Extending Traceability to Nuclear Medicine Imaging

Small Animal

Jeffrey T. Cessna

Physics Laboratory, National Institute of Standards and Technology, Gaithersburg, MD 20899-20899, USA

Small Animal Imaging

- Preclinical Studies
- Rodent disease model
- Expensive study animals
- Study biodistribution, biomarkers for therapy response
- Previous experience
  - Large number of animals
  - Animal sacrificed at different stages
  - Study response to treatment

Small Animal Imaging

- Clinical instruments in use for some time
- Dedicated scanner – rat/mouse
- Can follow fewer animals

General Scanner Performance Characteristics Compared Between Clinical and Preclinical Cameras

	Clinical PET	Preclinical PET	Clinical SPECT	Preclinical SPECT
Sensitivity	1-3%	2-4%	0.01%-0.03%	0.3%
Resolution	~5mm	1 to 2 mm	~10 mm	0.5 to 2 mm
FOV	50 cm	7 cm	50 cm	50 cm

Jansen and Vanderheyden. Nucl Med Biol 34:733-735, 2007

Small Animal Imaging

- Combined measurements with
  - Radionuclide activity calibrator
    - Injected activity
    - Activity of test object
  - Gamma cell counter
    - Activity of harvested organs

Collaboration

- University of New Mexico
- Bioscan – NanoSPECT/CT
- NIST
- Characterize 3 instruments
- Write guidance for appropriate procedures

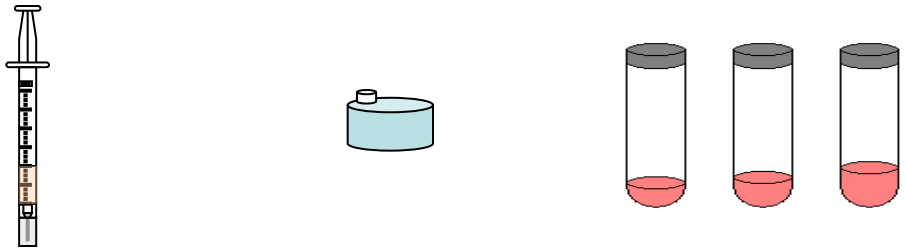
Instruments and Geometries

- Capintec CRC-Series dose calibrators
  1. 150 µL epoxy resin, containing 37 MBq (1 mCi) ^{57}Co total activity, in a 0.5 CC tuberculin syringe with 31 Ga. thin-walled needle
  2. 37 MBq (1 mCi) ^{57}Co total activity, as a liquid, in a sealed Bioscan NanoSPECT “Hot-rod” phantom

- Wallac-Wizard 1480 gamma-counter
  1. 0.05 mL – 0.5 mL epoxy resin, containing 74 kBq/mL (2 µCi/mL) ^{57}Co, in a 11.7 mm by 55 mm (4 mL) clear polystyrene round bottom tube (Wallac type 1147.55)

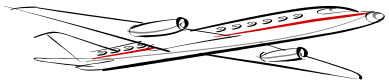
- NanoSPECT/CT® manufactured by Bioscan, Inc
  1. 37 MBq (1 mCi) ^{57}Co total activity, as a liquid, in a sealed Bioscan NanoSPECT “Hot-rod” phantom

NIST

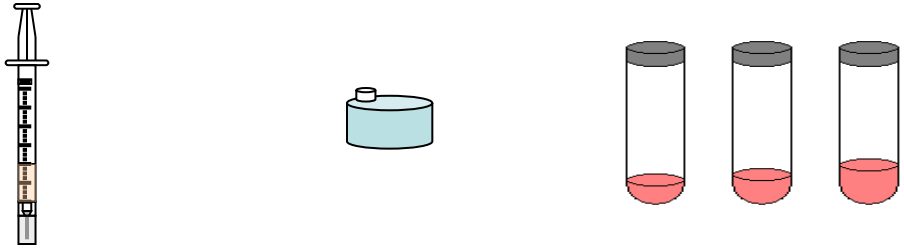


Calibrated Activity

Measured at NIST



Shipped to Univ of New Mexico



Measured at UNM

Standard protocols

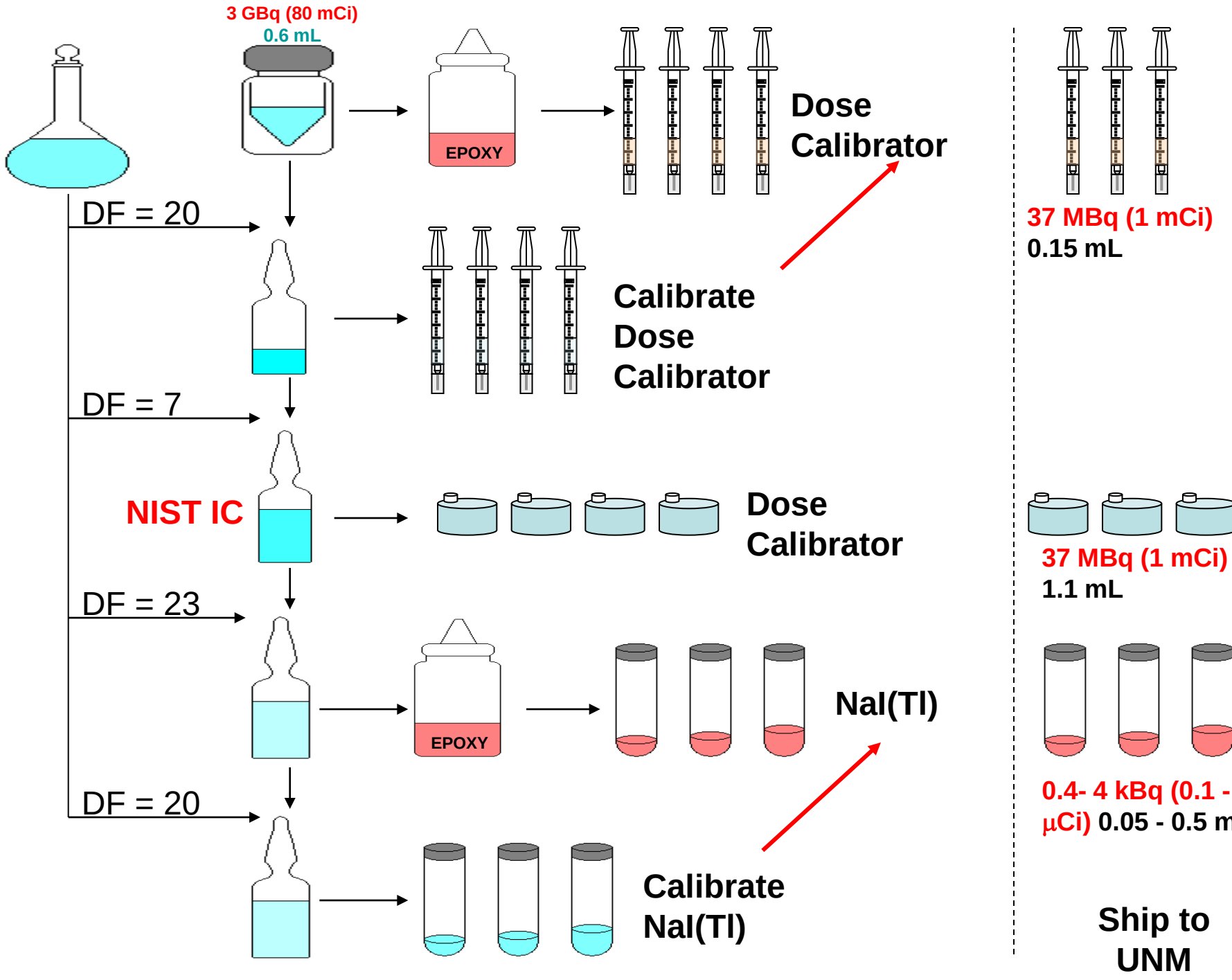
Dose Calibrator

Dose Calibrator

Gamma Counter

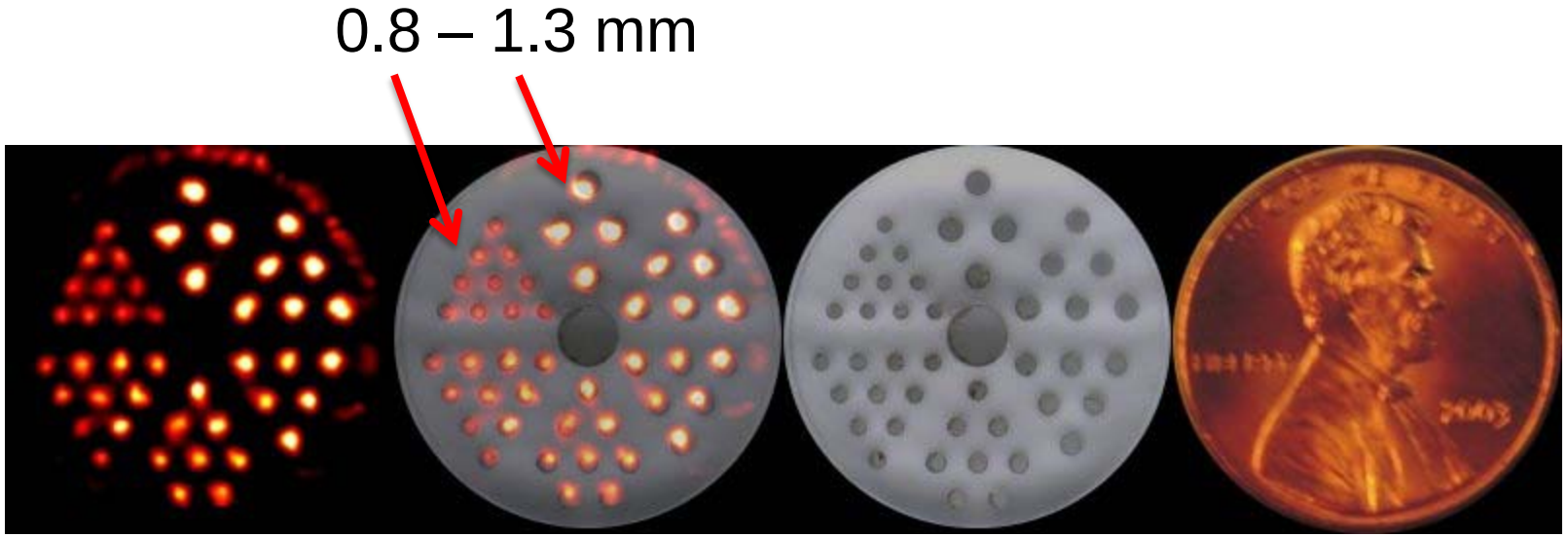
NanoSPECT

Establish relationships


3 GBq (80 mCi)
0.6 mL
EPOXY
Dose Calibrator
37 MBq (1 mCi)
0.15 mL
DF = 20
Calibrate Dose Calibrator
DF = 7
NIST IC
Dose Calibrator
37 MBq (1 mCi)
1.1 mL
DF = 23
EPOXY
NaI(Tl)
0.4- 4 kBq (0.1 -1 µCi) 0.05 - 0.5 mL
DF = 20
Calibrate NaI(Tl)
Ship to UNM

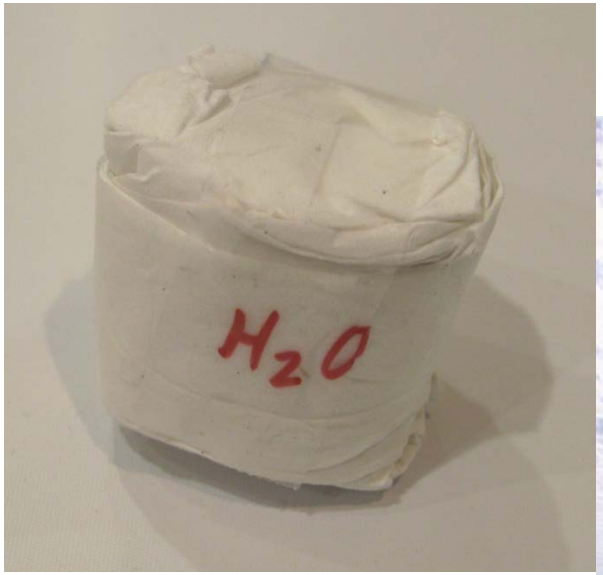
µJaszczak Phantom

NanoSPECT/CT



C. Lackas, H.U. Schrann, J.W. Hoppin, H. Halling, Research Center Jülich, Germany

Shipping Testing



Other Possibilities

- Small animal PET
  - University of Washington
  - Uniformity phantoms
  - Dose calibrator measurements
  - Traceable to NIST ^{68}Ge standard

Questions?