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THE EVOLVING U.S. HEALTH WORKFORCE

Perspectives: Using Results from HRSA's Health Workforce Simulation Model to Examine the Geography of Primary Care

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Objective. Inform health planning and policy discussions by describing Health Resources and Services Administration's (HRSA's) Health Workforce Simulation Model (HWSM) and examining the HWSM's 2025 supply and demand projections for primary care physicians, nurse practitioners (NPs), and physician assistants (PAs).

Data Sources. HRSA's recently published projections for primary care providers derive from an integrated microsimulation model that estimates health workforce supply and demand at national, regional, and state levels.

Principal Findings. Thirty-seven states are projected to have shortages of primary care physicians in 2025, and nine states are projected to have shortages of both primary care physicians and PAs. While no state is projected to have a 2025 shortage of primary care NPs, many states are expected to have only a small surplus.

Conclusions. Primary care physician shortages are projected for all parts of the United States, while primary care PA shortages are generally confined to Midwestern and Southern states. No state is projected to have shortages of all three provider types. Projected shortages must be considered in the context of baseline assumptions regarding current supply, demand, provider-service ratios, and other factors. Still, these findings suggest geographies with possible primary care workforce shortages in 2025 and offer opportunities for targeting efforts to enhance workforce flexibility.

Key Words. Primary care, scope of practice, health workforce, shortage, training

Essential to successful health planning and policy is a solid understanding of future health workforce supply and demand (Ono, Lafortune, and Schoenstein 2013; GAO 2015). Both federal and nonfederal entities use workforce forecasts to guide their health education, training, and care delivery programs. In support of program planning within the Department of Health and Human Services and across the broader health community, the Health Resources and

Services Administration (HRSA) periodically releases supply and demand projections for multiple health occupations. These projections inform policy at all levels and help ensure adequate provider supplies, particularly in underserved communities. Workforce projections also serve as critical planning tools for state and regional entities; health professions schools and educators; public health organizations; and professional organizations.

The HRSA recently released national and state-level projections of primary care provider supply and demand in 2025, with 2013 data as baseline. These estimates derive from the Health Workforce Simulation Model (HWSM; HHS/HRSA 2016a, b), an integrated microsimulation model that forecasts supply and demand for multiple professions in various settings. The HRSA's HWSM affords insight into the dynamics of provider supply and demand, and represents an important step in improving health workforce forecasts.

To promote discussion and review of the HWSM, we offer this Perspectives article. Our aim is twofold: First, we provide insight into the HWSM, briefly describing its methodology, key assumptions, strengths, and limitations. Second, we use the HWSM's primary care projections to illustrate the model's output and explore implications for health workforce flexibility related to the geography of provider supply and demand.

HEALTH WORKFORCE SIMULATION MODEL OVERVIEW

The HSRA's HWSM relies on an individual-level microsimulation methodology, rather than the cohort-based approach previously used by the HRSA and others (HHS/HRSA 2016a). Microsimulation offers a more granular framework for assessing health provider supply and demand and can better support future analyses of alternative health care delivery and utilization scenarios as more comprehensive data become available.

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The following text briefly outlines the HWSM's approach for estimating provider supply and demand, as well as the model's strengths and limitations. Details of the HWSM are available in the technical documentation posted on HRSA's website (HHS/HRSA 2014a; <http://bhwa.hrsa.gov/sites/default/files/bhwa/nchwa/projections/simulationmodeldocumentation.pdf>).

Provider Supply

The HWSM estimates the baseline supply for each modeled health occupation separately, using person-level data to characterize providers' age, sex, education, training, and geographic location. Where available, these micro-data reflect information compiled from national registries. For professions without detailed registries, data from the American Community Survey (ACS) are used, with individual records replicated based on their sample weights, to yield comprehensive, provider-specific baseline datasets. These individual-level datasets also incorporate state-level economic factors, including unemployment rates and average profession-specific wages. State-level estimates at baseline reflect each provider's practice location, while regional and national estimates reflect aggregated counts summed across applicable states.

New entrants to each year's workforce, as well as annual workforce attrition due to retirement, mortality, and career change, are simulated for each successive year beyond baseline using current patterns of training, retirement, and mortality. Thus, for a specific provider type, the workforce supply in a given year is equal to the previous year's supply plus the number of new entrants expected for that year minus the number of providers lost due to career change, retirement, and mortality. Ordinary least-squares regression is then used to estimate the number of hours each provider works each week over the course of the year. For each provider type, the projected annual supply is reported as full-time equivalents, calculated as the total estimated hours worked divided by the average number of hours worked per week.

Provider Demand

Estimates for health care demand similarly begin with individual-level data. First, population characteristics, including demographic and socioeconomic information, are obtained from ACS and other data compiled by the U.S. Census Bureau and U.S. states. This information is linked to health status and risk factor data from the Behavioral Risk Factors Surveillance System

(administered by the Centers for Disease Control and Prevention) and to health care utilization and insurance information collected through surveys, including the Medical Expenditures Panel Survey and the National Ambulatory Medical Care Survey (overseen by the Agency for Healthcare Research and Quality).

Regression models are then used to estimate each person's health care utilization at baseline based on their demographic and socioeconomic characteristics, health and insurance status, and health risk factors. These estimates reflect both delivery setting and provider type/specialty.

Finally, staffing ratios specific to each delivery setting, provider type, and utilization measure (e.g., office visits, procedures, hospitalizations) are derived, assuming that current provider supply is sufficient to meet current demand, with adjustment for identified provider shortages (Ono, Lafortune, and Schoenstein 2013). For example, baseline demand for primary care physicians is assumed to be equal to baseline supply plus the approximately 8,200 physicians needed to address HRSA's Primary Care Health Provider Shortage Areas (HPSAs; HHS/HRSA 2014b). The derived staffing ratios are assumed to remain constant over the projection period.

Demand in each year after baseline is estimated by "aging" the population forward 1 year and using Census Bureau projections to account for population growth, migration, aging, and mortality. The baseline staffing ratios are then applied to each successive year's population to estimate total annual demand by delivery setting and provider type. Demand estimates are calculated at the national level and then pro-rated to state levels based on each state's projected population characteristics (i.e., age, sex, socioeconomic characteristics, health status, insurance status, health risk factors).

HWSM Strengths and Limitations

Important strengths of the HWSM include application of a consistent approach to analyzing supply and demand across practitioner type and medical discipline; use of microsimulation methodologies to ensure representativeness and provide reliable population-level estimates; and the capability to simultaneously examine the impact of multiple health care drivers, including population growth, changing demographics, health status, and expanded health insurance coverage.

A major limitation of the HWSM lies in its assumption of baseline equivalence. While consistent with other recent health workforce projection models (Ono, Lafortune, and Schoenstein 2013), HRSA recognizes that this

assumption does not address local workforce imbalances. This limitation also impacts the interpretation of projected shortages and surpluses, as discussed later in this article.

Other limitations include the use of current levels of provider education, training, and attrition to estimate out-year supplies, and the use of baseline staffing ratios to estimate out-year demands. HRSA anticipates that future versions of the HWSM will allow more nuanced modeling of these factors.

Finally, HRSA recognizes that the current model produces only point estimates, rather than ranges, for supply and demand. While this is similar to other workforce projections, HRSA is continuing to build new capabilities into the HWSM to expand its scenario modeling capabilities and produce ranges of supply and demand.

PRIMARY CARE

The Institute of Medicine (IOM 1996) defines primary care as follows:

[T]he provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community.

In reiterating this definition, IOM emphasized several key aspects of primary care: It focuses on the person, not the illness; it serves as an initial resource when an individual seeks health care; and it is coordinated and comprehensive (Starfield and Horder 2007; IOM 2012). A report from the Agency for Health Research and Quality (Totten et al. 2016) expanded on these strengths, noting that primary care is amply sufficient to address a broad range of conditions, illnesses, and injuries, and that, even with serious conditions or diseases, primary care practitioners link an individual's health care utilization across settings and providers (Wilson et al. 2005). Moreover, by providing a usual source of care, primary care practitioners help individuals to foster ongoing provider relationships and to incorporate preventive services into their care plans. Specifically, primary care access is associated with lower rates of hospital readmission (Herrin et al. 2014; HRET 2015; McHugh et al. 2016). Higher numbers of general practitioners per capita are also associated with decreased hospital readmission rates (Herrin et al. 2014). Significant reductions in emergency department visits have been reported among

individuals with chronic physical and/or behavioral health conditions who had more than two visits to a primary care clinic (Kim, Mortensen, and Eldridge 2015). Similarly, a California study of previously uninsured adults found that a policy targeting greater use of primary care providers and greater continuity of care resulted in decreased numbers of emergency department visits (Pourat et al. 2015). Collectively, these findings underscore the need to ensure adequate supplies of primary care providers across the United States.

While millions of Americans may now have financial access to primary care through insurance coverage, many still do not have physical access to care, even in areas where provider supplies may appear adequate. For example, Huang and Finegold estimated that 7 million people may lack access to health providers in areas where increased demand under the Affordable Care Act is greater than 10 percent of baseline supply (Huang and Finegold 2013). Sharzer et al. estimated that 16 percent of adults have difficulty accessing care. Among adults reporting access problems, 30 percent could not find a doctor who would see them (Sharzer, Long, and Anderson 2016), suggesting that in many areas, narrow provider networks may limit access to health care (Jost 2016).

Primary care providers include physicians, nurse practitioners (NPs), and physician assistants (PAs) who practice in general and family medicine, general internal medicine, geriatrics, and general pediatrics (National Library of Medicine/MedLine Plus 2016).¹ The Association of American Medical Colleges estimates that approximately 30 percent of the physicians practicing in 2014 were primary care physicians (IHS Inc 2016), while nearly 40 percent of PAs practice in primary care (NCCPA 2016). In contrast, approximately 80 percent of NPs are prepared in family care, adult care, geriatric care, or pediatric care (AANP 2015a, b).

Although academic and clinical training requirements vary across professions, all three professions undergo examination and certification at the national level and licensure at the state level. Like physicians, NPs and PAs may take medical histories, conduct exams, diagnose and treat illnesses, order and interpret tests, develop treatment plans, and provide preventive care. While some restrictions exist regarding the type of medication, NPs and PAs may prescribe medication in all 50 states and the District of Columbia (AANP 2015a, b; AAPA 2016).

Nurse practitioners and PAs do not replace physicians completely, but they can serve important roles as independent providers and as primary care team members. Indeed, substantial research evidence shows that primary care quality, including reduced hospitalization and emergency room visits, patient

safety, and patient satisfaction, are comparable between patients served by NPs and PAs and those served by physicians (Mundinger et al. 2000; Horrocks, Anderson, and Salisbury 2002; Grumbach et al. 2003; Wilson et al. 2005; Laurant et al. 2009, 2005; Naylor and Kurtzman 2010; Hooker and Muchow 2015; Perloff, DesRoches, and Buerhaus 2016).

Recognizing that a well-trained, well-distributed primary care workforce is vital for America's health, considerable effort has focused on examining the distribution of primary care physicians, but less research has focused on NPs and PAs. Yet, because physicians, NPs, and PAs together form the bulwark of the primary care system, it is essential to take a holistic look at provider projections across occupations to obtain a clear picture of workforce adequacy and understand the collective geographic distribution of primary care practitioners.

This analysis offers a much needed window into primary care by examining the national, regional, and state distributions of primary care physicians, NPs, and PAs. These analyses speak to the importance of ongoing, rigorous work in developing projection models that consider entire sectors, rather than individual professions (Grover, Orlowski, and Erikson 2016). A comprehensive understanding of provider geography is also integral to health workforce planning (Dummer 2008) that supports effective deployment of the health workforce and overcomes geographic disparities in access to care.

APPROACH

Our analyses utilize HRSA's 2013 baseline estimates and 2025 projections of supply and demand for primary care physicians, NPs, and PAs. We examined supply and demand across provider type to give a comprehensive picture of how regional and state-level distributions of each profession may influence the adequacy of the U.S. primary care provider workforce between 2013 and 2025.

RESULTS

National Findings

In 2013, the supply of primary care physicians² in the United States is estimated to be 216,580 FTEs, while demand is estimated to be 224,780 FTEs (Table 1). This difference between supply and demand reflects the approximately 8,200 primary care physicians needed to de-designate HRSA's primary care HPSAs. Primary care physician adequacy, measured as the

Table 1: Primary Care Provider Supply and Demand, 2013

	Physicians			Nurse Practitioners (NPs)			Physician Assistants (PAs)					
	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)
United States	216,580	224,780	-8,200	-4	57,330	57,330	0	-	33,390	33,390	0	-
Northeast	43,720	41,600	2,120	5	10,950	10,640	310	3	6,300	6,100	200	3
<i>New England</i>												
Connecticut	2,690	2,710	-20	-1	980	690	290	42	420	400	20	5
Maine	1,320	990	330	33	510	250	260	104	240	150	90	60
Massachusetts	6,420	5,190	1,230	24	2,280	1,330	950	71	580	770	-190	-25
New Hampshire	1,110	950	160	17	460	240	220	92	180	140	40	29
Rhode Island	870	800	70	9	170	200	-30	-15	80	120	-40	-33
Vermont	630	450	180	40	220	120	100	83	100	70	30	43
<i>Middle Atlantic</i>												
New Jersey	6,050	6,590	-540	-8	1,020	1,690	-670	-40	340	980	-640	-65
New York	15,160	14,200	960	7	3,210	3,630	-420	-12	2,580	2,110	470	22
Pennsylvania	9,480	9,740	-260	-3	2,100	2,490	-390	-16	1,790	1,450	340	23
Midwest	48,230	49,270	-1,040	-2	11,700	12,560	-860	-7	6,500	7,380	-880	-12
<i>East North Central</i>												
Illinois	9,440	9,190	250	3	1,700	2,340	-640	-27	880	1,370	-490	-36
Indiana	4,040	4,810	-770	-16	1,380	1,220	160	13	230	710	-480	-68
Michigan	7,140	7,480	-340	-5	1,240	1,910	-670	-35	1,360	1,110	250	23
Ohio	8,170	8,660	-490	-6	1,960	2,210	-250	-11	450	1,290	-840	-65
Wisconsin	4,340	4,120	220	5	1,170	1,050	120	11	640	610	30	5
<i>West North Central</i>												
Iowa	2,140	2,240	-100	-4	420	570	-150	-26	490	330	160	48
Kansas	1,970	2,090	-120	-6	730	530	200	38	500	310	190	61
Minnesota	4,580	3,850	730	19	1,090	980	110	11	820	570	250	44

continued

Table 1. Continued

	Physicians			Nurse Practitioners (NPs)			Physician Assistants (PAs)					
	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)
Missouri	3,950	4,480	-530	-12	1,270	1,140	130	11	220	660	-440	-67
Nebraska	1,310	1,280	30	2	300	320	-20	-6	480	190	290	153
North Dakota	530	490	40	8	250	120	130	108	160	70	90	129
South Dakota	610	590	20	3	180	150	30	20	280	90	190	211
South	73,570	83,010	-9,440	-11	22,490	21,160	1,330	6	11,710	12,400	-690	-6
<i>South Atlantic</i>												
Delaware	670	680	-10	-1	160	170	-10	-6	90	100	-10	-10
District of Columbia	1,090	420	670	160	230	110	120	109	100	60	40	67
Florida	12,250	14,160	-1,910	-13	3,670	3,610	60	2	1,680	2,110	-430	-20
Georgia	5,930	6,690	-760	-11	1,570	1,700	-130	-8	950	990	-40	-4
Maryland	4,810	4,280	530	12	860	1,100	-240	-22	540	640	-100	-16
North Carolina	6,480	6,960	-480	-7	1,610	1,770	-160	-9	1,900	1,030	870	84
South Carolina	2,910	3,340	-430	-13	870	850	20	2	360	500	-140	-28
Virginia	5,670	5,800	-130	-2	1,980	1,480	500	34	700	860	-160	-19
West Virginia	1,340	1,480	-140	-9	340	380	-40	-11	390	220	170	77
<i>East South Central</i>												
Alabama	2,720	3,540	-820	-23	770	900	-130	-14	130	530	-400	-75
Kentucky	2,660	3,330	-670	-20	930	850	80	9	480	490	-10	-2
Mississippi	1,470	2,010	-540	-27	1,080	510	570	112	30	300	-270	-90
Tennessee	4,220	4,780	-560	-12	2,310	1,220	1,090	89	520	710	-190	-27
<i>East South Central</i>												
Arkansas	1,810	2,160	-350	-16	610	550	60	11	110	320	-210	-66
Louisiana	2,770	3,220	-450	-14	730	820	-90	-11	240	480	-240	-50

continued

Table 1. Continued

	Physicians			Nurse Practitioners (NPs)			Physician Assistants (PAs)					
	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)
Oklahoma	2,290	2,830	-540	-19	560	720	-160	-22	530	420	110	26
Texas	14,490	17,330	-2,840	-16	4,220	4,400	-180	-4	2,960	2,560	400	16
West	51,080	50,880	200	<1	12,190	12,970	-780	-6	8,870	7,500	1,370	18
<i>Mountain</i>												
Arizona	4,030	4,740	-710	-15	1,300	1,210	90	7	850	700	150	21
Colorado	3,950	3,510	440	13	1,100	890	210	24	1,290	520	770	148
Idaho	960	1,110	-150	-14	240	280	-40	-14	380	160	220	138
Montana	700	690	10	1	320	170	150	88	220	100	120	120
Nevada	1,460	1,850	-390	-21	320	470	-150	-32	240	270	-30	-11
New Mexico	1,440	1,400	40	3	530	350	180	51	320	210	110	52
Utah	1,520	1,970	-450	-23	410	500	-90	-18	360	290	70	24
Wyoming	350	390	-40	-10	160	100	60	60	140	60	80	133
<i>Pacific</i>												
Alaska	600	470	130	28	330	120	210	175	340	70	270	386
California	26,120	25,900	220	1	4,700	6,600	-1,900	-29	3,120	3,870	-750	-19
Hawaii	1,140	960	180	19	230	250	-20	-8	120	140	-20	-14
Oregon	3,350	2,900	450	16	920	740	180	24	520	430	90	21
Washington	5,430	5,020	410	8	1,630	1,280	350	27	960	750	210	28

Note. U.S. Census Bureau Regions are shown in bold and Divisions are italicized (http://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf). Numbers may not sum due to rounding. Adequacy = 100 * [projected 2013 supply (S) - projected 2013 demand (D)]/[projected 2013 demand (D)]. Projections reflect baseline assumptions regarding supply, demand, new entrants into each profession, retirement patterns, and provider-utilization ratios.

difference between supply and demand as a proportion of demand, is estimated to be -4 percent of 2013 demand. The estimated 2013 supplies of primary care NPs and PAs are 57,330 FTEs and 33,390 FTEs, respectively. Demands for these providers equal 2013 supplies, reflecting the assumption of baseline equivalence for NPs and PAs.

By 2025, the supply of primary care physicians is estimated to be 239,460 FTEs, while the demand is estimated to rise to 263,100 FTE, resulting in a shortage of 23,640 FTE primary care physicians (-9 percent of 2025 demand; Table 2). In contrast, both primary care NPs and PAs are expected to have national surpluses in 2025. The 2025 supply of primary care NPs is estimated to be 110,540 FTEs, and the demand is estimated to be 68,040 FTEs, yielding a national level surplus of 42,500 FTE NPs (62 percent of 2025 demand). The 2025 supply of primary care PAs is estimated to be 58,770 FTEs, and the demand is 39,060 FTEs, resulting in a surplus of 19,710 FTEs (50 percent of 2025 demand). Across all providers, aging and population growth account for the majority of increases in demand (86 to 90 percent). The remaining increases in demand for each provider type reflect expanded insurance coverage under the Affordable Care Act.

These findings are consistent with recent projections prepared for the Association of American Medical Colleges (IHS 2016), which estimated a shortfall between 14,900 and 35,600 primary care physicians by 2025. IHS also estimated that total U.S. physician shortages may range from 61,700 to 94,700 by 2025, suggesting primary care physician deficits are only one component of a larger health care challenge.

The HWSM projections reflect baseline assumptions regarding supply, demand, new entrants into each profession, retirement patterns, and provider-utilization ratios. Projected shortages and surpluses must be considered in the context of those assumptions. For example, if the national baseline shortage of primary care physicians is greater than the assumed 8,200 physicians needed to de-designate the HPSAs, then the 2025 shortages may be greater than estimated by the HWSM. Similarly, if 2013 primary care NP and PA demands are greater than baseline supplies, then the 2025 demands may be higher than projected, which could reduce projected surpluses of NPs and exacerbate projected shortages of PAs.

Regional and State-Level Findings

The modest shortages of primary care physicians in 2013 and 2025 (-4 percent of 2013 demand and -9 percent of 2025 demand) mask considerable

Table 2: Primary Care Provider Supply and Demand, 2025

	Physicians				Nurse Practitioners (NPs)				Physician Assistants (PAs)			
	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)
United States	239,460	263,100	-23,640	-9	110,540	68,040	42,500	62	58,770	39,060	19,710	50
Northeast	44,110	44,920	-810	-2	15,790	11,650	4,140	36	9,450	6,580	2,870	44
<i>New England</i>												
Connecticut	2,860	3,000	-140	-5	1,190	770	420	55	710	440	270	61
Maine	1,270	1,050	220	21	640	270	370	137	410	150	260	173
Massachusetts	6,470	5,580	890	16	2,420	1,430	990	69	880	820	60	7
New Hampshire	1,150	1,100	50	5	730	280	450	161	260	160	100	63
Rhode Island	840	850	-10	-1	220	210	10	5	150	130	20	15
Vermont	600	480	120	25	390	130	260	200	190	70	120	171
<i>Middle Atlantic</i>												
New Jersey	6,470	7,530	-1,060	-14	1,950	1,940	10	1	670	1,100	-430	-39
New York	15,310	15,190	120	1	4,550	3,890	660	17	3,890	2,220	1,670	75
Pennsylvania	9,140	10,140	-1,000	-10	3,700	2,600	1,100	42	2,290	1,480	810	55
Midwest	47,650	52,970	-5,320	-10	21,570	13,690	7,880	58	10,000	7,910	2,090	26
<i>East North Central</i>												
Illinois	9,620	10,020	-400	-4	3,290	2,560	730	29	1,380	1,500	-120	-8
Indiana	3,920	5,100	-1,180	-23	2,240	1,300	940	72	360	760	-400	-53
Michigan	6,940	7,900	-960	-12	2,870	2,030	840	41	1,940	1,180	760	64
Ohio	7,990	9,190	-1,200	-13	3,470	2,350	1,120	48	810	1,370	-560	-41
Wisconsin	4,260	4,420	-160	-4	1,900	1,130	770	68	900	660	240	36
<i>West North Central</i>												
Iowa	2,020	2,220	-200	-9	1,000	570	430	75	710	330	380	115
Kansas	1,930	2,220	-290	-13	1,140	560	580	104	700	330	370	112
Minnesota	4,590	4,290	300	7	2,360	1,100	1,260	115	1,310	640	670	105

continued

Table 2. Continued

	Physicians			Nurse Practitioners (NPs)			Physician Assistants (PAs)					
	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)
Missouri	3,930	5,150	-1,220	-24	1,890	1,310	580	44	530	770	-240	-31
Nebraska	1,330	1,360	-30	-2	740	340	400	118	700	200	500	250
North Dakota	520	480	40	8	290	120	170	142	260	70	190	271
South Dakota	600	610	-10	-2	390	160	230	144	400	90	310	344
South	84,690	98,550	-13,860	-14	43,540	25,470	18,070	71	21,150	14,730	6,420	44
<i>South Atlantic</i>												
Delaware	710	820	-110	-13	290	210	80	38	170	120	50	42
District of Columbia	1,070	400	670	168	180	100	80	80	120	60	60	100
Florida	14,620	17,680	-3,060	-17	7,640	4,520	3,120	69	3,530	2,650	880	33
Georgia	7,000	8,310	-1,310	-16	3,230	2,120	1,110	52	1,880	1,240	640	52
Maryland	5,300	5,060	240	5	1,600	1,300	300	23	1,050	760	290	38
North Carolina	7,620	8,640	-1,020	-12	3,550	2,200	1,350	61	3,180	1,290	1,890	147
South Carolina	3,220	3,940	-720	-18	1,700	1,010	690	68	640	590	50	8
Virginia	6,350	6,970	-620	-9	3,620	1,780	1,840	103	1,520	1,040	480	46
West Virginia	1,280	1,460	-180	-12	720	380	340	89	480	220	260	118
<i>East South Central</i>												
Alabama	2,680	3,870	-1,190	-31	1,080	980	100	10	260	580	-320	-55
Kentucky	2,560	3,520	-960	-27	1,300	900	400	44	640	520	120	23
Mississippi	1,490	2,220	-730	-33	1,210	570	640	112	70	330	-260	-79
Tennessee	4,410	5,460	-1,050	-19	3,100	1,400	1,700	121	940	820	120	15
<i>West South Central</i>												
Arkansas	1,820	2,410	-590	-24	1,210	620	590	95	160	360	-200	-56
Louisiana	2,830	3,500	-670	-19	1,180	900	280	31	420	520	-100	-19
Oklahoma	2,320	3,150	-830	-26	1,200	800	400	50	830	470	360	77

continued

Table 2. Continued

	Physicians			Nurse Practitioners (NPs)			Physician Assistants (PAs)					
	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)	Supply (S)	Demand (D)	S-D	Adequacy (%)
Texas	19,390	21,150	-1,760	-8	10,730	5,380	5,350	99	5,250	3,150	2,100	67
West	62,990	66,660	-3,670	-6	29,640	17,230	12,410	72	18,180	9,840	8,340	85
<i>Mountain</i>												
Arizona	6,050	7,040	-990	-14	3,450	1,800	1,650	92	1,990	1,040	950	91
Colorado	4,800	4,640	160	3	2,300	1,180	1,120	95	2,150	680	1,470	216
Idaho	1,100	1,350	-250	-19	630	340	290	85	610	200	410	205
Montana	700	750	-50	-7	380	190	190	100	330	110	220	200
Nevada	2,270	2,780	-510	-18	1,190	710	480	68	710	410	300	73
New Mexico	1,660	1,780	-120	-7	1,050	450	600	133	610	260	350	135
Utah	1,770	2,370	-600	-25	980	610	370	61	790	350	440	126
Wyoming	340	400	-60	-15	160	100	60	60	280	60	220	367
<i>Pacific</i>												
Alaska	660	580	80	14	530	150	380	253	510	90	420	467
California	32,470	34,020	-1,550	-5	13,620	8,700	4,920	57	7,290	5,030	2,260	45
Hawaii	1,210	1,130	80	7	410	290	120	41	210	170	40	24
Oregon	3,650	3,520	130	4	1,690	900	790	88	870	520	350	67
Washington	6,310	6,290	20	0	3,240	1,610	1,630	101	1,830	930	900	97

Note. U.S. Census Bureau Regions are shown in bold and Divisions are italicized (http://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf).
Numbers may not sum due to rounding.
Adequacy = 100 * [projected 2025 supply (S) - projected 2025 demand (D)]/[projected 2025 demand (D)].
Projections reflect baseline assumptions regarding supply, demand, new entrants into each profession, retirement patterns, and provider-utilization ratios.

variation in physician supply and demand at regional and state levels. Similarly, both the baseline equilibrium and 2025 surpluses estimated for NPs and PAs at the national level obscure important differences in provider adequacy across the United States.

At the regional level, 2013 primary care physician adequacy ranges from –11 percent of 2013 demand (a shortage) in the South Region to 5 percent of 2013 demand (a surplus) in the Northeast Region (Table 1). Comparable ranges in 2013 regional adequacy are observed for primary care NPs and PAs. For NPs, 2013 adequacy is lowest in the Midwest Region (–7 percent of 2013 demand) and highest in the South Region (6 percent of 2013 demand). For PAs, 2013 adequacy is also lowest in the Midwest Region (–12 percent of 2013 demand), while 2013 adequacy is highest in the West Region (18 percent of 2013 demand). The 2013 geographic distribution of NPs and PAs complements each other in the South and West regions. In the Midwest Region, both NP and PA supplies are in deficit in 2013, while physician supply appears to be close to adequate (–2 percent of 2013 demand).

Primary care provider distribution at the state level reveals even more variability. In 2013, 29 states have shortages of primary care physicians, with 18 states having shortages of 10 percent or more (Table 1). Shortages are particularly marked in the South, where, of the 17 jurisdictions, only Maryland and the District of Columbia have physician surpluses. Primary care physician shortages in the South Region range from 1 percent of 2013 demand in Delaware to 27 percent of 2013 demand in Mississippi. Shortages in primary care physicians are also notable in the Mountain Division of the West Region in 2013, with five of eight states having primary care physician deficits. These shortages range from 10 percent of 2013 demand in Wyoming to 23 percent of 2013 demand in Utah.

A number of states with 2013 primary care physician shortages also have shortages of primary care NPs and PAs (Table 1; Figure 1). For example, Alabama has a physician shortage estimated at 23 percent of 2013 physician demand coupled with an NP shortage of 14 percent of 2013 NP demand and a PA shortage of 75 percent of 2013 PA demand. Estimates for Louisiana and Nevada tell similar stories. Looking across provider type, Louisiana reveals shortages of all three primary care provider types: 14 percent of physician demand, 11 percent of NP demand, and 50 percent of PA demand. Nevada's provider shortages are 21 percent of physician demand, 32 percent of NP demand, and 11 percent of PA demand.

By 2025, primary care physician shortages become pervasive across all regions, with the greatest shortage expected in the South region, where the

Figure 1: States with Shortages of Primary Care Providers, 2013

Note. Projections reflect baseline assumptions regarding supply, demand, new entrants into each profession, retirement patterns, and provider-utilization ratios.

deficit is 14 percent of 2025 demand (Table 2). Although all regions are predicted to have surpluses of both primary care NPs and PAs by 2025, these regional surpluses are variable. For NPs, surpluses range from 36 percent of 2025 demand in the Northeast Region to 72 percent of demand in the West Region. For PAs, surpluses range from 26 percent of 2025 demand in the Midwest Region to 85 percent of demand in the West Region.

State-level projections of primary care physician adequacy in 2025 are again quite variable, with the projected severity of the 2025 shortages greater than in 2013. Thirty-seven states are expected to have shortages of primary care physicians in 2025, of which eight states will be unable to meet 20 percent or more of their demand in 2025. In addition, nine states are projected to have shortages of both primary care physicians and PAs (Table 2; Figure 2). While no state is projected to have a 2025 shortage of primary care NPs, many states are expected to have only small surpluses. Of particular note are two states, Alabama and New Jersey, where there are projected shortages of both physicians and PAs combined with only small surpluses of NPs.

care (Pettersen et al. 2012). This article looks forward to assess future provider availability and finds that, under current patterns of service delivery and physician recruitment, the availability of primary care physicians will decline nationwide, with all U.S. regions projected to experience physician shortages. Moreover, the geographic distribution of physicians is projected to become increasingly skewed, potentially leading to serious access problems. In 2013, 29 states had shortages of primary care physicians. This situation worsens in 2025 when the number of states with physician shortages increases to 37. These findings are consistent with other work reporting distributional imbalances (Huang and Finegold 2013). Moreover, shifts toward smaller population-to-primary care physician ratios may lead to greater shortages than are suggested by current projection models (Grover, Orlowski, and Erikson 2016).

Physicians, NPs, and PAs all contribute significantly to the provision of primary care (Pettersen et al. 2015). Indeed, NPs and PAs constitute more than 40 percent of the primary care workforce (HHS/AHRQ 2014). While physician recruitment to primary care, especially in underserved and rural areas, is limited, the number of NPs and PAs in primary care has been growing (Pohl, Barksdale, and Werner 2014). By 2025, all U.S. regions and states are projected to have a surplus of primary care NPs, and all but nine states are projected to have a surplus of primary care PAs. Furthermore, no state is projected to be deficient in all three provider types.

Suggested solutions to ensuring adequate and equitable access to primary care reflect a number of interrelated factors beyond workforce distribution. These include recruitment and retention; team members and roles; provider scopes of practice; payment models; and delivery modes (Grover, Orlowski, and Erikson 2016). Given that it takes an average of 6 to 8 years of education and training to produce new NPs and PAs, compared with 11 to 12 years (or more) for physicians, the potential to overcome geographic disparity in primary care access by focusing on NPs and PAs seems attractive, especially as NP and PA supplies are largely expected to be sufficient over the next decade according to the HWSM projections. Here, we consider two solutions to effectively use NPs and PAs to overcome geographic barriers to access: team-based care and expanded scopes of practice.

Workforce Solutions to Challenges—Team-Based Care

Recognizing the rise in chronic health conditions and disabilities, including asthma, obesity, behavioral health conditions, and neurodevelopmental

disorders (Porter, Pabo, and Lee 2013), many health systems are responding through reorganization. One such approach seeks to create stronger links between local primary care providers and specialty care available at regional centers (Perrin, Anderson, and Van Cleave 2014; Totten et al. 2016). Primary care providers can effectively handle common routine conditions and can also effectively monitor treatment for complex illnesses.

Porter et al. also offer a framework for rethinking primary care, suggesting that primary care be organized around groups of patients with similar needs, increased focus on team-based care, and better integration of primary care with specialty providers (Porter, Pabo, and Lee 2013).

Simulation modeling has shown that the use of care teams, together with improved information technology and data sharing, can meaningfully increase access to care and offset physician shortages (Green, Savin, and Lu 2013). Care teams, including NPs and PAs, working with primary care physicians, have been found to reduce costs and hospital readmissions for elderly patients with complex health needs (Melnick, Green, and Rich 2016). Although small or isolated populations may make it hard to cost-effectively implement in-person team-based care models (Doescher et al. 2014), the use of telehealth coupled with the effective integration of primary care practitioners into regionalized care teams can help to alleviate these limitations. Geographic analyses, such as introduced here, can support the planning needed to implement such approaches.

Workforce Solutions to Challenges—Expanding Scopes of Practice

Nurse practitioners and PAs effectively augment and expand physician capacity in many care settings (Horrocks, Anderson, and Salisbury 2002; Rohrer et al. 2013). Moreover, NPs and PAs offer a timely and cost-effective remedy for projected provider shortages (AANP 2013; Riley, Litsch, and Cook 2016). NPs and PAs may be particularly essential in ensuring access to care for underserved populations (Grumbach et al. 2003).

Yet in 27 of the 37 states with 2013 provider shortages, NPs have reduced or restricted scopes of practice (as of May 2016; AANP 2016). In approximately half of these 37 states, PAs also have less than full practice opportunities (AAPA 2016). As a result, NPs and PAs are not able to practice to the full extent of their training and preparation, and direct access to full services provided by NPs and PAs may be constrained for certain populations. Assuming that scopes of practice are unchanged in 2025, NPs and PAs are restricted from full scopes of practice in more than half of states with shortages of one or more provider types.

The demand for primary care services is expected to increase with the aging and growth of the population with multiple chronic conditions and the passing of the ACA. Nationwide, the number of states removing scope of practice restrictions has increased over the last several years, and the movement is to allow full practice authority for NPs (Tolbert 2013). Research suggests that if scope of practice restrictions is removed, NPs have the potential to increase access to primary care, particularly in medically underserved areas, and increase quality outcomes (IOM 2010; NGA 2012; Martsolf, Auerbach, and Arifkhanova 2015). Several studies have compared the impact of care provided by physicians and NPs (Newhouse et al. 2011; Johantgen et al. 2012; Tolbert 2013; Martinez-Gonzalez et al. 2014). The results of these studies indicate that NPs provide at least equal quality of care to patients as compared to physicians; NPs are able to successfully manage chronic conditions with good outcomes; and NPs are favored in patient satisfaction scores and in achieving patient compliance with health care recommendations. Based on these findings, it may be necessary to address state licensure and scope of practice laws relating to NPs and PAs that currently limit the services these practitioners can deliver to improve access to care, especially in medically underserved areas; increase care efficiency; and decrease costs. These findings also suggest the importance of continuing to develop state compacts, allowing NPs and PAs who are licensed in one state to have reciprocity with other states.³ Currently, 25 states have adopted the Nurse Licensure Compact (NLC), which allows an Advanced Practice Registered Nurse (APRN) to hold one multistate license and have the privilege to practice in any of the other compact states. The migration of nurses out of states where they were licensed is a significant issue in many states, and the NLC has provided more flexibility with regard to mobility. The NLC also increases opportunities for nurses who are practicing in telehealth environments. The state boards of nursing are ensuring that the NLC reflects best practices and high-quality care (NCSBN 2015).

Limitations

A major limitation of these projections is the uncertainty in how health care use and delivery will evolve over time. The ongoing collection of information to characterize these dynamics will greatly help to improve workforce projections.

It must be reiterated that these projections reflect assumptions about the relationship between supply and demand at baseline, and the findings must be interpreted in the context of those assumptions. For NPs and PAs, baseline supply and demand were assumed to be in equilibrium, while, for physicians, demand was assumed to be equal to 2013 supply plus the approximately 8,200 physicians needed to de-designate the primary care HPSAs. If the baseline supplies of NPs and PAs, for example, are less than baseline demands, then projected 2025 NP and PA supplies may, in fact, be balanced by projected demands.

CONCLUSION

Health Resources and Services Administration's recently released health workforce projections suggest primary care provider shortages through 2025. Deficits are particularly notable in the Midwest and South, where physician shortages are coupled with shortages of other primary care providers. These findings must be interpreted in the context of baseline assumptions regarding supply, demand, provider-service ratios, and other factors. Still, these findings reveal geographies with likely future primary care shortages and suggest opportunities for increasing workforce flexibility through greater focus on team care and expanding NP and PA scopes of practice. These findings also underscore the importance of continuing to strengthen health workforce modeling to improve estimates of provider supply and demand.

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NOTES

1. Some definitions of primary care include gynecologists and obstetricians who may provide primary care to women. These providers are not included in the HWSM primary care projections, consistent with the Association of American Medical Colleges' 2016 report (IHS Inc 2016) and with legislation governing the Medicare and Medicaid programs presented in the Reconciliation Act of 2010. Physician estimates also do not include hospitalists.
2. Physicians include providers who have a Doctor of Medicine or Doctor of Osteopathic Medicine degree and who have completed their graduate medical education. Full-time equivalent (FTE) estimates do not include residents or fellows pursuing graduate medical education.
3. Expanded state license reciprocity for physicians may also help to address physician shortages (Rogove and Stetina 2015).

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.