Estimating the size of the clinical medical imaging physics workforce

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Disclosures

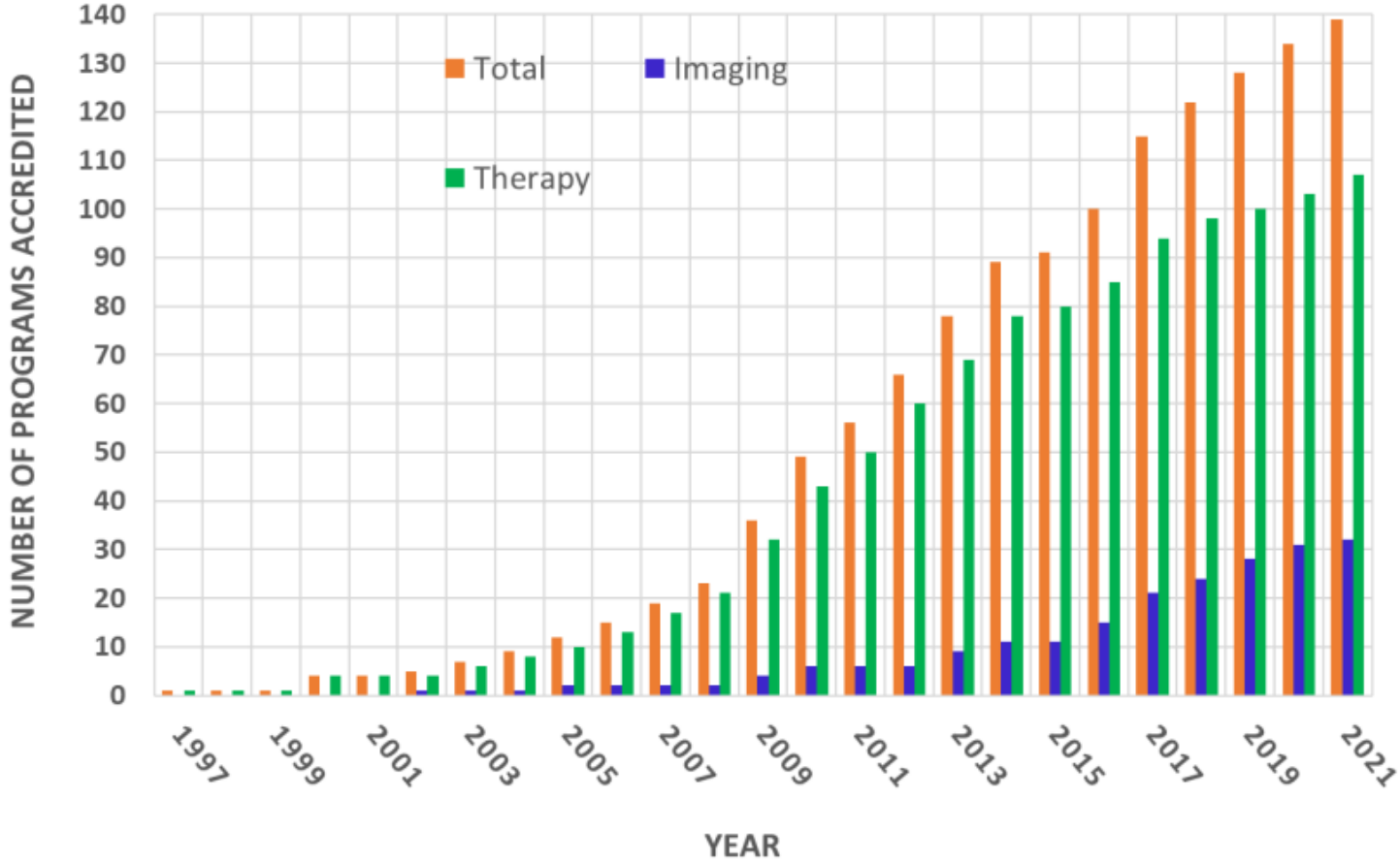
- Author has a patent “Apparatus for Tomography Repeat Rate/Reject Capture”
- Author receives research funding from Imalogix LLC

Outline

- Motivation and background
- Previous efforts
  - 2009 SUNY Albany CHWS Workforce Study
  - 2015 AAPM/SNMMI Joint Task Force on Nuclear Medicine Physics Training
- Current efforts of the DDSPWG

How many imaging physics residency programs do we need?

As of 3/24/2022, I count 38 accredited programs on the CAMPEP website. 12 of these also offer nuclear medicine option.



Dogan N. *CAMPEP Residency Program Report*. AAPM Annual Meeting; 2021. Available at https://www.sdampp.org/resources.php. Accessed March 24, 2022.

How many imaging physics residency programs do we need?

Residents admitted

Specialty	2019	2020
Therapy	149	147
Imaging	27	42

Total residents

Total # of Residents	2019	2020
Therapy	339	338
Imaging	64	73
Nuclear Medicine	5	11
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TOTAL	**408**	**422**

Dogan N. *CAMPEP Residency Program Report*. AAPM Annual Meeting; 2021. Available at https://www.sdampp.org/resources.php. Accessed March 24, 2022.

How long do AAPM/RSNA need to keep funding new imaging residency slots?

2022 AAPM / RSNA Imaging Physics Residency Grant:

The purpose of the AAPM funding is to provide 50% support of a resident's salary for two imaging physics residency programs. The awardee institution(s) will provide the other 50% support. After the period of the award is over, the intent is that the awardee institution(s) will continue to fully support this new imaging physics residency position. Demonstration of this intent should be included in the application materials.

History:
On November 29, 2017, the AAPM Board of Directors approved $140,000 in funding for two new imaging physics residency positions, in diagnostic, diagnostic with a nuclear medicine option, or nuclear medicine. With this funding, the selected institution(s) will receive $35,000 per year for two years as matching support for one resident.

The AAPM Board of Directors has approved $420,000 in support over 6-years ($70,000/year starting in 2019) to fund six spots in existing or new imaging residency programs. The RSNA Board of Directors approved $210,000 in funding for 3 additional slots in existing or new imaging residency programs.

AAPM. *Grants and Fellowships*. Available at https://gaf.aapm.org/. Accessed March 24, 2022.

How do we answer these questions?

- We need to know how many of us are needed
  - Demand
- We need to know how many of us there are
  - Supply
- Need to know additional details about each, for example…
  - What factors drive demand? Equipment? Regulations? Utilization?
  - Are there surrogates we can use to predict demand?
  - How many people to we need to train each year to maintain the size of our current workforce?

The DDSPWG

- Board of Directors
  - Professional Council [Status]
    - Workforce Assessment Cmte [Status]
      - Diagnostic Workforce SC [Status]
        - **Diagnostic Demand and Supply Projection Working Group** [Status]

Diagnostic Demand and Supply Projection Working Group (DDSPWG)

- bookmark this page (bookmarks show under "My AAPM" in the menu to left)

Committee Website | **Directory:** Committee | Membership

Email You may send email to this group now using gmail or outlook.
- or -
You may save the address *2022.DDSPWG@aapm.org*
to your local address book. This alias updates hourly from the AAPM Directory.

Charge The Diagnostic Demand and Supply Projection Working Group shall use collected data and appropriate analysis techniques to project the demand and supply for clinical and non-clinical Imaging Physicists. In addition to clinical imaging physicists, this effort will also apply to Medical Health Physicists, Medical Physicists in Industry or Regulatory roles, and Academic Medical Physicists involved with Imaging Physics. The DDSPWG will continuously develop and maintain computer models that support its mission. The DDSPWG will confer with any official representatives from other councils or committees during the development process.

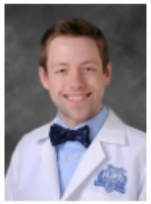
By-Laws: Not Referenced. **Rules:** Not Referenced.

AAPM. *AAPM Committee Tree: Diagnostic Demand and Supply Projection Working Group*. Available at https://www.aapm.org/org/structure/default.asp?committee_code=DDSPWG. Accessed March 24, 2022.

The DDSPWG (as of 3/24/2022)

VOTING Appointments

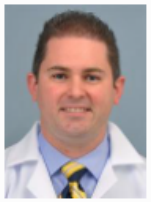
There are 6 voting members.



Nicholas B. Bevins, PhD
nickb@rad.hfh.edu
1/1/2019 - 12/31/2024 Member

Jaydev K. Dave, PhD
jaydev.dave@jefferson.edu
1/1/2019 - 12/31/2024 Member

David E. Hintenlang, PhD
David.Hintenlang@osumc.edu
1/1/2019 - 12/31/2024 Member



David W. Jordan, PhD
david.jordan@uhhospitals.org
1/1/2019 - 12/31/2024 Workgroup Chair

Brad K. Lofton, MS
b.lofton@campphysics.com
1/1/2019 - 12/31/2024 Member

Sean D. Rose
sean.d.rose@uth.tmc.edu
10/4/2021 - 12/31/2024 Member

NON-VOTING Appointments

There are 1 non-voting members and guests.

Pankaj Patel Ph.D.
pankajp@rad.hfh.edu
7/29/2020 - 12/31/2022 Guest (nonvoting)

AAPM. *AAPM Committee Tree: Diagnostic Demand and Supply Projection Working Group*. Available at https://www.aapm.org/org/structure/default.asp?committee_code=DDSPWG. Accessed March 24, 2022.

Some efforts that get at demand via staffing

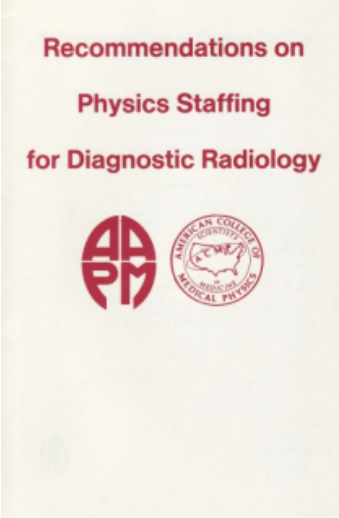
AAPM Report No. 33 (1991)

Table 2. The equipment of a facility and FTE physicists and support staff are summarized as follows:

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

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

AAPM-ACMP Recommendations (1993)



Cypel and Sunshine (2004)

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: n	Mean (SE)	Percentile 25th	50th (Median)	75th	Frequency of Evaluation (%): n	M	Q	S	A	B	Acc	Hours/Evaluation: n	Mean (SE)	Percentile 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	0	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
Portable C-arms																	
Part DMP	113	8 (1.0)	1	5	10	88	0	6	68	9	0	0	88	2 (0.1)	1	2	3
DMP only	141	14 (1.9)	0	8	15	106	1	8	157	5	1	0	105	3 (0.3)	1	2	3
Conventional tomography																	
Part DMP	89	2 (0.5)	0	1	3	50	4	2	88	6	0	0	50	3 (0.4)	1	2	3
DMP only	117	4 (0.7)	0	1	4	71	0	3	207	5	0	3	69	3 (0.2)	1	3	4
Bone mineral systems																	
Part DMP	94	2 (0.4)	0	1	2	45	2	2	26	0	7	27	45	2 (0.2)	1	1	2
DMP only	126	2 (0.3)	0	1	3	80	4	4	46	1	6	21	76	2 (0.2)	1	1	2

Note: Statistics are based on self-reported information and are rounded. n = number of individuals who responded to the question. SE = standard error. M = monthly, Q = quarterly, S = twice a year (semiannually), A = annually, B = every two years (biannually), Acc = acceptance testing only. Survey administration period is reference point for "past 12 months."

Cypel YS, Sunshine JH. Diagnostic medical physicists and their clinical activities. *J Am Coll Radiol*. 2004 Feb;1(2):120-6. doi: 10.1016/j.jacr.2003.11.006. PMID: 17411539.

AAPM Report 301 (2017) and the LoS model

AAPM REPORT NO. 301

An Updated Description of the Professional Practice of Diagnostic and Imaging Medical Physics

Some efforts that get at supply

SUNY Albany Center for Health Workforce Studies (CHWS) 2009 Workforce Study (also created a demand model)

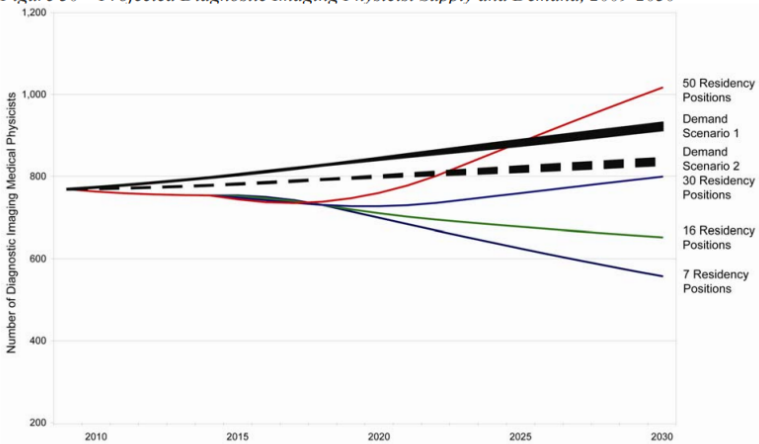
Workforce Study and Professional Survey Validation | AAPM Professional Council

April 14, 2011

Dear colleagues,

In January 2009, the AAPM sponsored two studies to be conducted by the Center for Health Workforce Studies at the School of Public Health at the State University of New York – Albany (SUNY).

Figure 30 – Projected Diagnostic Imaging Physicist Supply and Demand, 2009-2030



G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

AAPM/SNMMI Joint Task Force: Report on the current state of nuclear medical physics training (2015)

TABLE 1. Number of board certified Nuclear Medicine Physicists.

	Specialty			
Source	*NM*	*NM+DX*	*NM+TX*	*Total*
CRCPD/ABR	184	94	9	287
CRCPD/ABSNM				61
ABR	185	99	10	294

Harkness BA, Allison JD, Clements JB, et al. AAPM/SNMMI Joint Task Force: report on the current state of nuclear medicine physics training. *J Appl Clin Med Phys*. 2015;16(5):3-13. Published 2015 Sep 8. doi:10.1120/jacmp.v16i5.5661

Outline

- Motivation and background
- Previous efforts
  - 2009 SUNY Albany CHWS Workforce Study
  - 2015 AAPM/SNMMI Joint Task Force on Nuclear Medicine Physics Training
- Current efforts of the DDSPWG

The CHWS reports and models are freely available to AAPM members!

aapm.org/pubs/surveys.asp

nections H... iRIS: Log In START Activity_Documenta... Utilities Educational Mail - Rose, Sean D...

Encrypted | Logged in as Sean D. Rose, AAPM ID# 144581 | Logout Search Go

AMERICAN ASSOCIATION of PHYSICISTS IN MEDICINE

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- **Publications**
  - Medical Physics Journal
  - Journal of Applied Clinical Medical Physics
  - Newsletter
  - WPSC Newsletter
  - e-News
  - Research Spotlight
  - Physics Today
  - CT Protocols
  - MRI Homogeneity Testing Resources
  - Medical Physics Practice Guidelines
  - ACR-AAPM Practice

PUBLICATIONS

Surveys (Professional & Research) [all are PDFs]

- 2021 AAPM EDI Climate Survey
- 2020 Professional
- 2019 Professional
- 2018 Professional
- 2017 Professional
- 2016 AAPM Membership Survey
- 2016 Professional
- 2015 Professional
- 2014 Professional
- 2013 Professional
- 2012 Professional
- 2011 Professional
- 2010 Professional
  - Workforce Study and Professional Survey Validation
- 2009 Professional
- 2008 Salary
- 2007 Salary
- 2006 Salary
- 2005 Salary
- 2004 Salary (includes the Profile of Radiation Oncology Depts)
- 2004 Profile of Radiation Oncology Departments
- 2004 Research
- 2004 AAPM Membership Survey
- 2003 Salary
- 2002 Salary
- 2001 Salary
- 2000 Salary
- 2000 Salary Survey Gender Subset Analysis
- 1999 Salary
- 1998 Salary
- 1997 Salary
- 1996 Salary
- 1995 Salary
- 1994 Salary
- 1993 Salary
- 1992 Salary
- 1991 Salary
- 1990 Salary
- 1989 Salary
- 1988 Salary
- 1987 Salary
- 1986 Salary
- 1985 Salary
- 1983 Salary
- 1981 Salary
- 1979 Salary

AAPM. *Publications: Surveys (Professional & Research)*. Available at https://www.aapm.org/pubs/surveys.asp. Accessed March 24, 2022.

What was the purpose of the 2009 study?

The first study was a comprehensive study of the medical physics workforce to better understand current supply and demand for the profession. The study was designed to guide future policy initiatives related to education, training, and credentialing of medical physicists. The SUNY Center for Health Workforce Studies conducted interviews and focus groups, surveyed thousands of medical physicists, and developed simulation models to project supply and demand over the next two decades under various scenarios. They considered the evolving nature of education and training programs, including the requirement for residency training for clinical medical physicists. They also developed a simulation model for non-clinical medical physicists.

AAPM. *Publications: Workforce Study and Professional Survey Validiation*. Available at https://www.aapm.org/pubs/surveys.asp. Accessed March 24, 2022.

- This was before the 2012/2014 changes to ABR certification requirements
- At least partially motivated by wanting to understand the impact the change would have on supply/demand

What was the purpose of the 2009 study?

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They also conducted a study to validate the accuracy of the annual AAPM Professional Survey conducted by AIP.

AAPM. *Publications: Workforce Study and Professional Survey Validiation*. Available at https://www.aapm.org/pubs/surveys.asp. Accessed March 24, 2022.

- This was before the 2012/2014 changes to ABR certification requirements
- At least partially motivated by wanting to understand the impact the change would have on supply/demand

What did they do?

- a literature review and background report including a longitudinal analysis of historical trend data;
- interviews and focus groups with nearly 80 individuals knowledgeable about the medical physics profession;
- a survey of all currently active MPs including students, residents, educators, consultants, and employed MPs conducted in 2009 (N=5,487, response rate 48.1%); and
- development of simulation models to project supply and demand for MPs over the next 20 years under a number of training scenarios using data collected in the annual AAPM American Institute of Physics and the 2009 Center surveys.

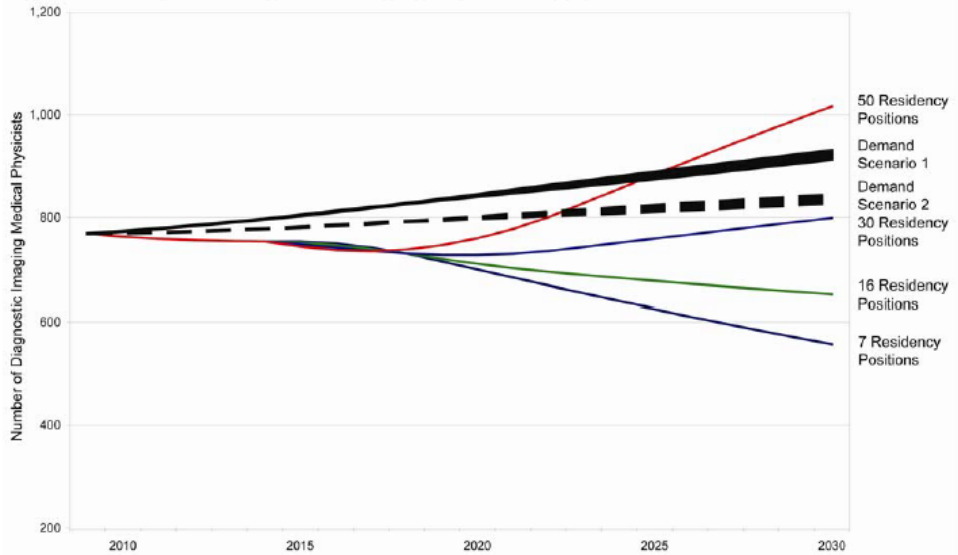
Executive Summary: Workforce Study of Medical Physicists in the U.S. Albany, NY: Center for Health Workforce Studies, SUNY Albany; 2010.

- They did a lot; details are available in the reports on the AAPM website
- Here we're going to focus on the stuff pertinent to the simulation models
- The survey noted above was of the AAPM membership

So how does their model work?

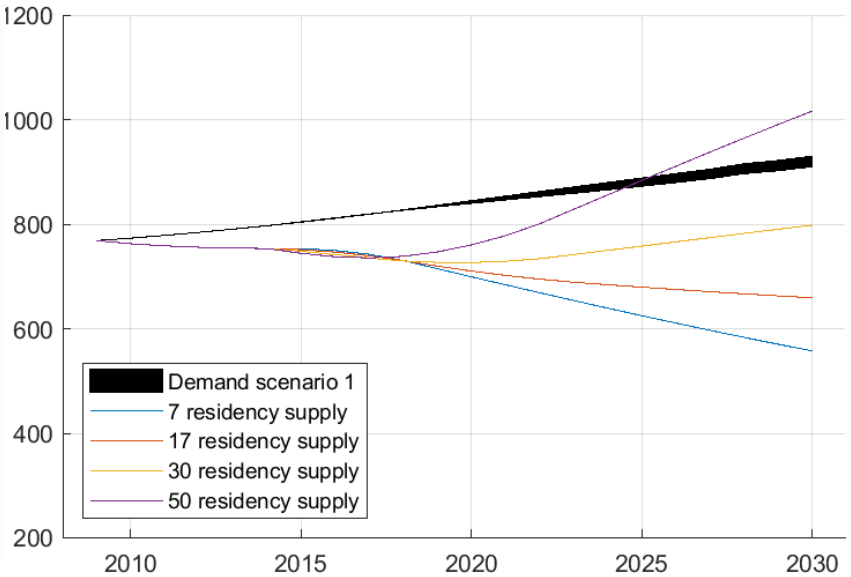
CHWS Supply and Demand Projections

Figure 30 – Projected Diagnostic Imaging Physicist Supply and Demand, 2009-2030



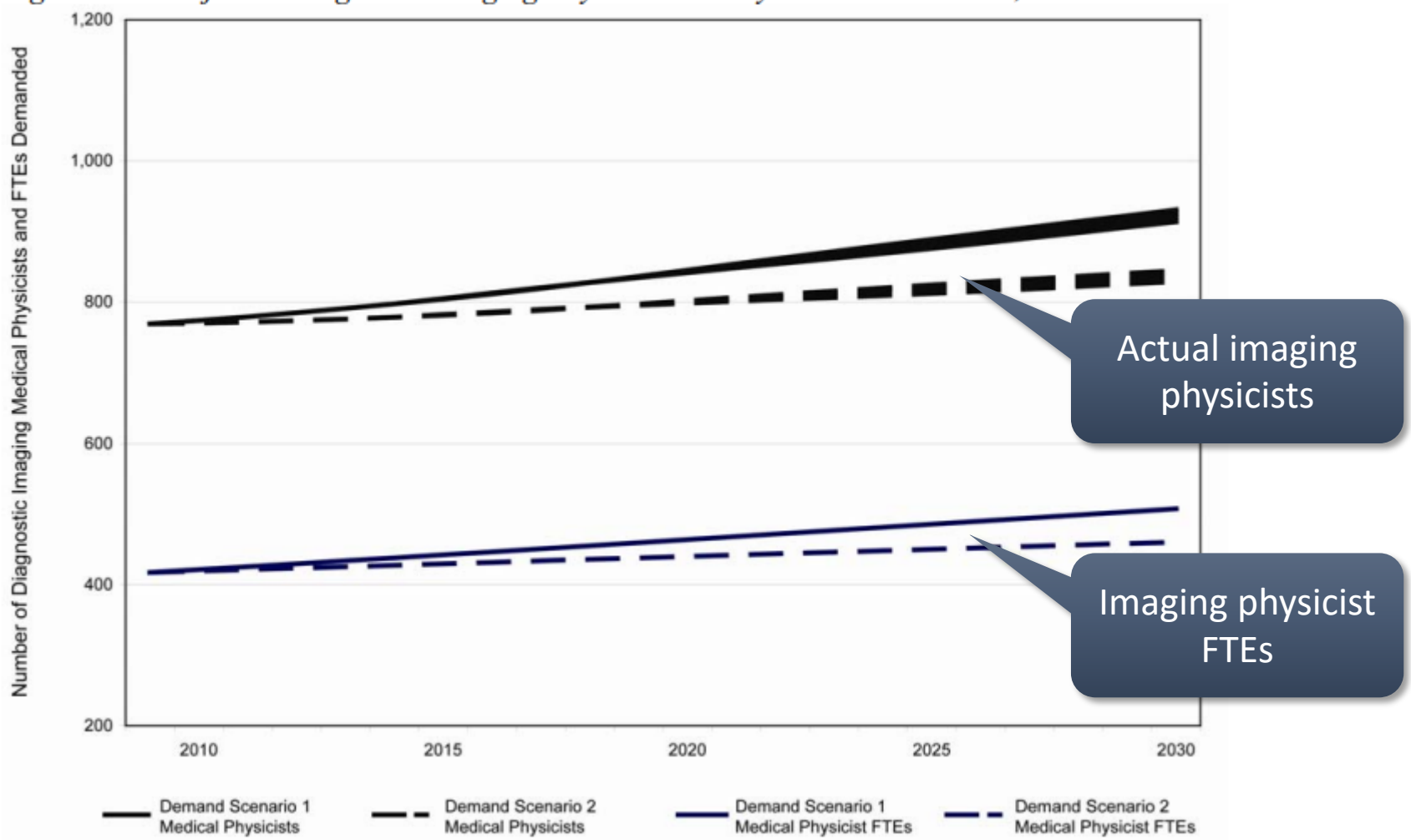
G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

Replica of their models based on the descriptions in the following slides



The demand model

Figure 16 – Projected Diagnostic Imaging Physicist and Physicist FTE Demand, 2009-2030



G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

The demand model

- Ties demand for FTEs (d_{FTE}) to US Census Bureau population projections (p) assuming we had the "right" number of imaging physicists in 2009 (t_0)
- In 2009, they estimated we had 1 FTE per 736,000 people, thus

$$d_{FTE}(t_0) = \frac{p(t_0)}{736000}$$

- They then modeled 2 demand scenarios
  - Baseline scenario (demand grows to maintain 1 FTE per 736000 people)

$$d_{FTE}(t_{k+1}) = \frac{p(t_{k+1})}{736000}$$

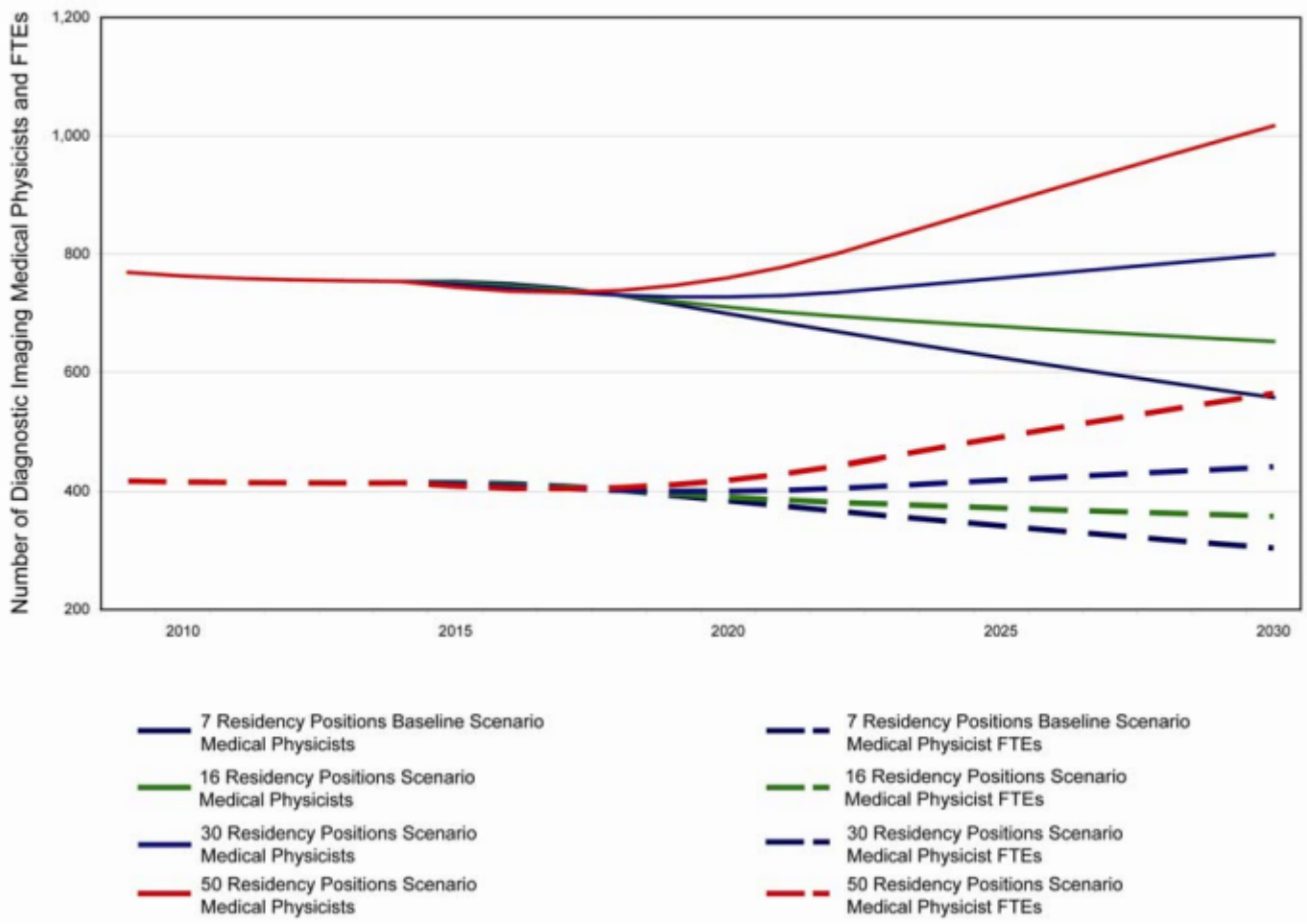
i.e., demand proportional to population!

  - "Under pressure" scenario (demand grows at half baseline rate)

$$d_{FTE}(t_{k+1}) = d_{FTE}(t_k) + \frac{1}{2} \times \frac{p(t_{k+1}) - p(t_k)}{736000}$$

The supply model

Figure 20 – Projected Diagnostic Imaging Physicist and Physicist FTE Supply, 2009-2030

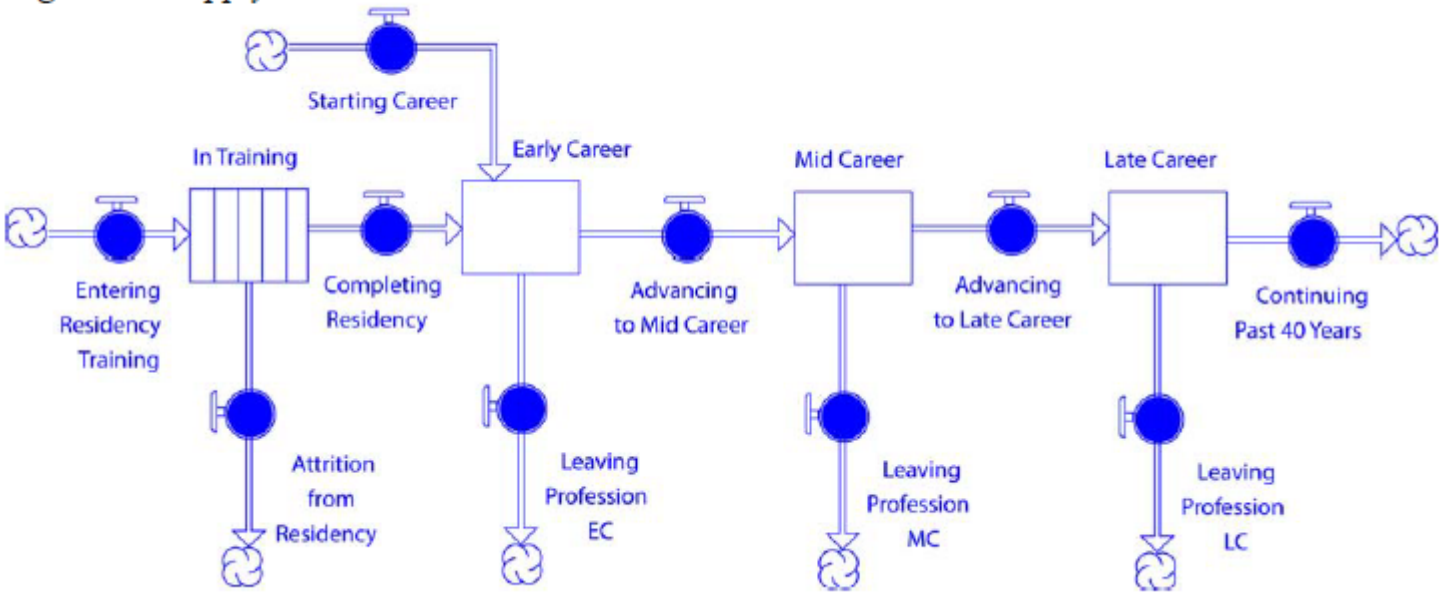


G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

The supply model

- Modeled number of physicists in 3 career "phases"

Figure 3 – Supply Model Structure



G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

The supply model… in math

t_k runs from 2009 to 2030 in steps of 1 year

$$f_1(t_{k+1}) = f_1(t_k) + g(t_k) - (c_1 + a_1)f_1(t_k)$$
$$f_2(t_{k+1}) = f_2(t_k) + c_1 f_1(t_k) - (c_2 + a_2)f_2(t_k)$$
$$f_3(t_{k+1}) = f_3(t_k) + c_2 f_2(t_k) - (c_3 + a_3)f_3(t_k)$$

The supply model… in math

Physicists in career phase 1 at beginning of year t_{k+1}

$$f_1(t_{k+1}) = f_1(t_k) + g(t_k) - (c_1 + a_1)f_1(t_k)$$
$$f_2(t_{k+1}) = f_2(t_k) + c_1 f_1(t_k) - (c_2 + a_2)f_2(t_k)$$
$$f_3(t_{k+1}) = f_3(t_k) + c_2 f_2(t_k) - (c_3 + a_3)f_3(t_k)$$

The supply model… in math

Physicists in career phase 1 at beginning of year t_k

$$f_1(t_{k+1}) = f_1(t_k) + g(t_k) - (c_1 + a_1)f_1(t_k)$$
$$f_2(t_{k+1}) = f_2(t_k) + c_1 f_1(t_k) - (c_2 + a_2)f_2(t_k)$$
$$f_3(t_{k+1}) = f_3(t_k) + c_2 f_2(t_k) - (c_3 + a_3)f_3(t_k)$$

The supply model… in math

Physicists entering career phase 1 during year t_k
(from residencies or other pathways)

$$f_1(t_{k+1}) = f_1(t_k) + g(t_k) - (c_1 + a_1)f_1(t_k)$$
$$f_2(t_{k+1}) = f_2(t_k) + c_1 f_1(t_k) - (c_2 + a_2)f_2(t_k)$$
$$f_3(t_{k+1}) = f_3(t_k) + c_2 f_2(t_k) - (c_3 + a_3)f_3(t_k)$$

The supply model… in math

Fraction of physicists in phase 1 moving to phase 2 each year

$$f_1(t_{k+1}) = f_1(t_k) + g(t_k) - (c_1 + a_1)f_1(t_k)$$
$$f_2(t_{k+1}) = f_2(t_k) + c_1 f_1(t_k) - (c_2 + a_2)f_2(t_k)$$
$$f_3(t_{k+1}) = f_3(t_k) + c_2 f_2(t_k) - (c_3 + a_3)f_3(t_k)$$

The supply model… in math

Fraction of physicists in phase 1 leaving the field entirely each year

$$f_1(t_{k+1}) = f_1(t_k) + g(t_k) - (c_1 + a_1)f_1(t_k)$$
$$f_2(t_{k+1}) = f_2(t_k) + c_1 f_1(t_k) - (c_2 + a_2)f_2(t_k)$$
$$f_3(t_{k+1}) = f_3(t_k) + c_2 f_2(t_k) - (c_3 + a_3)f_3(t_k)$$

The supply model… in math

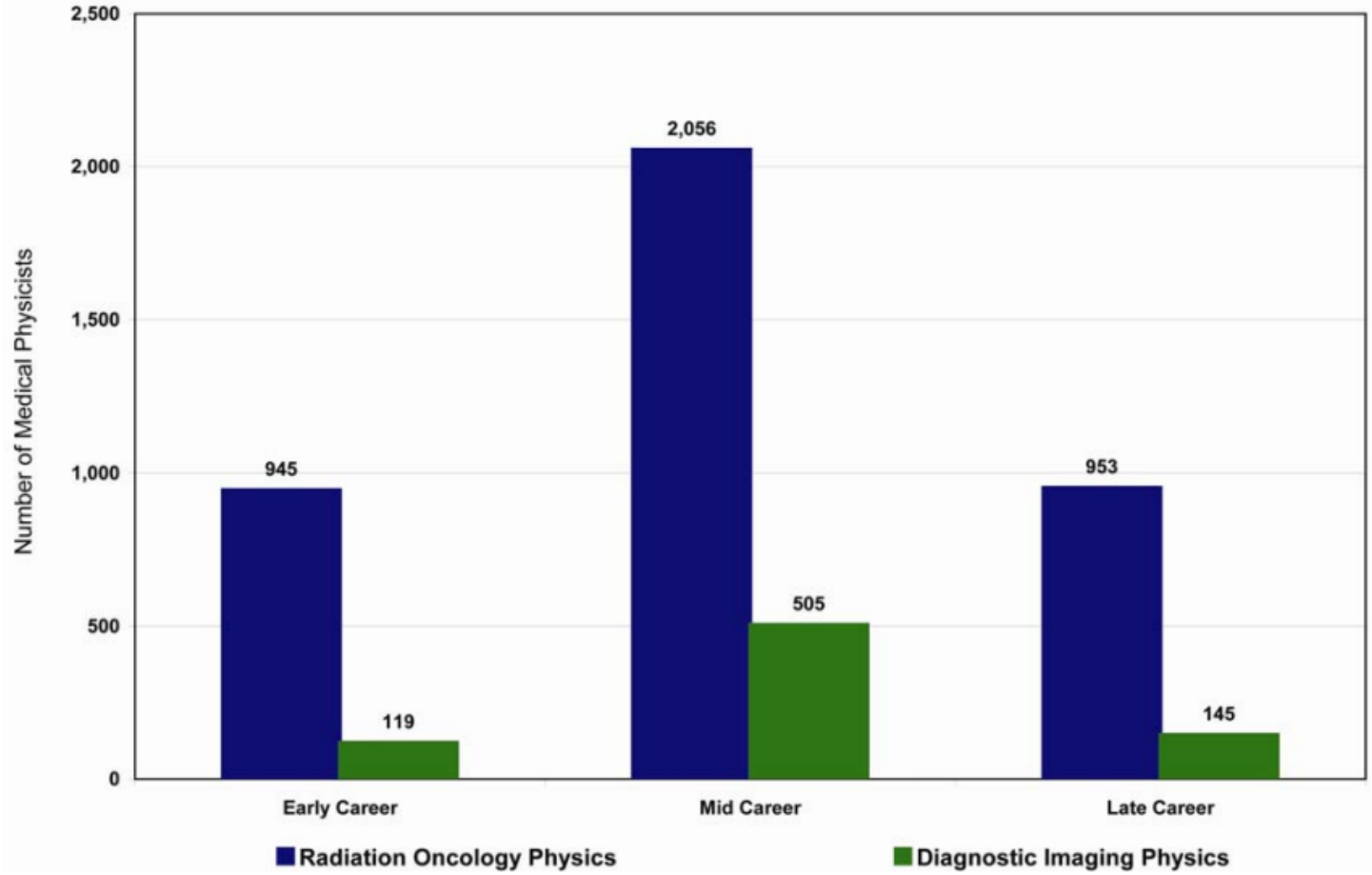
Things you have to provide the model

$$f_1(t_{k+1}) = f_1(t_k) + \boxed{g(t_k)} - (\boxed{c_1} + \boxed{a_1})f_1(t_k)$$
$$f_2(t_{k+1}) = f_2(t_k) + c_1 f_1(t_k) - (\boxed{c_2} + \boxed{a_2})f_2(t_k)$$
$$f_3(t_{k+1}) = f_3(t_k) + c_2 f_2(t_k) - (\boxed{c_3} + \boxed{a_3})f_3(t_k)$$

$$\boxed{f_n(t_0)\ for\ n = 1, \dots, 3}$$

Initial conditions and parameters informed by survey results

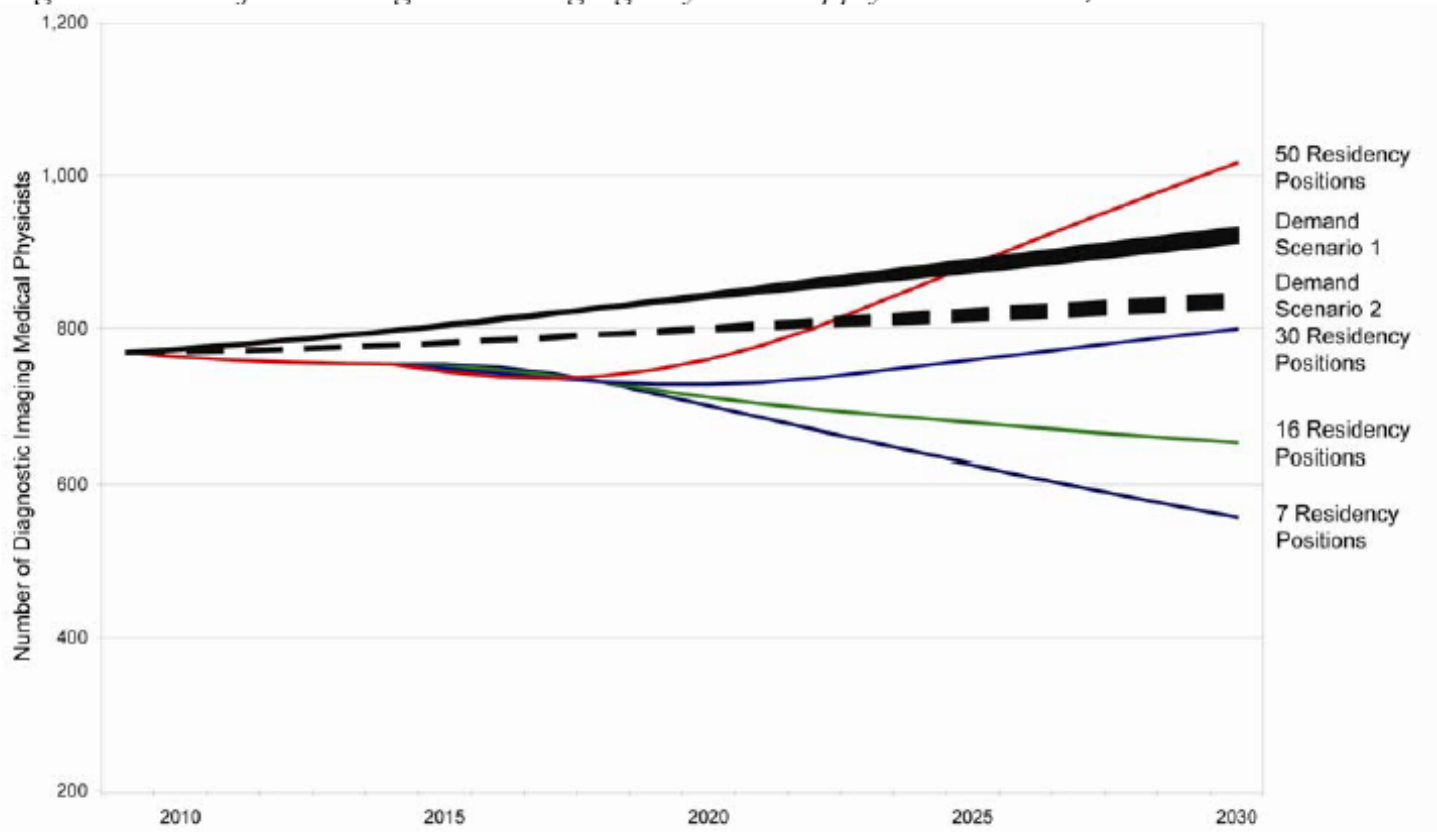
Figure 8 – 2009 Counts of Medical Physicists by Career Phase and Specialty



G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

End result

Figure 30 – Projected Diagnostic Imaging Physicist Supply and Demand, 2009-2030



G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

Outline

- Motivation and background
- Previous efforts
  - 2009 SUNY Albany CHWS Workforce Study
  - 2015 AAPM/SNMMI Joint Task Force on Nuclear Medicine Physics Training
- Current efforts of the DDSPWG

Purpose of the joint task force

- Estimate the demand for board-certified nuclear medicine physicists in the next 5–10 years,
- Identify the critical issues related to supplying an adequate number of physicists who have received the appropriate level of training in nuclear medicine physics, and
- Identify approaches that may be considered to facilitate the training of nuclear medicine physicists.

B. A. Harkness et al. AAPM/SNMMI Joint Task Force: report on the current state of nuclear medicine physics training. *Journal of Applied Clinical Medical Physics*, vol. 16, no. 5, pp. 3–13, 2015.

- Here we'll focus on their effort to determine the number of board-certified nuclear medicine physicists

Data sources for estimating number of nuclear medicine physicists

CRCPD maintains a database of physicist certified through ABHP, ABMP, ABR, CCMP, and ABSNM

CRCPD. *National QMP Registry*. Available at http://qmp.crcpd.org/. Accessed March 24, 2022.

Additionally looked at # respondents indicating they were board certified in Nuclear Medicine on 2012 AAPM Professional Survey

Joint Task Force results

- CRCPD data
  - They also got a list of board-certified physicists from the ABR (bottom row)
  - 8 individuals were both ABR and ABSNM certified
  - Total estimate was 287+61-8=340 board certified Nuclear Medicine physicists

TABLE 1. Number of board certified Nuclear Medicine Physicists.

	Specialty			
Source	*NM*	*NM+DX*	*NM+TX*	*Total*
CRCPD/ABR	184	94	9	287
CRCPD/ABSNM				61
ABR	185	99	10	294

B. A. Harkness et al. AAPM/SNMMI Joint Task Force: report on the current state of nuclear medicine physics training. *Journal of Applied Clinical Medical Physics*, vol. 16, no. 5, pp. 3–13, 2015.

Joint Task Force results

- AAPM Professional survey results shown below
  - Correction for 61% response rate gives $\frac{206}{0.61} \approx 340$ board certified physicists again! …but…

TABLE 2. Number of AAPM Professional Survey respondents indicating they were board certified in Nuclear Medicine and median years' experience.

All Degrees and Certification – 2012 Professional Survey		
Degree/Certification	#	*Median Yrs Experience*
MS-ABR(NM)	49	28
MS-ABSNM	20	19
MS-ABR(Radiologic)	16	36
PhD-ABR(NM)	64	30
PhD-ABSNM	24	25
PhD-ABR(Radiologic)	33	37
MS-ABR Diagnostic	200	22
PhD-ABR Diagnostic	199	22
Total ABR(NM)	162	
Total ABSNM	44	
Total NM Certified[a]	206	

[a] The sum of all ABR(NM) and ABSNM

B. A. Harkness et al. AAPM/SNMMI Joint Task Force: report on the current state of nuclear medicine physics training. *Journal of Applied Clinical Medical Physics*, vol. 16, no. 5, pp. 3–13, 2015.

Appears to include ABR (Radiologic) as well

Joint Task Force results

Final estimate

The data clearly show that nuclear medicine physicists comprise a small fraction of the total number of QMPs. This Task Force was not able to accurately determine the total number of board-certified nuclear medicine physicists. However, it is likely the number is in the range of about 350–450, or slightly less than 10% of those receiving the AAPM Professional Survey.

B. A. Harkness et al. AAPM/SNMMI Joint Task Force: report on the current state of nuclear medicine physics training. *Journal of Applied Clinical Medical Physics*, vol. 16, no. 5, pp. 3–13, 2015.

Outline

- Motivation and background
- Previous efforts
  - 2009 SUNY Albany CHWS Workforce Study
  - 2015 AAPM/SNMMI Joint Task Force on Nuclear Medicine Physics Training
- Current efforts of the DDSPWG

To project anything, we first need to estimate how many of us there are currently

- Set out to estimate the size of the clinical imaging physics workforce as of 2019-2020
- Compared this with CHWS projections and estimates of the AAPM/SNMMI Joint Task Force
- Ideally will use these as initial conditions to adapt CHWS model for future projections

Potential data sources

- There is no single comprehensive dataset cataloging the number of clinical imaging physicists, but there are a bunch of options
  - AAPM membership database
  - Annual AAPM Professional Survey
  - CRCPD QMP database
  - State radiation control programs

AAPM Membership database

- Advantages
  - Can exclude those that reside, and therefore likely work, outside the US
  - Can separate retirees and trainees based on membership category
  - Readily available
- Limitations
  - Specialties are self-reported, may not be reliable
  - Difficult to reliably distinguish clinical physicists from those working in research, regulatory, or other non-clinical functions
  - Some retirees choose to maintain full membership
  - Doesn’t capture unknown number of non-AAPM members working in medical physics

AAPM Professional Survey

- Advantages
  - Annually performed
  - Collects information about employment, subspecialty, and mix of clinical/non-clinical work
- Limitations
  - Respondents are self-selected
  - Not designed for representative sampling
  - Doesn’t capture unknown number of non-AAPM members working in medical physics

CRCPD QMP database

- Advantages
  - Updated at least annually
  - Captures ABR, ABMP, ABHP, CCPM, and ABSNM certification
  - Certification category provided in each listing (e.g., Diagnostic Medical Physics)
  - Individuals with multiple certifications are appropriately captured with multiple listings
- Limitations
  - Can contain entries for physicists no longer working
  - Can contain physicists who don’t do any clinical work
  - Doesn’t capture physicists without board certification

State radiation control programs

- Advantages
  - Typically require renewal every one to three years; not likely to contain retired individuals
  - Often include both board-certified and non-certified individuals

- Limitations
  - Have to avoid double counting people who are registered or licensed in multiple states
  - State regulations differ, so data can capture different subpopulations of the imaging physics workforce
  - Physicist exclusively working with ultrasound and MRI aren't captured

DDSPWG approach

- Collected registration/licensure data from 11 states
- Estimated # of X-ray imaging physicists, nuclear medicine physicists, and exclusively nuclear medicine physicists
- Discard names from state lists if address is out-of-state to avoid counting duplicates
- Filter state lists with the CRCPD database to determine number of board-certified physicists practicing in each state
- Extrapolate state estimates to national estimates using ratio estimator

$$n_{US} = n_{sample} \times \frac{x_{US}}{x_{sample}}$$

Total population of US

Number of physicists in sampled states

Total population of sampled states

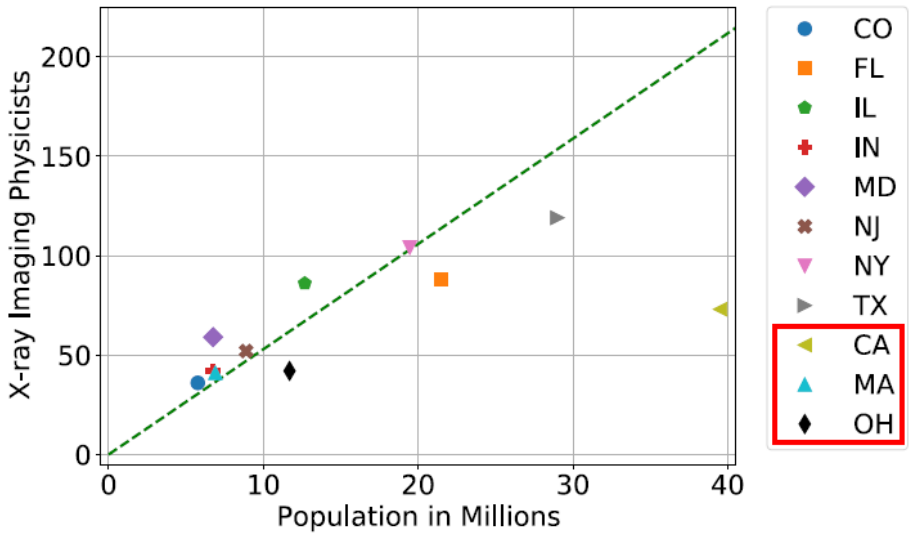
State data and inclusion criteria

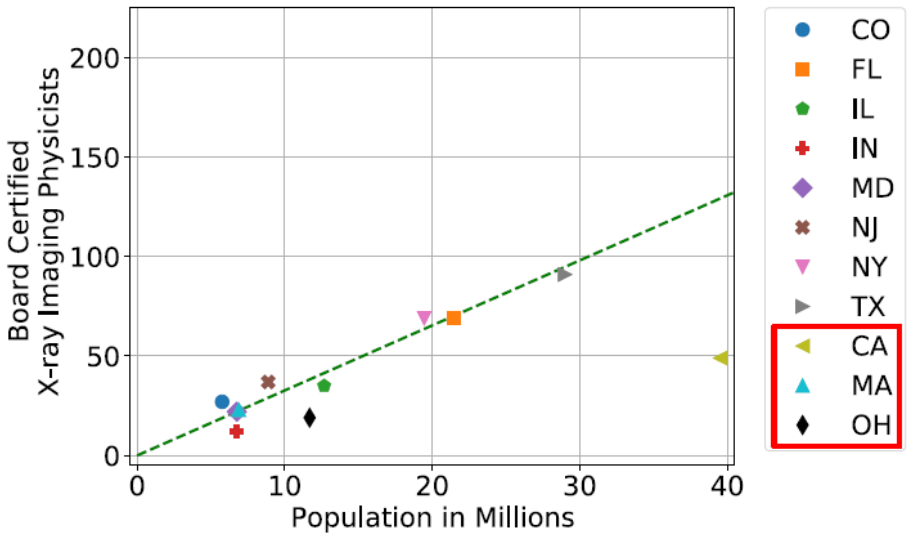
State	Data	Criteria for Inclusion in Nuclear Medicine Physicist Supply Estimate	Criteria for Inclusion in Diagnostic (X-Ray) Physicist Supply Estimate
CA	Individuals authorized to conduct mammography surveys [17 CCR § 30315.52]	N/A	All included
CO	Individuals approved to perform evaluations of radiation machines, facilities, and operators for compliance. [6 CCR 1007-1 Part 02, 2.4.4.1]	N/A	Qualified inspectors authorized to perform certification evaluations in CT, fluoroscopy, or mammography.
FL	Individuals with temporary or full licensure in either Diagnostic Radiological Physics or Medical Nuclear Physics. This includes all individuals able to provide nuclear or radiological physics services [FS Title XXXII § 483.901]	Full licensure in medical nuclear physics.	Full licensure in diagnostic radiological physics.
IL	Registered diagnostic imaging specialists in mammography and/or general radiography. Hospitals performing CT or mammography are required to have a radiation protection program overseen by such an individual [32 Ill. Adm. Code 410]	N/A	All included
IN	List of approved physicists and inspectors. Routine testing of diagnostic X-ray equipment must be performed by these individuals [410 IAC 5-6.1-118(c)]	N/A	Individuals qualified as diagnostic imaging physicists or X-ray machine inspectors.
MD	List of state licensed private inspectors. This license allows individuals to inspect X-ray equipment as part of the State's certification process [COMAR 26.12.02].	N/A	All included

State data and inclusion criteria

State	Data	Criteria for Inclusion in Nuclear Medicine Physicist Supply Estimate	Criteria for Inclusion in Diagnostic (X-Ray) Physicist Supply Estimate
MA	List of consultants for health physics services in the areas of (1) diagnostic radiology (excluding mammography) and (2) mammography [105 CMR 120]	N/A	All included
NJ	Qualified medical physicists for the supervision of quality assurance programs for computed tomography, diagnostic X-ray, and/or mammography equipment [NJAC 7:28-22.12 and 7:28-15.4]. Qualified medical physicist assistants in radiography and fluoroscopy were not included.	N/A	All included
NY	Individuals with full licensure in either diagnostic radiological physics or medical nuclear physics. This includes all individuals able to provide nuclear or radiological physics services [8 EDN § 166]	Full licensure in medical nuclear physics.	Full licensure in diagnostic radiological physics.
OH	Opt-in lists of certified radiation experts available to perform cone beam CT testing and shielding design and area surveys. Certified radiation experts can serve as the individual responsible for radiation protection for an imaging provider [Ohio Adm. Code 3701:1-66-03]	N/A	All included
TX	Individuals with temporary or full licensure in either Diagnostic Radiological Physics or Medical Nuclear Physics. This includes all individuals able to provide nuclear or radiological physics services [22 TAC §160]	Full licensure in medical nuclear physics	Full licensure in diagnostic radiological physics

Results – X-ray imaging physicists





State	# Physicists on CRCPD Registry	# Physicists on State List	# Board Certified Physicists in State	2019 State Population	Total Physicists Per Million Residents	Board Certified Physicists Per Million Residents
CO	36	36	27	5758736	6.25	4.69
FL	46	88	69	21477737	4.1	3.21
IL	51	86	35	12671821	6.79	2.76
IN	16	42	12	6732219	6.24	1.78
MD	36	59	22	6751429	8.74	3.26
NJ	52	52	37	8882190	5.85	4.17
NY	103	104	69	19453561	5.35	3.55
TX	129	119	91	28995881	4.1	3.14
CA	123	73	49	39512223	1.85	1.24
MA	34	41	23	6892503	5.95	3.34
OH	75	42	19	11689100	3.59	1.63

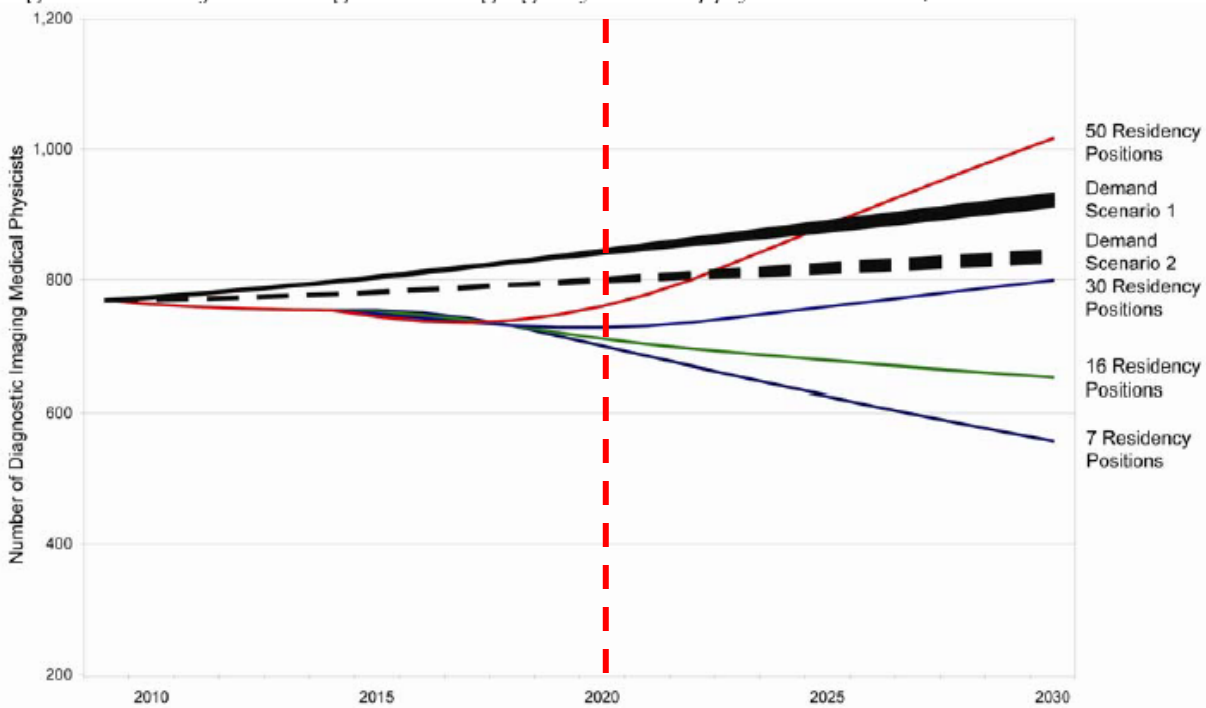
National estimate of total X-ray imaging physicists:
1737 (SD=155)

National estimate of board-certified X-ray imaging physicists:
1073 (SD=52)

Results – X-ray imaging physicists

Projections from 2009
CHWS Workforce Study

Figure 30 – Projected Diagnostic Imaging Physicist Supply and Demand, 2009-2030



G. J. Forte. Technical report: Medical physicist supply and demand modeling. Albany, NY: Center for Health Workforce Studies, SUNY Albany; Sep. 2010.

New estimates from the DDSPWG

National estimate of total X-ray imaging physicists: 1737 (SD=155)

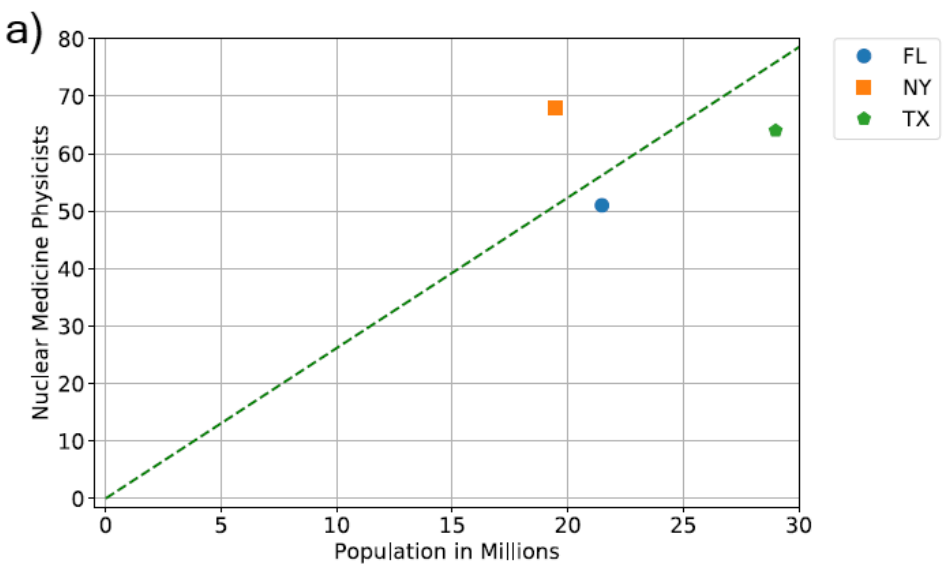
National estimate of board certified X-ray imaging physicists: 1073 (SD=52)

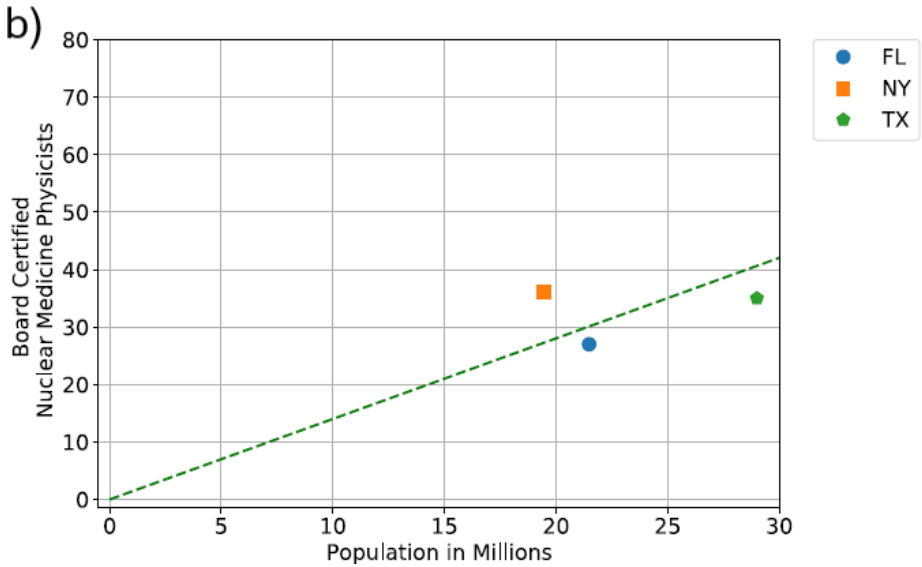
Why the discrepancy?

Potential reasons

- Events between 2009 and 2019 that likely impacted per-capita demand
  - Medicare Improvements for Patients and Providers Act (MIPPA) accreditation requirement started in 2012
  - Changes in requirements of The Joint Commission in 2015 and 2019
- Initial conditions for CHWS study were based on survey of AAPM membership
- CHWS assumptions for # of physicists entering field through residencies and other pathways

Results – Nuclear medicine physicists





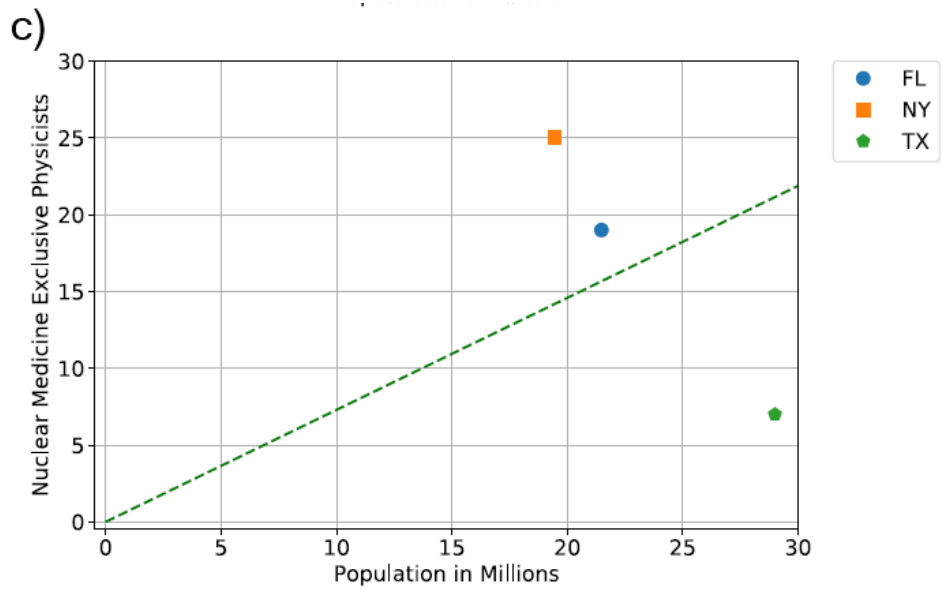
State	# Physicists on CRCPD Registry	# Physicists on State List	# Board Certified Physicists in State	2019 State Population	Total Physicists per Million Residents	Board Certified Physicists per Million Residents
FL	19	51	27	21477737	2.37	1.26
NY	67	68	36	19453561	3.5	1.85
TX	70	64	35	28995881	2.21	1.21

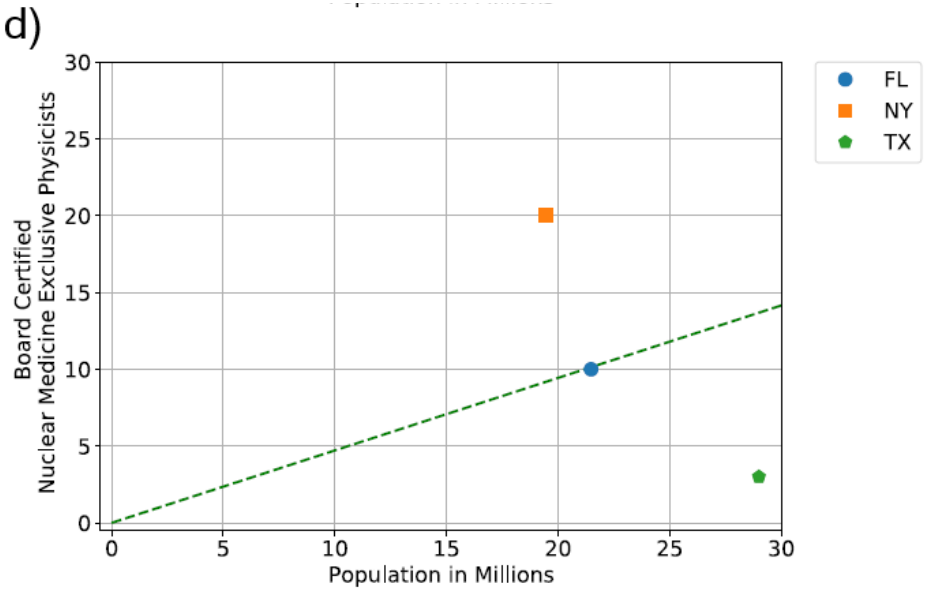
National estimate of nuclear medicine physicists:
859 (SD=120)

For comparison:
AAPM/SNMMI Joint Task Force estimated 350-450 board certified in 2015

National estimate of board-certified nuclear medicine physicists:
460 (SD=60)

Results – Exclusively Nuclear medicine physicists



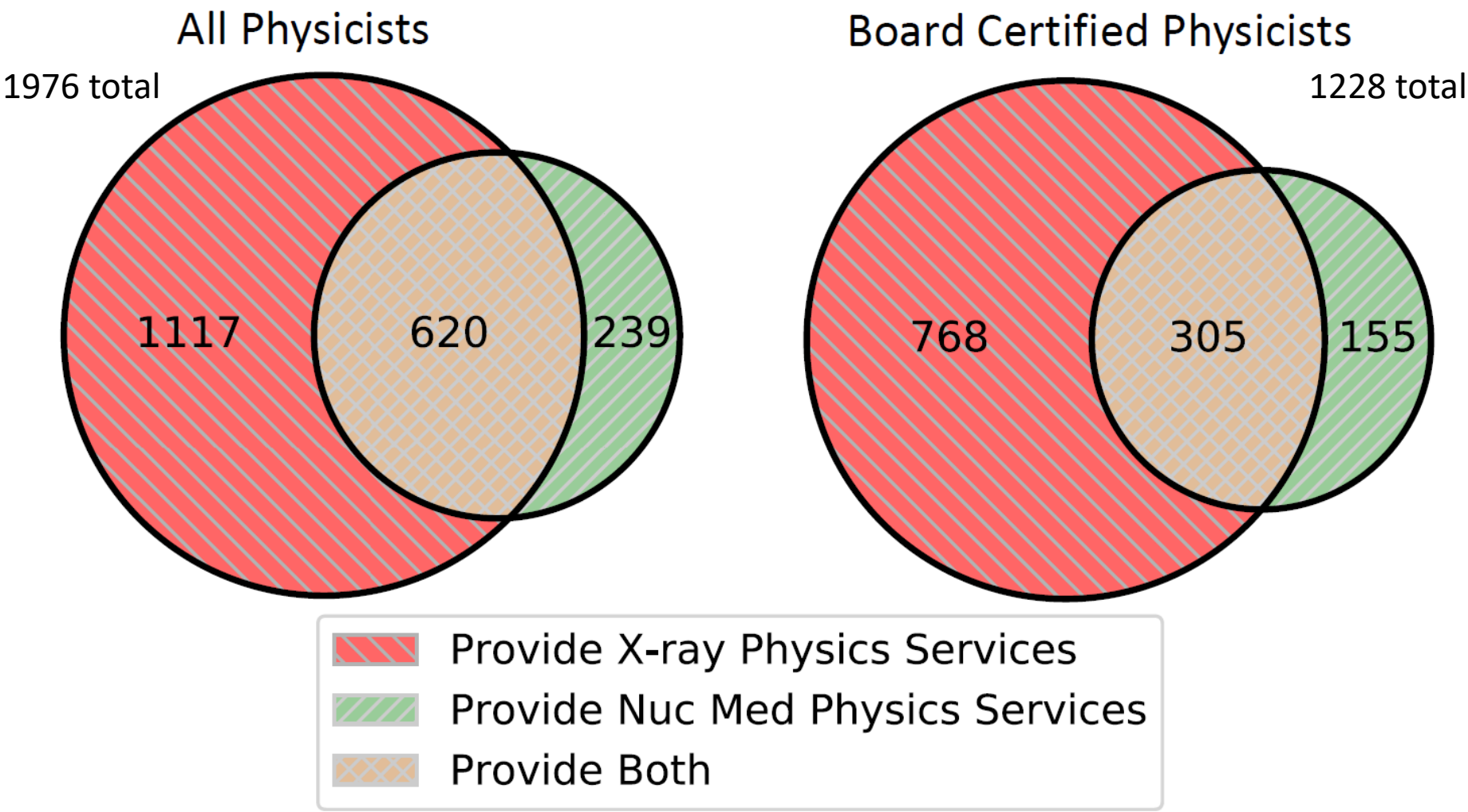


State	# Physicists on CRCPD Registry	# Physicists on State List	# Board Certified Physicists in State	2019 State Population	Total Physicists per Million Residents	Board Certified Physicists per Million Residents
FL		19	10	21477737	0.88	0.47
NY		25	20	19453561	1.29	1.03
TX		7	3	28995881	0.24	0.1

National estimate of exclusively nuclear medicine physicists: 239 (SD=101)

National estimate of board certified exclusively nuclear medicine physicists: 155 (SD=85)

Summary of estimates



Some Limitations

- Differences between state credentialing programs
- National estimates based off states with defined licensure or registration requirements
  - Could bias estimates, particularly for board certified physicists
- Excluded individuals residing outside of the state they were registered/licensed in
  - Avoids double counting, but we would miss a person who isn't licensed/registered in the state they live in
- Didn't get at FTEs

Big thanks to everyone involved

DDSPWG

- Nicholas Bevins
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- Brad Lofton
- Pankaj Patel

Diagnostic Workforce Subcommittee

- Nathan Busse
- Renee Butler
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- Mary Ellen Jafari
- David Jordan
- Megan Lipford
- Jianqiao Luo
- Osama Malawi
- Sarah McKenney
- Thomas Nishino
- Robert Pizzutiello
- Lei Qin
- James Speitel
- Joseph Steiner
- Joshua Wilson
- Justin Brown
- Caroline Cheney
- Shengwen Deng
- Dhara Mehta
- Caleb Stallcup
- Susan White
- Nicholai Wingreen