The path to assessing diagnostic workforce

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Objectives

1. Understand some challenges w/collecting data on practice of Dx medical physics

2. Understand AAPM’s future approach to characterizing diagnostic medical physics

3. Become familiar with pending AAPM diagnostic workforce report
My opinion

As a community, we DxMPs do a poor job communicating our value, and it is incredibly difficult to capture and quantify the value of many of the things we do via survey.

Our value goes beyond testing equipment.
Important to note

Michael Mills and Ed Nickoloff have spent hundreds and hundreds of hours on this work, in addition to the other and more recent volunteers on the subcommittee.

This is a massive challenge. If you have an easy solution, I’m all ears.
DWWSS, est. 2008

To measure the work associated with Diagnostic Medical Physics Procedures and estimate the workforce required to provide diagnostic physics services in the United States.

http://www.aapm.org/org/structure/default.asp?committee_code=DWWSS
Previous AAPM reports

1991 AAPM Report No. 33 of TG 5

1993 AAPM-ACMP Bilateral Recommendations on Physics Staffing for Diagnostic Radiology
“The AAPM recommendations for physics staffing are based on the type and amount of equipment in the radiology facility. However, the physics services extend far beyond the support of the listed equipment. The equipment merely serves as an index value for assessment of the needed physics staff.”
### AAPM Physics Staffing Recommendations

<table>
<thead>
<tr>
<th>Amount of Equipment</th>
<th>Staff Recommendations* For Physicists</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>I. Diagnostic X-ray</strong></td>
<td></td>
</tr>
<tr>
<td>For each mobile radiography unit</td>
<td>0.015 FTE</td>
</tr>
<tr>
<td>For each general x-ray room</td>
<td>0.015 FTE</td>
</tr>
<tr>
<td>For each mobile fluoroscope</td>
<td>0.03 FTE</td>
</tr>
<tr>
<td>For each R/F room</td>
<td>0.05 FTE</td>
</tr>
<tr>
<td>For each Special Procedures Room</td>
<td>0.08 FTE</td>
</tr>
<tr>
<td>For each digital system**</td>
<td>0.04 FTE</td>
</tr>
<tr>
<td>For each CT scanner</td>
<td>0.08 FTE</td>
</tr>
<tr>
<td><strong>II. In Nuclear Medicine</strong></td>
<td></td>
</tr>
<tr>
<td>For each scintillation camera</td>
<td>0.10 FTE</td>
</tr>
<tr>
<td>For each image processing computer</td>
<td>0.25 FTE</td>
</tr>
<tr>
<td>For each SPECT</td>
<td>0.25 FTE</td>
</tr>
<tr>
<td>For each PET</td>
<td>TBD***</td>
</tr>
<tr>
<td><strong>III. Ultrasound</strong></td>
<td></td>
</tr>
<tr>
<td>For each ultrasound scanner</td>
<td>0.015 FTE</td>
</tr>
<tr>
<td><strong>IV. MRI</strong></td>
<td></td>
</tr>
<tr>
<td>For each MRI</td>
<td>0.1 - 0.25 FTE</td>
</tr>
</tbody>
</table>

Recommended ratio of DxMPs : Support Staff 1:1.5
AAPM Report 33, Table 2

<table>
<thead>
<tr>
<th>Equipment</th>
<th>PTE's per Equipment</th>
<th>Recommended FTE Physicists</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 general x-ray rooms</td>
<td>0.015/room</td>
<td>0.225</td>
</tr>
<tr>
<td>4 RF rooms</td>
<td>0.05/room</td>
<td>0.20</td>
</tr>
<tr>
<td>3 special procedures rooms</td>
<td>0.08/room</td>
<td>0.24</td>
</tr>
<tr>
<td>2 digital systems</td>
<td>0.04/system</td>
<td>0.08</td>
</tr>
<tr>
<td>1 CT scanner</td>
<td>0.08/room</td>
<td>0.08</td>
</tr>
<tr>
<td>5 radiographic portable units</td>
<td>0.015/unit</td>
<td>0.075</td>
</tr>
<tr>
<td>2 portable fluoroscopic units</td>
<td>0.03/unit</td>
<td>0.06</td>
</tr>
<tr>
<td>2 nuclear medicine imagers</td>
<td>0.10/unit</td>
<td>0.20</td>
</tr>
<tr>
<td>1 image processing computer</td>
<td>0.25/unit</td>
<td>0.25</td>
</tr>
<tr>
<td>1 SPECT unit</td>
<td>0.25/unit</td>
<td>0.25</td>
</tr>
<tr>
<td>4 ultrasound units</td>
<td>0.015/unit</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Total..............................................1.72

400-600 bed hospital
AAPM Report 33, Table 2

400-600 bed hospital

**Practical Staffing:**

2.0 FTE Physicists and 2.6 (1.5 x 1.75) FTE Support Staff

The facility could hire 1 full-time physicist in x-ray with an additional 72% part-time physicist in Nuclear Medicine, Ultrasound and Radiation Safety operations. In practical terms, 2 physicists are appropriate. The appropriate physics support staff is 2.6 FTE's.

Things have changed since 1991. Report 33 has not been superseded.

**Total scope of example:**

- 22 x-ray rooms
- 1 CT
- 7 mobile x-ray
- 2 gamma cameras
- 1 SPECT
- 4 US
- 1 image processing computer
AAPM ACMP – Physics Staffing for Diagnostic Radiology – 1993

• Members of the Trilateral Task Force: AAPM, ACMP and ACR Commission on Physics
  • Edward Nickoloff (Chair)
  • Stewart Bushong (AAPM)
  • Charles Kelsey (AAPM)
  • James Kereiakes (ACR)
  • Mark Mishkin, MD (ACR)
  • Lawrence Rothenberg (ACMP)
  • Louis Wagner (AAPM)

• Contributing Consultants
  • James Deye
  • Thomas Payne
  • Ray Tanner

Slide courtesy of Michael Mills, PhD
Survey + consensus

• Survey distributed, responses from 52 institutions of mixed size

• Analysis studied by group of senior DxMPs and a physician

• Group consensus reached and recommendations published
TABLE 1. Simplified staff recommendations for diagnostic radiology\textsuperscript{(a)}

<table>
<thead>
<tr>
<th>Type of Diagnostic Equipment</th>
<th>Recommended Physicist Staff\textsuperscript{(b)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>x-ray\textsuperscript{(c)}</td>
<td>1 FTE/40 x-ray tubes\textsuperscript{(d)}</td>
</tr>
<tr>
<td>ultrasound</td>
<td>1 FTE/50 units</td>
</tr>
<tr>
<td>nuclear Medicine</td>
<td>1 FTE/8 imagers</td>
</tr>
</tbody>
</table>

\textsuperscript{(a)} The physics support staff is 1.5 FTE per physicist and includes QC technologists and radiation safety personnel, but it does not include x-ray servicemen.

\textsuperscript{(b)} This value is based upon routine clinical duties performed in diagnostic radiology facilities. It does not include staff for magnetic resonance, teaching, or research.

\textsuperscript{(c)} Includes radiographic, fluoroscopic, tomographic, mammographic, portables, and CT units.

\textsuperscript{(d)} One FTE is equivalent to one person working 230 8-hour days per year.

Note: No MR & no PET
Worksheet to Determine Recommended Physics Staffing for Diagnostic Radiology

FTE Physicists

# X-ray Tubes

FTE Physicists

# Ultrasound Units

FTE Physicists

# Nuclear Imagers

Subtotals

# FTE Physicists

Total # FTE Physicists

0.95

0.08

0.38

1.41
Thoughts on AAPM-ACMP

• Considerably simplified compared to Report 33
• Heroic effort to get agreement with all societies then representing the professional concerns DxMPs
• Ultimately endorsed by AAPM and ACMP but not ACR
• Remains most recent DxMP staffing document endorsed by AAPM
Keep in mind

“...largest financial investment in high technology equipment in the medical facility... experts who can ensure that the investment is fully realized in daily performance.” -AAPM Report No. 33

“The financial investment in equipment is enormous.” - Bilateral task force
What is the right question to ask?

• “How many diagnostic medical physicists does the U.S. need?”
• “How many diagnostic medical physicists (or how much physics support) does a given facility need?”
• “How much physics support does a given machine, facility, or operation require?”
Terminology

What does it mean to “support” a machine (CT scanner, MRI scanner, mammography unit, etc.)?
Terminology

• What are “basic” diagnostic medical physics services?

• What are “comprehensive” diagnostic medical physics services?
Practice environments

• What are the real natures of consulting and in-house physics support?

• What are the differences?

• What are the similarities?
Practice environments

• What do we do about “blended” models vs. pure consulting and pure in-house?

• How can we normalize or account for those differences with a model that does not force a facility (or a physicist) to be treated strictly as one or the other?
2012 manpower survey

Did not yield the coherent and decipherable data for which we had strived.
We don’t fit neatly into boxes

• % of time devoted to clinical service
• Practice subspecialty (x-ray, MR, NM, HP, therapy, etc.)
• % of time devoted to non-clinical activities (education, administration, AAPM, etc.)
• Nature of the clinical support provided (perform QC, supervise technologists, P&P, etc.)
• Regulatory environment & impact on time spent per unit

Slide courtesy of Michael Mills, PhD
Committee members’ perspectives

• Multiple committee members have recent, deep experience in both in-house and consulting
  • 5-7 years in consulting and 3-5 years in-house, back-to-back, at start of this effort

• Committee has mix of members currently working in both consulting and in-house roles
  • Mix of settings
  • In-house are academic and non-academic
  • Consulting members have special projects and consulting services in addition routine equipment evaluation and accreditation work
  • In-house members support both single large facilities and health system networks
Future approach

• Levels of Service (LoS) model

• Get us all on the same page wrt characterizing our work (via published report)

• Survey (using new LoS taxonomy & terminology)

• Follow-up report
Levels of Service

• Level 1
• Level 2
• Level 3
• Level 0
Level 1

• Required services, or de facto requirements
• Well-defined
• Relatively high degree of agreement on procedures, time, effort

...EPEs
Level 2

- Well-described
- Frequently the responsibility of a medical physicist*
- Carried out according to published methods, procedures, standards
- Includes mandatory and non-mandatory svcs

... FGI safety program a la NCRP 168 ... RSO

*Not exclusively carried out by medical physicists
Level 3

• Not well-defined
• Not mandatory outside institution
• Broadly: research or developmental activities

... testing new tools & techniques, basic science, clinical research
Level 0

• Essential activities
• Cost of making medical physics services available
• Perhaps negotiable, perhaps necessary

... getting CE, calibrating instruments, maintaining certifications & licenses, operations & personnel mgmt
Neat.

• How does this help?

• Consensus+ on Level 1 times for each modality
  • Deliverable for AAPM membership
  • Transparency with membership

• Allows us to ask better questions... USEFUL DATA
Diagnostic Medical Physicists and Their Clinical Activities

Yasmin S. Cypel, PhD\textsuperscript{a}, Jonathan H. Sunshine, PhD\textsuperscript{a,b}

**Purpose:** The primary objective of this study was to obtain basic, descriptive information about medical physicists involved in diagnostic radiology-related activities, the diagnostic-related activities that they performed, and the time spent on these activities.

**Methods:** A survey was sent to a randomly selected sample of 1511 medical physicists from July through October 2001 using primarily e-mail methods; a total of 851 surveys was received, for a response rate of 56%. Of these, 427 were responses from physicists who do partly or only clinical diagnostic medical physics; it is this group for which results are presented.

**Results:** Fifty-four percent of the physicists who reported doing any clinical diagnostic medical physics performed clinical activities only in diagnostic medical physics. Fourteen percent of all those doing clinical diagnostic medical physics were women. Over 97% of the physicists doing clinical diagnostic medical physics reported having graduate degrees in physics; 53% had PhDs. The mean total weekly hours worked by physicists doing clinical diagnostic medical physics was 42. Medical physicists doing only clinical diagnostic activities reported working approximately 40 hours weekly, whereas those doing partly clinical diagnostic medical physics reported working 14 hours weekly in the field (approximately one-third of their work time). Radiography and fluoroscopy, computed tomography, nuclear medicine, and mammography are all fields in which the majority of those doing any clinical diagnostic medical physics are active. Full-time physicists...
Sunshine survey (2001)

- Random selection of AAPM membership
- 1511 initially
- 56% response
- 50% of those “do partly or only diagnostic medical physics”
- ... N = 427
- ~40 question multiple choice
- 12 month lookback
Partly vs. only

46% only

54% partly

Who is speaking for us?
“Only Dx” respondents

13% reported being in private practice
Respondent profile

• 40-50 hours per week

• All modalities

• Lower % for US & MR

• Holds for partly and only Dx
Stats

Median # units “responsible for”
- Only = 25 (mean = 85, 25\textsuperscript{th}-75\textsuperscript{th} = 2-100)
- Partly = 10 (mean = 41, 25\textsuperscript{th}-75\textsuperscript{th} = 3-50)

Work at two facilities

Overall median # units “evaluated”
- 57 (mean = 113, 25\textsuperscript{th}-75\textsuperscript{th} = 9-148)
Definition lacking

Responsible for

vs.

Evaluated or consulted on
### Table 3. Computed tomography (CT) and other x-ray clinical activities performed in past 12 months, by level of involvement in clinical diagnostic medical physics (DMP)

<table>
<thead>
<tr>
<th>Type of Unit and Physicist Work Pattern</th>
<th>Number of Units</th>
<th>Frequency of Evaluation (%)</th>
<th>Hours/Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Evaluated/Image Consultation</td>
<td>50th</td>
<td>25th (Median)</td>
</tr>
<tr>
<td>Breast Imaging: mammography tubes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part DMP</td>
<td>118</td>
<td>12 (1.3)</td>
<td>1</td>
</tr>
<tr>
<td>DMP only</td>
<td>145</td>
<td>16 (2.1)</td>
<td>3</td>
</tr>
<tr>
<td>Breast Imaging: stereotactic breast biopsy tubes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part DMP</td>
<td>93</td>
<td>2 (0.3)</td>
<td>0</td>
</tr>
<tr>
<td>DMP only</td>
<td>128</td>
<td>2 (0.2)</td>
<td>0</td>
</tr>
<tr>
<td>CT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part DMP</td>
<td>124</td>
<td>5 (0.5)</td>
<td>1</td>
</tr>
<tr>
<td>DMP only</td>
<td>150</td>
<td>7 (1.0)</td>
<td>1</td>
</tr>
<tr>
<td>Radiographic tubes (excluding portables)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part DMP</td>
<td>119</td>
<td>42 (5.5)</td>
<td>5</td>
</tr>
<tr>
<td>DMP only</td>
<td>144</td>
<td>70 (7.7)</td>
<td>5</td>
</tr>
<tr>
<td>Radiographic tubes (portables only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part DMP</td>
<td>116</td>
<td>13 (1.6)</td>
<td>1</td>
</tr>
<tr>
<td>DMP only</td>
<td>137</td>
<td>19 (2.4)</td>
<td>2</td>
</tr>
<tr>
<td>CR-DR systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part DMP</td>
<td>89</td>
<td>2 (0.5)</td>
<td>0</td>
</tr>
<tr>
<td>DMP only</td>
<td>113</td>
<td>3 (0.7)</td>
<td>0</td>
</tr>
<tr>
<td>Fluoroscopic tubes (excluding portable C-arms)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part DMP</td>
<td>120</td>
<td>18 (2.9)</td>
<td>2</td>
</tr>
<tr>
<td>DMP only</td>
<td>137</td>
<td>25 (3.1)</td>
<td>4</td>
</tr>
</tbody>
</table>
Interesting question(s)

Do the large number and, more particularly, broad range of equipment units for which the typical diagnostic medical physicist is responsible create strains, and do physicists feel that the quality of their work is unduly challenged thereby?

Cypel & Sunshine, JACR 2004
### Table 1 – Typical times for Level 1 Equipment Performance Evaluations (EPEs) (Travel not included)

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Hours per EPE</th>
<th>Modifier</th>
<th>Total hours per year for Level 1 services only</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQSA physics survey, S/F</td>
<td>Annual MQSA physics services for analog (screen-film) mammography systems. Includes hands-on survey time, QC program review, and report preparation**.</td>
<td>6.0</td>
<td>1.3</td>
<td>7.8</td>
</tr>
<tr>
<td>MQSA physics survey, DR only, no DBT*</td>
<td>Annual MQSA physics services for DR systems. Includes hands-on survey time, QC program review, printer and one primary RWS (review workstation) evaluation, and report preparation**.</td>
<td>5.0</td>
<td>1.3</td>
<td>6.5</td>
</tr>
<tr>
<td>MQSA physics survey, DR*</td>
<td>Annual MQSA physics services for digital breast tomosynthesis (DBT) systems. Includes hands-on survey time, QC program review, printer and one primary RWS (review workstation) evaluation, and report preparation**.</td>
<td>8.0</td>
<td>2.0</td>
<td>16</td>
</tr>
</tbody>
</table>
DxMP could cover ~6-7 of these facilities...

LEVEL 1 ONLY

<table>
<thead>
<tr>
<th>Equipment</th>
<th>#</th>
<th>Level 1 EPE hrs/yr per unit</th>
<th>Total hrs/yr for Level 1 EPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>5</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>Radiographic</td>
<td>15</td>
<td>2.2</td>
<td>33</td>
</tr>
<tr>
<td>Table-tower and Mobile Fluoroscopy</td>
<td>15</td>
<td>3.3</td>
<td>49.5</td>
</tr>
<tr>
<td>Angiography / FGI</td>
<td>5</td>
<td>7.8</td>
<td>39</td>
</tr>
<tr>
<td>Ultrasound (3 transducers per unit)</td>
<td>6</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Transducers</td>
<td>18</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mammography</td>
<td>4</td>
<td>6.5</td>
<td>26</td>
</tr>
<tr>
<td>Stereotactic Breast Biopsy</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SPECT</td>
<td>2</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>PET-CT</td>
<td>1</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>MRI</td>
<td>2</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Radiologist Workstation</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Minimal threat device(s) (e.g., DEXA or dental)</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>246.5</td>
</tr>
</tbody>
</table>
Current status

• Wrote a report (~25 pages) in 2015...
• Internal review conducted and comments addressed
• Public review conducted and comments addressed
• Professional Council approved
• EXCOM ... approved?

• Deciding on best publication path
Two major questions face medical physicists at the moment: How do we define our role in supporting the medical imaging community, and will we have an adequate workforce to meet the need? The way these questions are answered will have far-reaching effects.

The need for medical imaging physics support has increased dramatically in recent years. The growth in medical physicists to review procedures that are likely to involve significant skin irradiation. Physicians performing fluoroscopically-guided interventional procedures will have to receive radiation safety education by May 2015, potentially adding more to local physicists' workloads. At least a half dozen other states have recently enacted similar rules. Recommendations along the same lines
Two major questions

“How do we define our role in supporting the medical imaging community, and will we have an adequate workforce to meet the need?”

Geise, JACR, online Dec. 2014
Challenge

“Like radiologists, [Dx] medical physicists need to decide if it is time to switch to a role that is based on value or stay with one in which their worth is based on volume.”

Geise, JACR, online Dec. 2014
Objectives Summary

1. Understand learned some challenges with collecting data on practice of Dx medical physics

2. Understand learned AAPM’s future approach to characterizing diagnostic medical physics

3. Become familiar with pending AAPM diagnostic workforce report
Answer the call