Preparing for Parts 2 & 3 of the ABR Nuclear Medical Physics Exam

Robert MacDougall, M.Sc., DABR
Boston Children’s Hospital
Harvard Medical School
Background

- DX and NM Physicist at Boston Children’s Hospital
- CAMPEP Residency Henry Ford Health System (Completed 2010)
- Passed ABR Diagnostic Med Phys (2011)
- Passed ABR Nuclear Med Phys (2015)
Outline

- Requirements for Initial and Additional certification
- Focus of Part 2 and Part 3
- Part 2 – Study Material, Time Management
- Part 3 (Oral) – Preparation, Exam Day
Outline

- Requirements for Initial and Additional certification
- Focus of Part 2 and Part 3
- Part 2 – Study Material, Time Management
- Part 3 (Oral) – Preparation, Exam Day
ABR – Certified NM Physicists

Total = 294

- NM + DX
  - 99, 34%
- NM
  - 184, 63%
- NM + TX
  - 10, 3%

NM + DX (99, 34%)
NM (184, 63%)
NM + TX (10, 3%)
NM Certification Since May 2010

Total = 32

Additional (19, 59%)

Initial (13, 41%)
Process for initial certification

1. Completed CAMPEP-accredited residency and passed Part 1
2. Obtained clinical experience in nuclear medicine during residency
3. Program director attestation of appropriate didactic and clinical training
Process for additional certification

1. Any ABR diplomate certified in one medical physics specialty may pursue certification in additional specialties.
Process for additional certification

1. Any ABR diplomate certified in one medical physics specialty may pursue certification in additional specialties.

2. Cannot pursue *two additional* certificates simultaneously.
Process for additional certification

1. Any ABR diplomate certified in one medical physics specialty may pursue certification in additional specialties.

2. Cannot pursue two additional certificates simultaneously.

3. Must be meeting MOC.
Process for additional certification

1. Any ABR diplomate certified in one medical physics specialty may pursue certification in additional specialties.

2. Cannot pursue two additional certificates simultaneously.

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4. At least one year equivalent (0.8 FTE) of clinical experience in additional specialty after previous certification.
Process for additional certification

1. Any ABR diplomate certified in one medical physics specialty may pursue certification in additional specialties.

2. Cannot pursue two additional certificates simultaneously.

3. Must be meeting MOC.

4. At least one year equivalent (0.8 FTE) of clinical experience in additional specialty after previous certification.

5. Experience attested by individual certified by ABR or AMBP in specialty.
Beginning 2019

1. Clinical experience must be prospective.
Beginning 2019

1. Clinical experience must be prospective.
2. Clinical experience and supervision plans must be developed prior to initiation of clinical experience
Beginning 2019

1. Clinical experience must be prospective.

2. Clinical experience and supervision plans must be developed prior to initiation of clinical experience.

3. Supervisor must be ABR-certified in specialty.
Beginning 2019

1. Clinical experience must be prospective.
2. Clinical experience and supervision plans must be developed prior to initiation of clinical experience
3. Supervisor must be ABR-certified in specialty

...Details to come in 2016
Beginning 2019

1. Clinical experience must be prospective.
2. Clinical experience and supervision plans must be developed prior to initiation of clinical experience.
3. Supervisor must be ABR-certified in specialty.

...Details to come in 2016 2017...
Outline

➢ Requirements for Initial and Additional certification
➢ Focus of Part 2 and Part 3
➢ Part 2 – Study Material, Time Management
➢ Part 3 (Oral) – Preparation, Exam Day
“If you don’t know where you are going, you’ll end up someplace else”

-Yogi Berra
ABR NEWS

Jerry D. Allison, Geoffrey S. Ibbott and J. Anthony Seibert

ABR Physics Trustees

The Purpose and Scope of the ABR Oral Exam

The Oral Exam in Medical Physics is designed to test the clinical skills of the candidate and assess the candidate’s readiness to practice medical physics independently. The exam includes a broad range of topics that provide the candidate an opportunity to:

• demonstrate that he or she understands how common medical physics equipment performance evaluations are conducted,
• analyze the results of medical physics evaluations and make appropriate recommendations,
• explain how the performance of clinical equipment may affect patient care,
• analyze uncommon situations and explain how he or she would approach them, and
• communicate the results of medical physics evaluations.

The focus of the oral exam is on clinical competence, which is a factor distinguishing it from the Part 1 and Part 2 exams that focus on the fundamental concepts of medical physics and include detailed calculations.
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Part 2 - Required Reading

Initial Certification

Medical Physics

PLEASE NOTE: List of Constants and Physical Values

The ABR is now providing candidates with a list of constants, physical values, and related information, which can be found on the bottom of this page. While the list includes many constants and physical values, the ABR does not warrant the list as a compilation of all constants and physical values needed on the examinations. Candidates should review the list carefully before their examinations to familiarize themselves with the contents and list organization.

Exam Study Guide

- Computer-Based Exams
- Medical Physics Oral Exam
- Download this study guide in printable .pdf format
Sample Question

4. If the minimum, mean, and maximum pixel counts in the central field of view of a smoothed intrinsic flood image are 4500, 5200, and 5500, respectively, what is the integral uniformity?

A. 5%
B. 6%
C. 10%
D. 14%
E. 15%
Part 2 - Required Reading

Sections 15-21
Suggested Reading
Appendices
Part 2 - Required Reading

Sections 15-21
Suggested Reading
Appendices

Complete Practice Questions!

Physics in Nuclear Medicine
Simon R. Cherry
James A. Sorenson
Michael E. Phelps

The Essential Physics of Medical Imaging
Third Edition
Jerrold T. Bushberg
J. Anthony Seibert
Edwin M. Leidholdt, Jr.
John M. Boone

Boston Children’s Hospital
HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL
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# Part 3 Preparation

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<tr>
<td>Radiation protection</td>
<td>Internal dosimetry, including MIRD; fetal dose; units; personnel safety, including facility surveys and occupational dose limits; radiation protection principles; patient safety, including breastfeeding and pregnancy; shielding, including facility and personnel protection; regulations and regulatory bodies, including shipping and waste disposal; ALARA; time, distance, and shielding; and radiation surveys</td>
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## The Design and Delivery of the Oral Exam

The oral exam consists of 25 questions in five categories. Each candidate is examined by five examiners, each of whom asks one question in each of the five categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Examiner 1</th>
<th>Examiner 2</th>
<th>Examiner 3</th>
<th>Examiner 4</th>
<th>Examiner 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
<td>Cat 1 – Q 1</td>
<td>Cat 1 – Q 2</td>
<td>Cat 1 – Q 3</td>
<td>Cat 1 – Q 4</td>
<td>Cat 1 – Q 5</td>
</tr>
<tr>
<td>Category 2</td>
<td>Cat 2 – Q 1</td>
<td>Cat 2 – Q 2</td>
<td>Cat 2 – Q 3</td>
<td>Cat 2 – Q 4</td>
<td>Cat 2 – Q 5</td>
</tr>
<tr>
<td>Category 3</td>
<td>Cat 3 – Q 1</td>
<td>Cat 3 – Q 2</td>
<td>Cat 3 – Q 3</td>
<td>Cat 3 – Q 4</td>
<td>Cat 3 – Q 5</td>
</tr>
<tr>
<td>Category 4</td>
<td>Cat 4 – Q 1</td>
<td>Cat 4 – Q 2</td>
<td>Cat 4 – Q 3</td>
<td>Cat 4 – Q 4</td>
<td>Cat 4 – Q 5</td>
</tr>
<tr>
<td>Category 5</td>
<td>Cat 5 – Q 1</td>
<td>Cat 5 – Q 2</td>
<td>Cat 5 – Q 3</td>
<td>Cat 5 – Q 4</td>
<td>Cat 5 – Q 5</td>
</tr>
</tbody>
</table>
Part 3: 1 year out
Practice *Independently*

- Acceptance testing of new equipment
- Physics surveys
- Accreditation procedures, pass/fail criteria
- Technologist QC
- Radiation safety policies and procedures
### AAPM NUCLEAR MEDICINE REVIEW COURSE
ROOM 207D - ANAHEIM CONVENTION CENTER
COURSE DIRECTOR: THADDEUS WILSON

**Saturday, July 11**

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:15pm – 2:15pm</td>
<td>CT Technology &amp; Dosimetry</td>
<td>Frank Dong</td>
</tr>
<tr>
<td>2:15pm - 3:15pm</td>
<td>Radiation Shielding Design</td>
<td>Doug Simpkin</td>
</tr>
<tr>
<td>3:15pm - 3:30pm</td>
<td><strong>Afternoon Break</strong></td>
<td></td>
</tr>
<tr>
<td>3:30pm - 4:30pm</td>
<td>Hospital Radiation Protection</td>
<td>Doug Simpkin</td>
</tr>
<tr>
<td>4:30pm - 5:30pm</td>
<td>Patient and Fetal Dose</td>
<td>Stephanie Leon</td>
</tr>
<tr>
<td>7:00pm - 8:00pm</td>
<td>Radionuclides, Radiopharmaceuticals, Radiation Detection</td>
<td>Mark Madsen</td>
</tr>
<tr>
<td>8:00pm - 9:00pm</td>
<td>Gamma Camera Physics &amp; Technology</td>
<td>Sharon White</td>
</tr>
<tr>
<td>9:00pm - 10:00pm</td>
<td>PET/SPECT Physics &amp; Technology</td>
<td>Fred Fahey</td>
</tr>
</tbody>
</table>

**Dinner on your own**
Acceptance Testing

**NEMA NU 1**

**Performance Measurements of Gamma Cameras**

**NEMA NU 2-2007**

**Performance Measurements of Positron Emission Tomographs**
Acceptance Testing

Axial Sensitivity Profile

NEC Rate
# Acceptance Testing

<table>
<thead>
<tr>
<th>NEMA 2007 TESTS</th>
<th>RESULTS</th>
<th>ACCEPTANCE</th>
<th>Typical</th>
<th>Impression</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESOLUTION 256 x 256</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 cm transverse FWHM [cm]</td>
<td>4.6</td>
<td>≤ 6.5</td>
<td>5.9</td>
<td>PASS</td>
</tr>
<tr>
<td>1 cm axial FWHM [cm]</td>
<td>4.3</td>
<td>≤ 6.0</td>
<td>5.5</td>
<td>PASS</td>
</tr>
<tr>
<td>10 cm transverse FWHM [cm]</td>
<td>5.4</td>
<td>≤ 6.5</td>
<td>6.0</td>
<td>PASS</td>
</tr>
<tr>
<td>10 cm axial FWHM [cm]</td>
<td>5.6</td>
<td>≤ 6.5</td>
<td>6.0</td>
<td>PASS</td>
</tr>
<tr>
<td>RESOLUTION 400 x 400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 cm transverse FWHM [cm]</td>
<td>4.2</td>
<td>≤ 4.7</td>
<td>4.4</td>
<td>PASS</td>
</tr>
<tr>
<td>1 cm axial FWHM [cm]</td>
<td>4.2</td>
<td>≤ 4.8</td>
<td>4.5</td>
<td>PASS</td>
</tr>
<tr>
<td>10 cm transverse FWHM [cm]</td>
<td>4.8</td>
<td>≤ 5.2</td>
<td>4.9</td>
<td>PASS</td>
</tr>
<tr>
<td>10 cm axial FWHM [cm]</td>
<td>5.9</td>
<td>≤ 6.2</td>
<td>5.9</td>
<td>PASS</td>
</tr>
<tr>
<td>SENSITIVITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 cm [cps/MBq]</td>
<td>9806</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 cm [cps/MBq]</td>
<td>10065</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVERAGE Sensitivity</td>
<td>9935.5</td>
<td>≥ 8500</td>
<td>9500</td>
<td>PASS</td>
</tr>
<tr>
<td>SCATTER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scatter Fraction</td>
<td>34</td>
<td>≤ 40</td>
<td>≤ = 34</td>
<td>PASS</td>
</tr>
<tr>
<td>Peak true rate [kcps]</td>
<td>600 kcps @36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured &lt;=36 kBq/cc</td>
<td>544 kcps @27</td>
<td>500</td>
<td>550</td>
<td>PASS</td>
</tr>
<tr>
<td>Peak NEC rate [kcps]</td>
<td>181 kcps @27</td>
<td>&gt; =155</td>
<td>175</td>
<td>PASS</td>
</tr>
</tbody>
</table>

## ACCURACY

<table>
<thead>
<tr>
<th>Result</th>
<th>Mean bias</th>
<th>Count rate accuracy</th>
<th>Mean bias</th>
<th>Count rate accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;= +/-.5%</td>
<td>PASS</td>
<td>&lt;= +/-.4%</td>
<td>PASS</td>
</tr>
<tr>
<td></td>
<td>&lt;= +/-.6%</td>
<td>PASS</td>
<td>&lt;= +/-.5%</td>
<td>PASS</td>
</tr>
</tbody>
</table>
Nuclear Medicine Performance Tests – At Least Annually

1. Intrinsic Uniformity - Performed to ensure that the intrinsic detector integral and differential uniformity are sufficient to minimize the production of artifacts and ensure that patient abnormalities can be visualized without interference from the imaging system. These tests also monitor a scintillation unit for electronic problems and crystal deterioration (hydration).

2. System Uniformity - Performed to check all commonly used collimators for defects that might produce artifacts in planar and tomographic studies.

3. Intrinsic or System Spatial Resolution - Performed to ensure that the detector resolution is sufficient to provide satisfactory detection of lesions and delineate detail in clinical images.

4. Relative Sensitivity - Performed to verify that count rate per time between the two heads is within 5%.

5. Energy Resolution - Performed to verify that scatter rejection is sufficient to provide optimal contrast in clinical studies. Note: On some systems, energy resolution is very difficult to measure precisely.

6. Count Rate Parameters - Performed to ensure that the time to process an event is sufficient to maintain spatial resolution and uniformity in clinical images acquired at high count rates.

7. Formatter/Video Display - Performed to ensure that systems used to produce hard copy and monitors that are used for interpretation of clinical studies provide satisfactory image quality in terms of uniformity and spatial resolution.

8. Overall System Performance for SPECT Systems - Performed to quantitatively verify that SPECT systems provide satisfactory tomographic uniformity, contrast, and spatial resolution.

9. System Interlocks - Performed to verify that all system interlocks are operating as designed and that the system is safe and reliable for the nuclear medicine technologist to operate and for imaging patients.

10. Dose Calibrators - Performed annually to verify that readings from this instrument are accurate (accuracy test). All basic measurements of performance must be done at the time of installation and repeated after major repair. This test must be done according to protocols accepted by the appropriate state regulatory agencies or the NRC.

    - “Test” measurement of battery voltage (if applicable)
    - Zero adjustment (if applicable)
    - Background adjustment
    - Accuracy with NIST traceable standard

11. Thyroid Uptake and Counting Systems - Performed to verify energy calibration, energy linearity, energy resolution, sensitivity, and reliability (Chi-squared test) for the measurement of organ function and the assay of patient samples.

    - I-123 capsule or long-lived standard calibration check
    - Count of background
    - High voltage/gain checks
    - Energy resolution
    - Chi-square test

Boston Children's Hospital
Until every child is well

HARVARD MEDICAL SCHOOL TEACHING HOSPITAL
Physics Surveys
ACR Accreditation
## Technologist QC

<table>
<thead>
<tr>
<th>Test</th>
<th>Performed By</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Shutdown</td>
<td>Nuclear Medicine Technologist</td>
<td>Daily</td>
</tr>
<tr>
<td>CT Tube Warm-Up</td>
<td>Nuclear Medicine Technologist</td>
<td>Daily</td>
</tr>
<tr>
<td>CT Fast Calibrations</td>
<td>Nuclear Medicine Technologist</td>
<td>Daily</td>
</tr>
<tr>
<td>PET Daily QA</td>
<td>Nuclear Medicine Technologist</td>
<td>Daily</td>
</tr>
<tr>
<td>Update Gain</td>
<td>Nuclear Medicine Technologist</td>
<td>Weekly</td>
</tr>
<tr>
<td>CTC</td>
<td>Nuclear Medicine Technologist</td>
<td>Weekly</td>
</tr>
<tr>
<td>Well Counter</td>
<td>Nuclear Medicine Technologist</td>
<td>Monthly</td>
</tr>
<tr>
<td>System Back-Up</td>
<td>Nuclear Medicine Technologist</td>
<td>Monthly</td>
</tr>
<tr>
<td>Preventative Maintenance</td>
<td>Biomedical Engineering Staff</td>
<td>Bi-annually</td>
</tr>
<tr>
<td>Physicist Survey</td>
<td>Qualified Physicist</td>
<td>Quarterly/Annually*</td>
</tr>
</tbody>
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Radiation Safety Policies and Procedures

Radiation Safety and Guidelines

The Radiation Safety Program

Signs, Posting and Labeling

Transporting Radioactive Materials

To comply with local, state and federal regulations while transporting radioactivity, you must:

Radioactive Material Storage, Disposal and Security

To indicate that an item is radioactive, or that there is radioactive material used or stored in that area a "CAUTION RADIOACTIVE MATERIALS" sign must be posted. This includes:
- Doors to all areas where radioactive materials are used, stored, and/or handled;
- Refrigerators, centrifuges, incubators, hoods, sinks, and any other equipment in which radioactive materials is used or stored.
Part 3: 6 months out
Spend time with technologists!
Attend Resident Lectures

Joint Program in Nuclear Medicine
Tuesday Morning Clinical Conferences
April 21, 2015
Abrams Conference Room
Brigham & Women’s Hospital, L1

Topic:
“Hyperthyroidism”
Presenter:
Mark Mingos, M.D.
JPNM Resident
Shadow Radiologist

- Protocoling/Dosage
- Patient Communication
- Interpretation
Identify areas of Weakness

- e.g. Cardiac studies in a pediatric hospital
- Look to other hospitals
Part 3: 3 months out
Form a Study Group

- Devise schedule for required reading (e.g. books, TG reports, regulations)
- Meet weekly and Quiz Each Other on previous reading
- Ask difficult questions you can’t easily answer
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Part 3: Exam Day
Relax!

- Examiners want you to succeed
- Evaluating competency to practice independently
- Do not guess
- Explain reasoning
Thank You and Good Luck!