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.

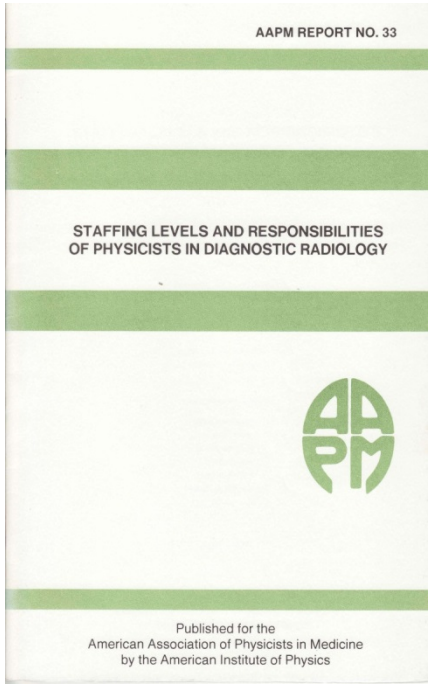
DWWSS, est. 2008

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

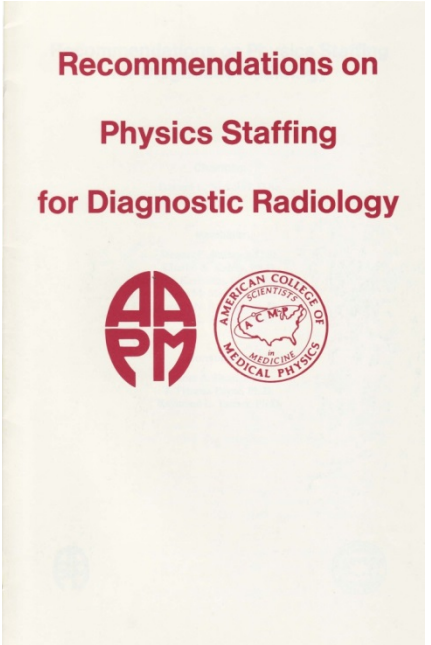
http://www.aapm.org/org/structure/default.asp?committee_code=DWWSS

Previous AAPM reports

1991 AAPM Report No. 33 of TG 5



1993 AAPM-ACMP Bilateral Recommendations on Physics Staffing for Diagnostic Radiology



AAPM Report 33 excerpt

"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 Report 33, Table 1

AAPM Physics Staffing Recommendations

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

Recommended ratio of DxMPs : Support Staff

1 : 1.5

AAPM Report 33, Table 2

400-600 bed hospital

Equipment	FTE's per Equipment	Recommended FTE Physicists
15 general x-ray rooms	0.015/room	0.225
4 RF rooms	0.05/room	0.20
3 special procedures rooms	0.08/room	0.24
2 digital systems	0.04/system	0.08
1 CT scanner	0.08/room	0.08
5 radiographic portable units	0.015/unit	0.075
2 portable fluoro-scopic units	0.03/unit	0.06
2 nuclear medicine imagers	0.10/unit	0.20
1 image processing computer	0.25/unit	0.25
1 SPECT unit	0.25/unit	0.25
4 ultrasound units	0.015/unit	0.06
Total		1.72

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

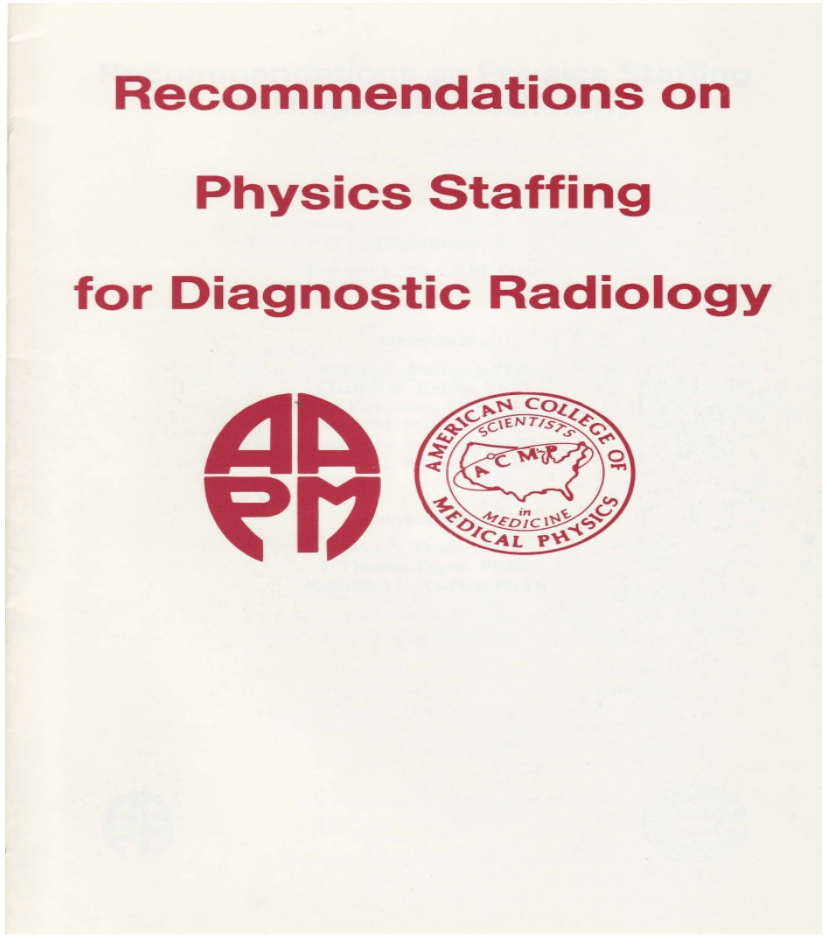
The facility could hire 1 full-time physicist in x-ray with an additional 72% part-time physicist in Nuclear Medicine, Ultrasound and Radiation Safety operations. In practical terms, 2 physicists are appropriate. The appropriate physics support staff is 2.6 FTE's.

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[a]

Type of Diagnostic Equipment	Recommended Physicist Staff[b]
x-ray[c]	1 FTE/40 x-ray tubes[d]
ultrasound	1 FTE/50 units
nuclear Medicine	1 FTE/8 imagers

(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.*

(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.*

(c) *Includes radiographic, fluoroscopic, tomographic, mammographic, portables, and CT units.*

(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

Subtotals
FTE Physicists

FTE Physicists

0 0.5 1.0 1.5 2.0 2.5 3.0

X-ray Tubes

0 10 20 30 [38] 40 50 60 70 80 90 100 110 120

= 0.95

FTE Physicists

0 0.10 0.20 0.30 0.40 0.50 0.60

Ultrasound Units

0 [4] 5 10 15 20 25 30

= 0.08

FTE Physicists

0 0.50 1.00 1.50

Nuclear Imagers

0 1 2 [3] 4 5 6 7 8 9 10 11 12

= 0.38

Total # FTE Physicists = 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

Slide courtesy of Michael Mills, PhD

1995, 2003, 2008, 2015 Abt reports for radiation oncology physics services

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*

"Diagnostic Workforce Study"

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 o

- 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

"Sunshine report"

Diagnostic Medical Physicists and Their Clinical Activities

Yasmin S. Cypel, PhD[a], Jonathan H. Sunshine, PhD[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

J Am Coll Radiol 2004;1:120-126.

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, 25th-75th = 2-100)
- Partly = 10 (mean = 41, 25th-75th = 3-50)

Work at two facilities

Overall median # units "evaluated"

- 57 (mean = 113, 25th-7th = 9-148)

Definition lacking

Responsible for

vs.

Evaluated or consulted on

Hours per survey

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)

Type of Unit and Physicist Work Pattern	Number of Units Evaluated/Image Consultation					Frequency of Evaluation (%)							Hours/Evaluation				
			Percentile												Percentile		
	n	Mean (SE)	25th	50th (Median)	75th	n	M	Q	S	A	B	Acc	n	Mean (SE)	25th	50th (Median)	75th
Breast imaging: mammography tubes																	
Part DMP	118	12 (1.3)	1	6	16	90	0	3	9	87	0	1	89	7 (0.7)	5	6	8
DMP only	145	16 (2.1)	3	7	15	113	1	3	10	87	0	0	113	8 (0.5)	5	7	10
Breast imaging: stereotactic breast biopsy tubes																	
Part DMP	93	2 (0.3)	0	1	2	67	0	0	7	90	0	3	64	7 (0.6)	4	5	8
DMP only	128	2 (0.2)	0	1	2	95	0	1	4	94	1	0	93	6 (0.3)	4	6	7
CT																	
Part DMP	124	5 (0.5)	1	3	6	97	4	5	8	76	2	4	93	6 (0.7)	2	4	6
DMP only	150	7 (1.0)	1	4	7	115	6	3	15	72	1	3	108	6 (0.5)	3	4	6
Radiographic tubes (excluding portables)																	
Part DMP	119	42 (5.5)	5	25	51	105	1	4	10	84	1	1	102	3 (0.2)	2	2	3
DMP only	144	70 (7.7)	5	42	89	113	0	9	11	77	1	3	108	3 (0.4)	1	2	4
Radiographic tubes (portables only)																	
Part DMP	116	13 (1.6)	1	8	15	90	0	6	4	90	0	0	89	2 (0.1)	1	2	2
DMP only	137	19 (2.4)	2	10	20	105	0	6	11	83	0	0	104	2 (0.2)	1	2	2
CR-DR systems																	
Part DMP	89	2 (0.5)	0	0	2	40	3	5	8	80	0	5	40	6 (1.0)	2	4	6
DMP only	113	3 (0.7)	0	1	5	63	6	11	10	63	0	10	61	7 (1.5)	2	3	7
Fluoroscopic tubes (excluding portable C-arms)																	
Part DMP	120	18 (2.9)	2	9	20	106	1	4	8	86	0	1	104	3 (0.2)	2	2	3
DMP only	137	25 (3.1)	4	15	30	112	1	12	14	71	1	1	109	3 (0.3)	2	2	4
Portable C-arms																	

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

Appendix 1, Table 1

768 **Table 1 – Typical times for Level 1 Equipment Performance Evaluations (EPEs)**
769 **(Travel not included)**
770

Task	Description	Hours per EPE	Modifier	Total hours per year for Level 1 services *only*
MQSA physics survey, S/F	Annual MQSA physics services for analog (screen-film) mammography systems. Includes hands-on survey time, QC program review, and report preparation**.	6.0	1.3	7.8
MQSA physics survey, DR only, no DBT*	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**.	5.0	1.3	6.5
MQSA physics survey, DR*	Annual MQSA physics services for digital breast tomosynthesis (DBT) systems. Includes hands-on survey time, QC program review, printer and one	8.0	2.0	16

Appendix 1, cont'd

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

DxMP could cover ~6-7 of these facilities

…LEVEL 1 ONLY

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

Problem statement

THE MEDICAL PHYSICS CONSULT

MAHADEVAPPA MAHESH, MS, PhD, RICHARD L. MORIN, PhD

Medical Physics at the Crossroads

Richard A. Geise, PhD

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

increased by about 40% over the same period [3].

Attention to the performance of imaging systems is also increasing. According to ACR accreditation program data, the number of advanced imaging systems accredited by the ACR has grown at average rates of 5% per year for MR scanners and 10% per year for CT, PET, and SPECT. The ACR's accredi-

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

JACR, online Dec. 2014:

http://dx.doi.org/10.1016/j.jacr.2014.10.022

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 w/ collecting data on practice of Dx medical physics

2. ~~Understand~~ Learned AAPM's future approach to characterizing diagnostic medical physics

3. ~~Become~~ Became familiar with pending AAPM diagnostic workforce report

Answer the call