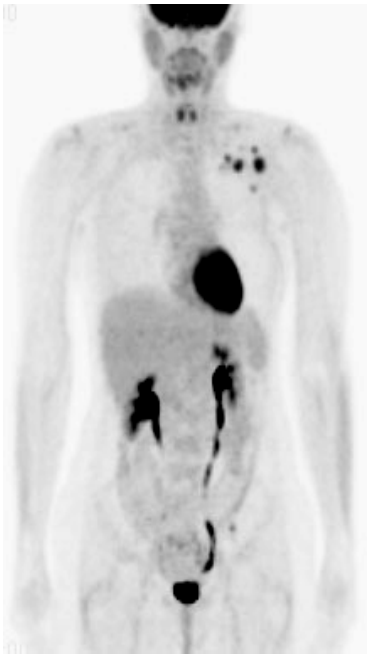
# Scanner Validation Purpose:

**Ensure scanner meets certain performance criterion needed for multi-center clinical trials via a clinical simulation phantom exercise.**

**Standardization and Harmonization of image quality and quantitative accuracy**







# Chest Phantom

- Clinical simulator to measure:
  - Lesion detectability
  - Lesion quantitation
- Fill with F-18 FDG
- Precision Filling Technique
- Concentration (0.14μCi/ml)
- 4:1 Lesion/Background Ratio

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# Imaging Process

- Fill phantom (precise technique)
- Performing imaging according to prescribed protocol
- Image after specific time delay
- Reconstruction parameters
- MD to identify lesions
- Submit images for review

- Quantitative measurements ($SUV_{max}$ and $SUV_{ave}$)
  - At image quality core lab
  - At site

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# Demonstration Project -11 scanners

## SUV Measurements

| Location | Ave SUV | Range SUV | StdDev | COV |
|---|---|---|---|---|
| Background (1.0) | 0.99 | 0.97 – 1.09 | 0.04 | 3.7% |
| | | | | |
| Lesion (4.0) | Max SUV | | | |
| 20mm | 3.00 | 2.41 – 4.06 | 0.51 | 17.0% |
| 15mm | 2.58 | 2.02 – 3.54 | 0.44 | 17.0% |
| A 10mm | 1.43 | 1.08 – 2.03 | 0.28 | 19.8% |
| B 10mm | 1.50 | 1.09 – 2.25 | 0.30 | 20.1% |
| C 10mm | 1.60 | 1.82 – 1.32 | 0.17 | 10.7% |

**CTN Reconstruction Work Group**

**Standardized/Harmonized image quality and quantitation**

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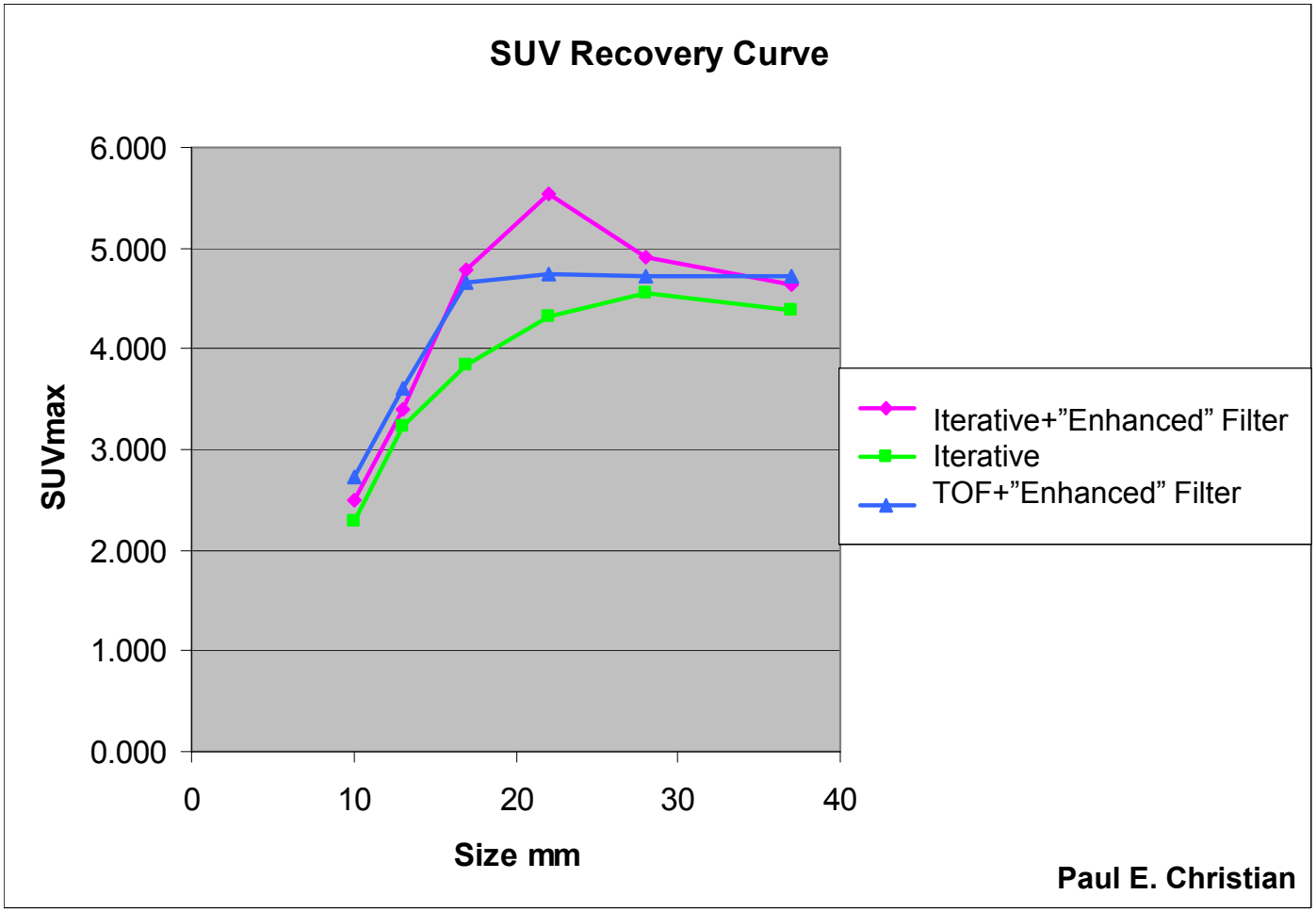
# Challenges

- Operational:
  - Ship phantom multiple times
  - Sites must image and ship quickly
  - DICOM CD images not readable with commercial software (FDA approved)
- Site Pitfalls:
  - Find time in clinical schedule
  - Made CD on third party system or PACS (44% repeat)
  - Scanner mis-calibrated (absolute activity) (11% repeat)
  - Filled phantom incorrectly (7% repeat)
  - Data entry (Patient weight, injection time, dose) (10%)
  - Dose calibrator error (3%)

# New PET/CT Systems



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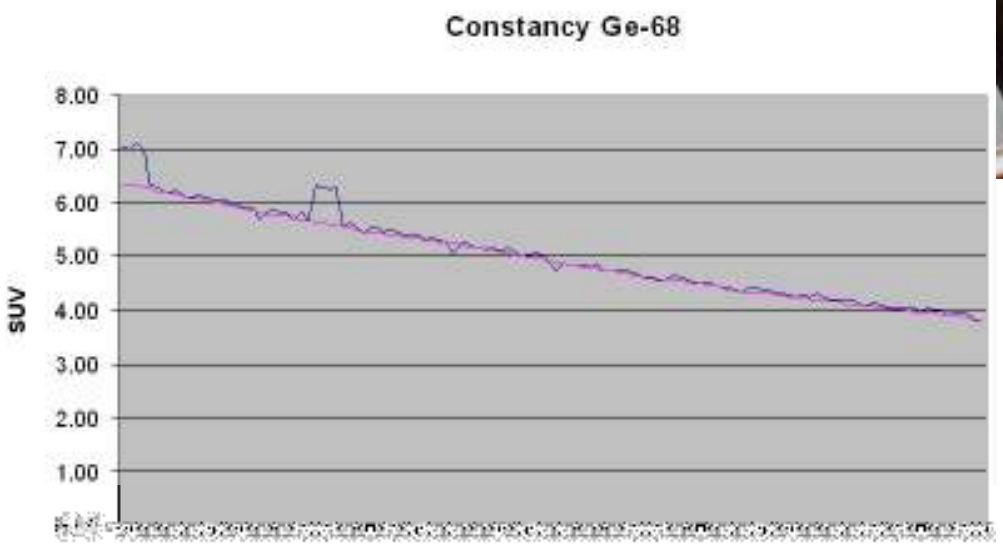
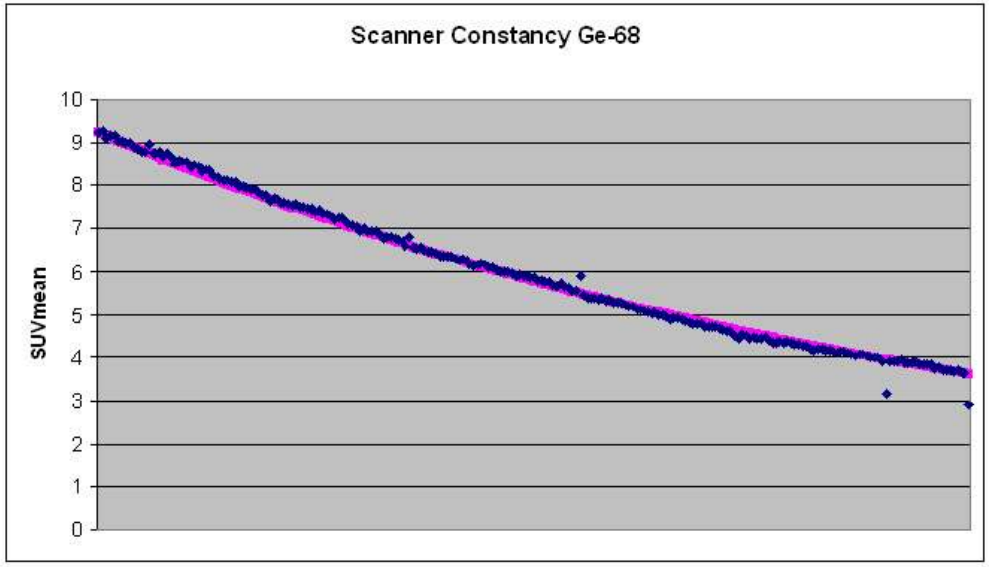
# Quality Control

- Dose Calibrator
- CT Scanner
  - CT checks
  - Calibration
  - Inspection
- PET Scanner
  - Blank scan
  - Constancy
  - PET and CT alignment
  - Record of PMs and calibrations

Courtesy: Paul E. Christian

# Scanner Constancy




**One Year**

**Courtesy: Paul E. Christian**

# CTN Scanner Validation

- **Validated scanners 32**
- **Sites currently imaging phantoms 19**
- **Sites waiting for phantoms >17**

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# Scanner Validation

**Submit Scanner Questionnaire**
- Scanner make, model, mode, etc
- Dose calibrator model, etc
- Site contact personnel information

**Receive and Image Phantom**

**Submit Scanning Information to Core Lab**
- Submit imaging form
- Submit DICOM images on CD

**Core Lab Reviews Images and Data**

**Site Completion of SUV Measurements**

**Core Lab Reviews Site SUV Measurements**

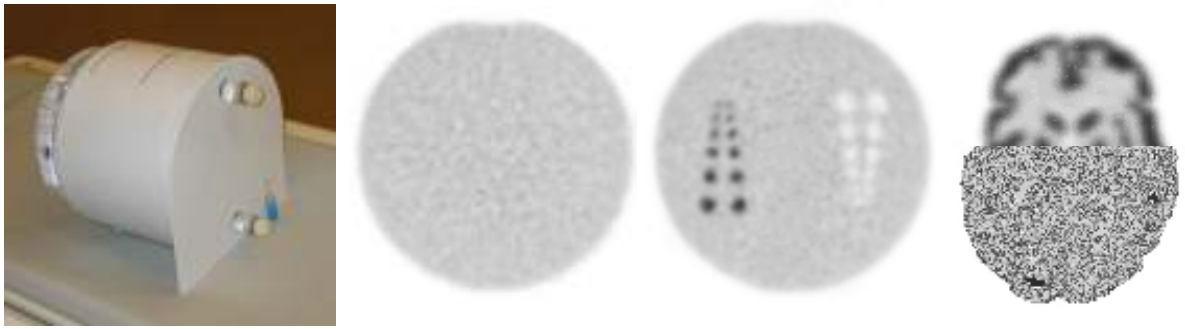
**Site Validation Complete**

**Site Receives Scanner Validation Certificate**

# Scanner Validation Sub-Committee

## 2010 Goals:

Testing brain imaging phantom



Characteristics and Advantages

- Uniformity evaluation
- Resolution pattern of hot and cold rods
- Clinical simulation of central brain region

# Scanner Validation Sub-Committee

Testing myocardial imaging phantom

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