Diagnostic medical physics* workforce

**including nuclear medicine*

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"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

Another update due; field has changed

These inform our current 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)

AAPM Report 33

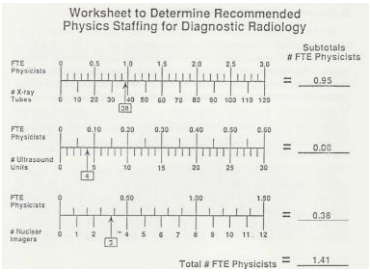
AAPM Physics Staffing Recommendations

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	0.05 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	0.18 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



"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 those 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		Percentile 50th (Median)	Percentile 75th	Frequency of Evaluation (%)						Hours/Evaluation		Percentile 50th (Median)	Percentile 75th
	n	Mean (SE)	25th		n	M	Q	S	A	B Acc	n	Mean (SE)	25th	
Breast imaging: mammography tubes														
Part DMP	118	12 (1.3)	1	6	16	90	0	3	9	8 7 0	1	89 7 (0.7)	5	6 8
DMP only	145	16 (2.1)	3	7	15	113	1	3	10	8 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	7	9 0 0	3	64 7 (0.6)	4	5 8
DMP only	128	2 (0.2)	0	1	2	95	0	1	4	9 4 1	0	93 6 (0.3)	4	6 7
CT														
Part DMP	124	5 (0.5)	1	3	6	97	4	5	8	7 6 2	4	93 6 (0.7)	2	4 6
DMP only	150	7 (1.0)	1	4	7	115	6	3	15	7 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	10	8 4 1	1	102 3 (0.2)	2	2 3
DMP only	144	70 (7.7)	5	42	89	113	0	9	11	7 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	4	9 0 0	0	89 2 (0.1)	1	2 2
DMP only	137	19 (2.4)	2	10	20	105	0	6	11	8 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	8	8 0 0	5	40 6 (1.0)	2	4 6
DMP only	113	3 (0.7)	0	1	5	63	6	11	10	6 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	8	8 6 0	1	104 3 (0.2)	2	2 3
DMP only	137	25 (3.1)	4	15	30	112	1	12	14	7 1 1	1	109 3 (0.3)	2	2 4

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.

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

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

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"?
- Many of us practice in a blended model

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 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

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 data from large # of working physicists

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
- Describes common duties of DxMP's
- Tabulates consensus values for time required for Level 1 EPE's
- SHORT SURVEY IMMINENT

Next steps for DWWSS

- Considering data sources and collection approaches
- Submitted grant application & trying to budget within 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"
- Trend: $\frac{d^2C}{dt^2} > 0$

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 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

Thank you