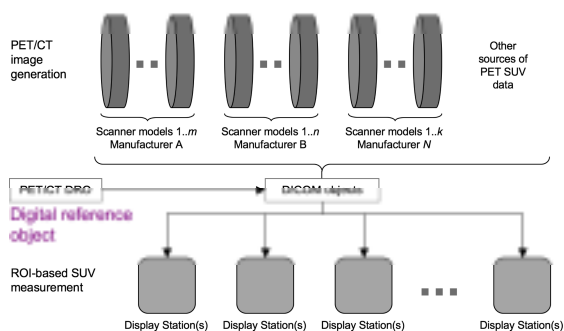


PET/CT SUV Digital Reference Object

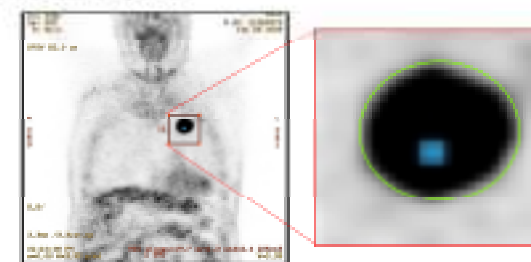
Problem statement

- When we use PET image analysis software
 - Is it reporting the values we expect it to?
 - How accurate are the reported values?
- Two main components to the calculation
 - What DICOM fields and formulas are used to calculate the standardized uptake value (SUV)?
 - How is the ROI defined and what combination of voxels are used?

Data flow for DICOM PET/CT images



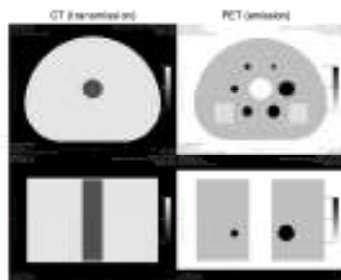
ROI analysis



- What pixels (or fraction) are included?
- Are the correct values reported?

Digital reference object (DRO) specifications

- Based on the NEMA / MITA Image Quality phantom
 - PET and CT sets of DICOM images generated from scratch using dcmrk
 - DICOM fields populated with values appropriate for SUV calculations

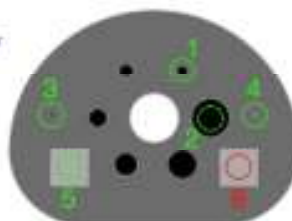


Can be generated with smoothing and/or noise

DRO Test Regions

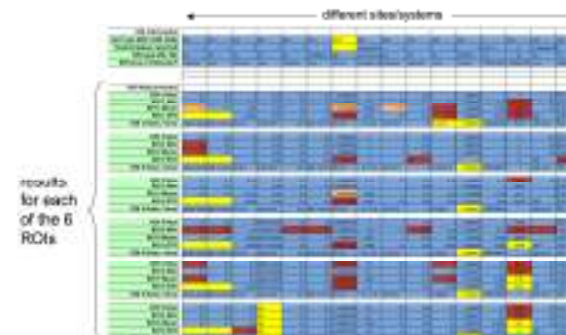
- SUV values in general are either 0, 1.0, or 4.0, except
 - A single voxel in ROI 3 is set to 4.11
 - A single voxel in ROI 4 is set to -0.11
 - A checkerboard pattern is used to provide a deterministic test for calculation of the standard deviation in 2D (ROI 5) and 3D (ROI 6)

ROIs 1-6 used for reporting values



Results: 13 sites, 20 different display systems

blue = okay, yellow = ?, pink = borderline, red = wrong



Display systems tested

Vendor	Platform	Version
1	GE	AW Volume Viewer 4.5
2	GE	Dynamic VUE RDR v.04.0c
3	GE	Volume Viewer 9.0.07
4	GE	Xbox 1.1402
5	Hermes	Hermes Hybrid Viewer RDR v.1.40
6	Kentec	Kentec N/A
7	MedImage	MedView 11.8.3
8	MedImage	MedView 12.0.3
9	MM	MM Software 8.1 (Build AC-1508)
10	MM	MM Software 4.1.0 (Build 0)
11	MM	MM Software 5.3.8
12	MM	MM Software 5.4.3
13	Oerik	Oerik v4.0
14	Philips	EBM Fusion Viewer V9.5.2.6532
15	Philips	EBM Fusion Viewer V9.5.3.452.60
16	Philips	EBM Fusion Viewer V9.5.2.145
17	Philips	Fusion 5.208
18	Sepani	Oasis 1.0.2HP4
19	Siemens	syngo.via MMView WALL
20	Siemens	syngo 88 VMS0A

Summary

- In general most (but not all) systems correctly calculated SUVmean and SUVmax
- There were increasing levels of problems with SUVmin, standard deviation and area
- There were anecdotal reports of software changes in response to tests performed with the PET/CT digital reference object (DRO)
- The PET/CT DRO is a useful method for testing the validity of PET SUV calculations

Thanks to the DRO Testing team and the QIBA FDG-PET Technical Committee

Janice Campbell	William Beaumont Hospital
Paul Christian	University of Utah
Mathew Kelly	Siemens Molecular Imaging
Martin Lodge	Johns Hopkins University
Matt Mille	NIST
Mark Muzi	University of Washington
Wendy Macdougald	University of Washington
Elizabeth Philips	GE Healthcare
Lucy Pike	St Thomas' Hospital, UK
Janet Reddin	University of Pennsylvania
Bob Songhria	Mount Vernon Hospital, UK
John Sunderland	University of Iowa
John Wolodzko	CoreLab Partners
Bin Zhang	Philips Healthcare