The path to assessing diagnostic physics* workforce

**including nuclear medicine*

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Objectives

1. Understand challenges of collecting data on diagnostic medical physics practice
2. Understand AAPM's future approach to characterizing diagnostic medical physics
3. Become familiar with AAPM Report 301's updated description of diagnostic workforce

DWWSS, est. 2008

Charge:

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

"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?"

Overview of prior work to date

Several efforts have quantified diagnostic workforce needs over time

Another update due, and field has changed

These inform our approach and provide reference data

Past assessments

- AAPM Report No. 33 (1991)
- AAPM-ACMP Recommendations on Physics Staffing for Diagnostic Radiology (1993)
- Sunshine Report, JACR (2004)
- AAPM Dx Workforce and Manpower Survey (2012)

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

AAPM Report 33

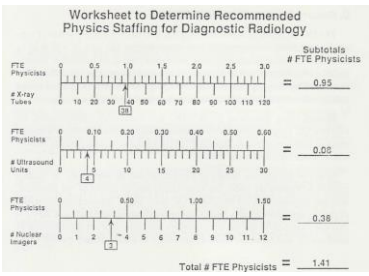
AAPM Physics Staffing Recommendations

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	0.03 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	0.18 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-ACMP Recommendations



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
- Remained most recent (1993) DxMP staffing document endorsed by AAPM until May 2017

Slide courtesy of Michael Mills, PhD

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

"Sunshine report" (2004)

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 surveyed ca. 2001 regarding past 12 months' work
- 56% response
- 50% of those "do partly or only diagnostic medical physics"
  - 46% of these "only"
  - 54% of these "partly"
- 13% of "only diagnostic" respondents in private practice

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	98	7	0	1	89	7 (0.7)	5	6	8
DMP only	145	16 (2.1)	3	7	15	113	1	3	108	7	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	79	0	0	3	64	7 (0.6)	4	5	8
DMP only	128	2 (0.2)	0	1	2	95	0	1	49	4	1	0	93	6 (0.3)	4	6	7
CT																	
Part DMP	124	5 (0.5)	1	3	6	97	4	5	87	6	2	4	93	6 (0.7)	2	4	6
DMP only	150	7 (1.0)	1	4	7	115	6	3	157	2	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	108	4	1	1	102	3 (0.2)	2	2	3
DMP only	144	70 (7.7)	5	42	89	113	0	9	117	7	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	49	0	0	0	89	2 (0.1)	1	2	2
DMP only	137	19 (2.4)	2	10	20	105	0	6	118	3	0	0	104	2 (0.2)	1	2	2
CR-DR systems																	
Part DMP	89	2 (0.5)	0	0	2	40	3	5	88	0	2	5	40	6 (1.0)	2	4	6
DMP only	113	3 (0.7)	0	1	5	63	6	11	106	3	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	88	6	0	1	104	3 (0.2)	2	2	3
DMP only	137	25 (3.1)	4	15	30	112	1	12	147	1	1	1	109	3 (0.3)	2	2	4

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

2012 AAPM Dx manpower survey

Analysis of collected data suggested conclusions markedly inconsistent with known realities of practice.

Results could not be summarized in a useful form and published.

(Aside: Therapy Physics Workforce)

AAPM hired Abt Associates to design and run surveys (1995, 2003, 2008, 2015)

AAPM developed staffing models from data

Other models (ACR, ASTRO) use different inputs (patients vs. procedures vs. machines, etc.)

Lessons Learned I: What to Do

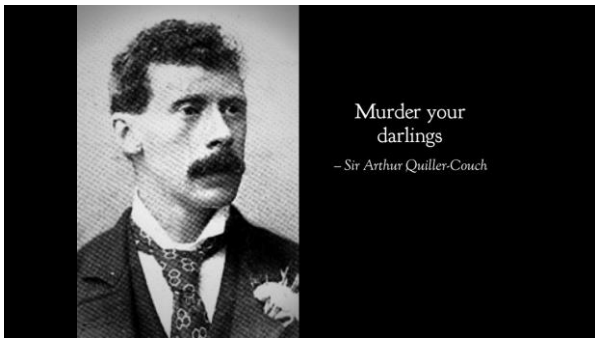
AAPM Report 33: cautioned there's more to Dx physics work than equipment inventory

AAPM-ACMP blended survey response data with consensus of committee – cross-section of veteran Dx medical physicists

Lessons Learned I: What to Do

All of these* collected data from actual medical physicists doing Dx work

AAPM 2012 survey group assembled a dedicated, hard-working, passionate team of volunteers (we assume the others did too)



DWWSS members' perspectives

- Veteran Dx MP who do mostly or all clinical work
- In-house academic, in-house community, and consulting members
- Some members have significant experience in two or more settings
- In-house members from both individual hospitals and health system networks
- Consulting members have special projects and consulting services in addition to routine equipment evaluation and accreditation work for clients of all sizes

Lessons Learned II: What to Change

Categorizing the respondent by practice setting (consultant, in-house, academic, community, etc.):

- useful for *demographics* to validate respondent population
- appears to confound the *data*

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

Terminology

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

...or to "cover" one?
...or to "be responsible for"?
...or to "consult on"?

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 / similarities?
- Are all facilities strictly "academic" or "not"?

Practice environments

- What do we do about "blended" models vs. pure consulting and pure in-house?
- Can we account for differences using a model that does not force a facility (or a physicist) to be treated strictly as one or the other?

Remember Report 33? (1991)

Need to let go of trying to get single authoritative answer from the equipment inventory …

"… 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)

New Framework: Levels of Service

- DWWSS developed the Levels of Service (LoS) model
- Attempts to describe and classify DxMP work without relying on traditional practice model or environment categories
- Published in AAPM Report 301 (May 2017)

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 more granular, specific questions

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

Validation Needed

- Report 301, Table 1 is an *anecdotal consensus*
- Agrees well with Cypel & Sunshine (2004)
- Cypel & Sunshine collected real data from large # of working physicists – respondent caveats apply
- Mills, Nickoloff, et al. in 2012 collected real data from large # of working physicists

Validation Example & LoS:

- 1 Large Hospital:
  - 6 MRI
  - 3 PET-CT
  - 6 CT
  - 5 NM cameras
  - 7 X-ray rooms
  - 4 R&F rooms
  - 23 C-arms
  - 2 special procedures fluoro
  - 8 single-plane angio/cath
  - 3 biplane angio/cath
  - 16 portable X-ray
  - 3 digital mammography
  - 1 stereo biopsy
  - 2 bone density
  - 6 dental
  - 4 mammography workstations
  - 35 diagnostic workstations

How many physicists?

- Add up testing hours:
  - Approx. 260 hours for annual testing
  - 35 person-days per year
  - (Round up to 8 weeks)
- Implies:
  - 1 person for ~2 months
  - 1 FTE could serve 4-5 similar facilities

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Actual staffing?

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Actual staffing?

1 Senior Diagnostic MP, 2 Junior Diagnostic MP (also 1 full-time RSO and 1 ARSO)

Current status

- AAPM Report 301 published in May 2017
- "An Updated Description of the Professional Practice of Diagnostic and Imaging Medical Physics"
- Formalizes the LoS model / definitions
- Describes common duties of DxMP's
- Tabulates consensus values for time required for Level 1 EPE's

Next steps for DWWSS

- Considering data sources and collection approaches
- Requested budget to hire experts to design and conduct one (or more) surveys for AAPM
- Validate Level 1 EPE times from Report 301
- Quantify Level 2 work actually being done
- Assess time being spent on Level 3 work
- Estimate demand/market size via state X-ray lists, ACR totals, etc.

Challenges Ahead

Pathway into the workforce

- ABR certification via CAMPEP residency
- Shortage of diagnostic residency programs and slots
- What role can/will DMP programs play?

- A robust workforce needs assessment should help motivate and justify solutions at national level
  - E.g. AAPM-RSNA-SNMMI program startup grants

Medical Physics Assistants

- MPA role in Dx MP is emerging and evolving

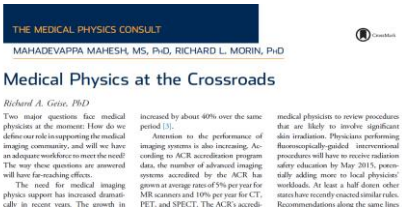
- What will be their impact on supply and demand?

- Answer likely to evolve over shorter vs. longer term

Rapid changes in field

- Coming changes in healthcare economics
- Medical Physics 3.0 driving expansion in ways difficult to foretell in detail
- New & expanding Joint Commission, regulatory requirements
- Want model for extrapolation, not "snapshot"
- Theme/trend: $\frac{d^2C}{dt^2} > 0$

Value amidst healthcare chaos



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 alone 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

Medical Physics Value Proposition

- DxMP community often does not communicate its value well
- Difficult to capture, quantify value of much of what we do via questionnaires.

Our value reaches <u>far</u> beyond testing equipment.

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 challenges of collecting data on diagnostic medical physics practice
2. ~~Understand~~ Learned AAPM's future approach to characterizing diagnostic medical physics
3. ~~Become~~ Became familiar with AAPM Report 301's updated description of diagnostic workforce

Answer the call