

## Celebrating Education in Medical Nuclear Physics

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Where the world comes for answers



7/22

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## Who I am

- Nuclear medicine physicist for 40 years
- Boston Children's Hospital for 19 years
- Professor of Radiology Emeritus at Harvard Med Sch
- Georgetown Univ (Rad Sci) and Wake Forest (Med Phys)
- Past Program Director of BCH Img/NM Med Phys Residency
- HMS Joint Program of NM Teacher of the Year (2019)
- NM Tech Certification Board Member (2016-2023)
- I have taught medical physicists, health physicists, physicians, technologists, radiopharmacists, undergrad physics majors and the lay public

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## Medical Physics Training

- Undergraduate experience
  - Guest lectures: Opportunities in Med/NM Physics
  - Physics in Medicine and Biology course
- Grad students and Post-Docs
  - Research primary interest
  - Provide opportunities in other areas
- Med Phys Residency

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## Components for a NM Physics Education

- Course work
- NM Research
- Clinical training
- Teaching

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## My Introduction to NM (1976)



What device is this?

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## My Introduction to NM (1976)



Rectilinear scanner

- Gamma cameras were new
- PC II PET at MGH
- Gamma camera SPECT just reported (Keyes/Jaszczak)
- $^{131}\text{I}$  for thyroid treatment
- CT introduced in 1972
- MR imaging of citrus

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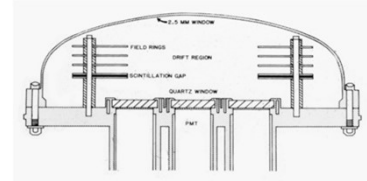
### What was essential to learn? Basics!

- Radiation detection
- Image science (signals, noise, contrast)
- Performance parameters
  - Efficiency/sensitivity
  - Resolution: spatial, energy, temporal
  - Uniformity
- Internal dosimetry
- Radiation biology
- Radiation safety and public health
- Tomographic reconstruction

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### NM Research

- Delve deeper
- Learn something of broader application
- Presentations and publications



Gas Scintillation Proportional Chamber (Xe at 10 ATM)

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### NM Physics Clinical Training

- In the past, lacking in some cases (like mine)
- Big fan of med phys residency training!
- Be part of the team so one understands what others do including physicians, technologists, health physicists, ...
- Work with them, perhaps make their lives easier
- Establish a QC and testing program
- Practice improvement project
  - Better use of instrumentation
  - Optimize imaging protocol
  - Dose optimization
- Dosimetry for radionuclide therapy

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### QC and Testing Program Gamma Camera, SPECT, PET

- Acceptance Testing
- Daily Testing
- Quarterly or Annual Testing

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### Gamma Camera Acceptance Testing

- |                      |                          |
|----------------------|--------------------------|
| • Inspection         | • Extrinsic Sensitivity  |
| • Uniformity         | • Linearity              |
| – Intrinsic          | • Energy Resolution      |
| – Extrinsic          | • Count Rate Performance |
| • Spatial Resolution | • SPECT                  |
| – Intrinsic          | – Uniformity             |
| – Extrinsic          | – Resolution             |
|                      | – Contrast               |

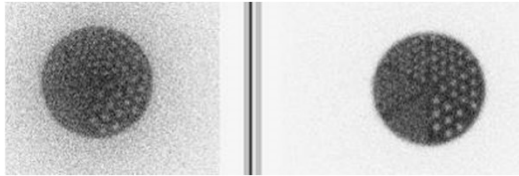
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### Gamma Camera Quality Control

- Daily
  - Background
  - Uniformity (Intrinsic or Extrinsic)
- Weekly
  - 4 Quadrant Bars (Spatial Resolution and Linearity)
- Quarterly/Annually
  - Extrinsic Sensitivity
  - Extrinsic Uniformity
  - Count Rate Performance
  - SPECT evaluation

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## $^{123}\text{I}$ with Different Collimators



LEUHR

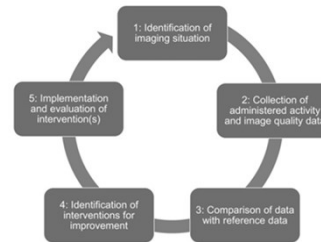
ME

Note:  $^{123}\text{I}$  has 2-3% high energy photons in addition to the 159 keV gamma ray.

Snay ER et al. J Nucl Med Technol. 2011;39:100-104.

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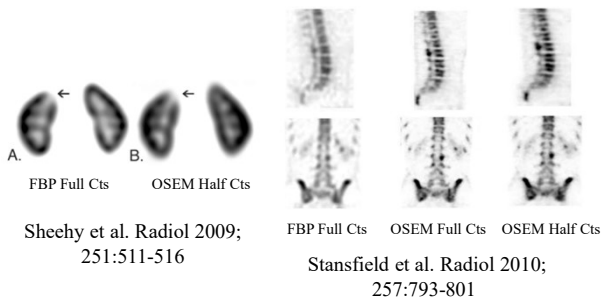
## Dose Optimization



Poli GL, et al. Developing and implementing an imaging optimization study in pediatric nuclear medicine: Experience and recommendations from an IAEA Coordinated Research Project. J Nucl Med. 2021;62:570-576.

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## Use of OSEM-3D Reconstruction In SPECT

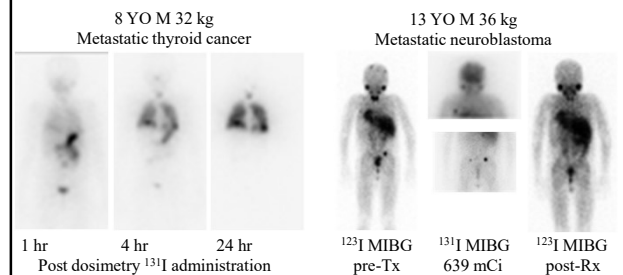


Sheehy et al. Radiol 2009; 251:511-516

Stansfield et al. Radiol 2010; 257:793-801

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## Radionuclide Therapy



Now also Xofigo, Lutathera, Pluvicto

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## Medical Physics Residency

- Clinical training (a little about a lot) is a great addition to PhD research training (a lot about a little)
- Working in a clinical environment with a wide range of health professionals
- Working around the clinical schedule (flexibility)
- Providing your input to your clinical colleagues in an accessible manner
- Diagnostic imaging vs NM residency
- We need NM residency slots!

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## BCH Diagnostic Imaging Med Phys Residency

- Radiation Safety
- Rad/Mammo
- Fluoro
- **NM**
- CT
- MR
- Informatics
- US
- 3 Advance Rotations

Each rotation is 2 months including NM  
 NM topics: instrumentation, hybrid imaging, reconstruction, quality control, radionuclide therapy

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## BCH Nuc Med Phys Residency

- Radiation Safety
- Rad/Mammo
- Fluoro
- **NM**
- CT
- MR
- Informatics
- ~~US~~
- Hybrid Imaging
- Advanced Reconstruction
- 1 Advance Rotation

Each rotation still 2 months with 1 advanced rotation  
One full year of Nuc Med training

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## Medical Physics Education of Other Health Professionals

- Strive to be correct, pertinent and accessible
- Avoid any “advanced” math e.g. calculus
- Mathematical proofs hold no weight
- Explain how the physics is pertinent
- I focus on basics, clinical application, quality control, artifacts and radiation safety
- Even with board reviews, I provide basic, usable information. I do **not** teach to the exam!

Great opportunity for med phys trainees to stretch their teaching skills, BUT with supervision!

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## Medical Imaging and What You Should Know About Radiation

Fred Fahey

Radiation Safety Committee Chair  
Boston Children’s Hospital  
Professor of Radiology  
Harvard Medical School

Effective Communication About Radiation Dose and Radiation-Induced Risks for Pediatric Patients  
T. Atwood, L. States, F. Fahey, A. LaBella  
Wed 7:30-9:30 Rm 206

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