The Complexities of Physician Supply and Demand: Projections from 2013 to 2025

Final Report

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This report was prepared for the Association of American Medical Colleges by

Tim Dall, Managing Director, Life Sciences

Terry West, Director

Ritashree Chakrabarti, Consultant

Will Iacobucci, Analyst

IHS Inc.

1150 Connecticut Ave., N.W.

Suite 401

Washington, DC 20036

EXECUTIVE SUMMARY

In 2010, the AAMC Center for Workforce Studies published an update to its 2008 report titled, *The Complexities of Physician Supply and Demand: Projections Through 2025*. The AAMC engaged IHS Inc. (IHS, www.ihs.com) to conduct a new study, incorporating the latest modeling methods and available data on trends and factors affecting the physician workforce. IHS is a publically traded company providing comprehensive economic modeling and forecasting services covering more than 170 industries in over 200 countries. The Life Sciences team at IHS conducts health economic and workforce studies for federal and state governments, trade and professional associations, for-profit Life Sciences companies, hospital systems, and non-profit organizations. The principal IHS consultant for this project, Tim Dall, helped develop the AAMC's workforce projections for the 2008 and 2010 reports.

Working with the AAMC Center for Workforce Studies, IHS identified key trends likely to affect the supply and demand for health care services and physicians over the next decade and projected future national adequacy of physician supply through 2025 under multiple scenarios. While the modeling took place at the detailed specialty level, projections for individual specialties were aggregated into four broad categories for reporting: primary care, medical specialties, surgical specialties, and "other" specialties.[1] To reflect future uncertainties in health policy and care use and delivery patterns, and to reflect the complexities inherent in modeling, projections are presented in ranges rather than a specific number.

Synopsis of Study Methods

This study used a microsimulation approach to project the supply of and demand for health care services and physicians. The supply and demand projection models have been used for health workforce modeling for federal and state governments, and for trade and professional associations for physician and other health occupations.

The supply model, under a Status Quo scenario, simulated the likely career decisions of physicians taking into consideration current numbers, specialty mix and demographics of new entrants to the physician workforce, retirement and mortality patterns, and patterns of patient care hours worked. Supply data and inputs came primarily from the 2013 AMA Physician Masterfile and take into consideration current national shortages for primary care and psychiatry based on the federal government's Health Profession Shortage Area analyses for primary care and mental health. (There are no equivalent designations for

[1] **Primary care** consists of general & family practice, general internal medicine, general pediatrics, and geriatric medicine. **Medical specialties** consist of allergy & immunology, cardiology, critical care, dermatology, endocrinology, gastroenterology, hematology & oncology, infectious diseases, neonatal-perinatal medicine, nephrology, pulmonology, and rheumatology. **Surgical specialties** consist of general surgery, colorectal surgery, neurological surgery, obstetrics & gynecology, ophthalmology, orthopedic surgery, otolaryngology, plastic surgery, thoracic surgery, urology, and vascular surgery. The **Other specialties** category consists of anesthesiology, emergency medicine, neurology, pathology, physical medicine & rehabilitation, psychiatry, radiology, and all other specialties.

shortages in other disciplines, so these specialties were assumed to be in equilibrium at baseline, potentially masking any existing shortages or surpluses.) Additional supply scenarios modeled were the implications if physician retirement patterns changed (including delaying retirement or retiring earlier by ± two years); younger physicians (those currently age<35 and new graduates) working fewer patient care hours compared with older cohorts; and a modest expansion of GME programs.

The demand model simulated the implications of changing demographics as the population grows and ages, along with projected changes in disease prevalence and other health risk factors among the population if health care use and delivery patterns remained unchanged. Then, the implications of expanded medical insurance coverage changes associated with the Affordable Care Act (ACA) were modeled. To reflect likely changes over the next decade in care use and delivery patterns, we modeled scenarios assuming growth in integrated care delivery models, assuming expanded use of retail clinics where care is often provided by nurse practitioners and physician assistants, and increased staffing of advanced practice nurses (APRNs). We also discuss the implications of the rapidly growing supply of physician assistants, as well as other trends that might affect demand such as growth in concierge practice, uncertainties around immigration reform, and changes in medicine and technology. Insufficient data are available currently to develop reliable projections of future physician demand related to these trends. Modeling scenarios will be developed in the future as data become available.

Key Findings

Study results suggest the demand for physician services is growing faster than supply. While growth in the supply of APRNs and other health occupations may help to alleviate projected shortfalls to an extent, even taking into consideration potential changes in staffing, the nation will likely face a growing shortage in many physician specialties—especially surgery-related specialties. A multi-pronged strategy will be needed to help ensure that patients have access to high-quality care.

All supply and demand projections are reported as full time equivalent (FTE) physicians, where an FTE is defined for each specialty as the average weekly patient care hours for that specialty.[2] Key findings include:

- **Demand for physicians continues to grow faster than supply, leading to a projected shortfall of between 46,100 and 90,400 physicians by 2025**. Although physician supply is projected to increase modestly between 2013 and 2025, demand will grow more steeply (Exhibit ES-1). Across scenarios modeled, total physician demand is projected to grow by 86,700 to 133,200 (11-17%), with population growth and aging accounting for 112,100 (14%) in growth. By comparison, physician supply will likely increase by 66,700 (9%) if labor force participation patterns remain unchanged,

[2] For example, if average patient care hours per week in a particular specialty were 40 hours, but an individual physician in that specialty with a given age and sex was projected to work 35 hours, then that physician would be counted as 0.875 FTEs (=35/40 hours). Average patient care hours worked per week ranged from a low of 35.3 hours for preventive medicine to a high of 54.3 hours for neonatal & perinatal medicine.

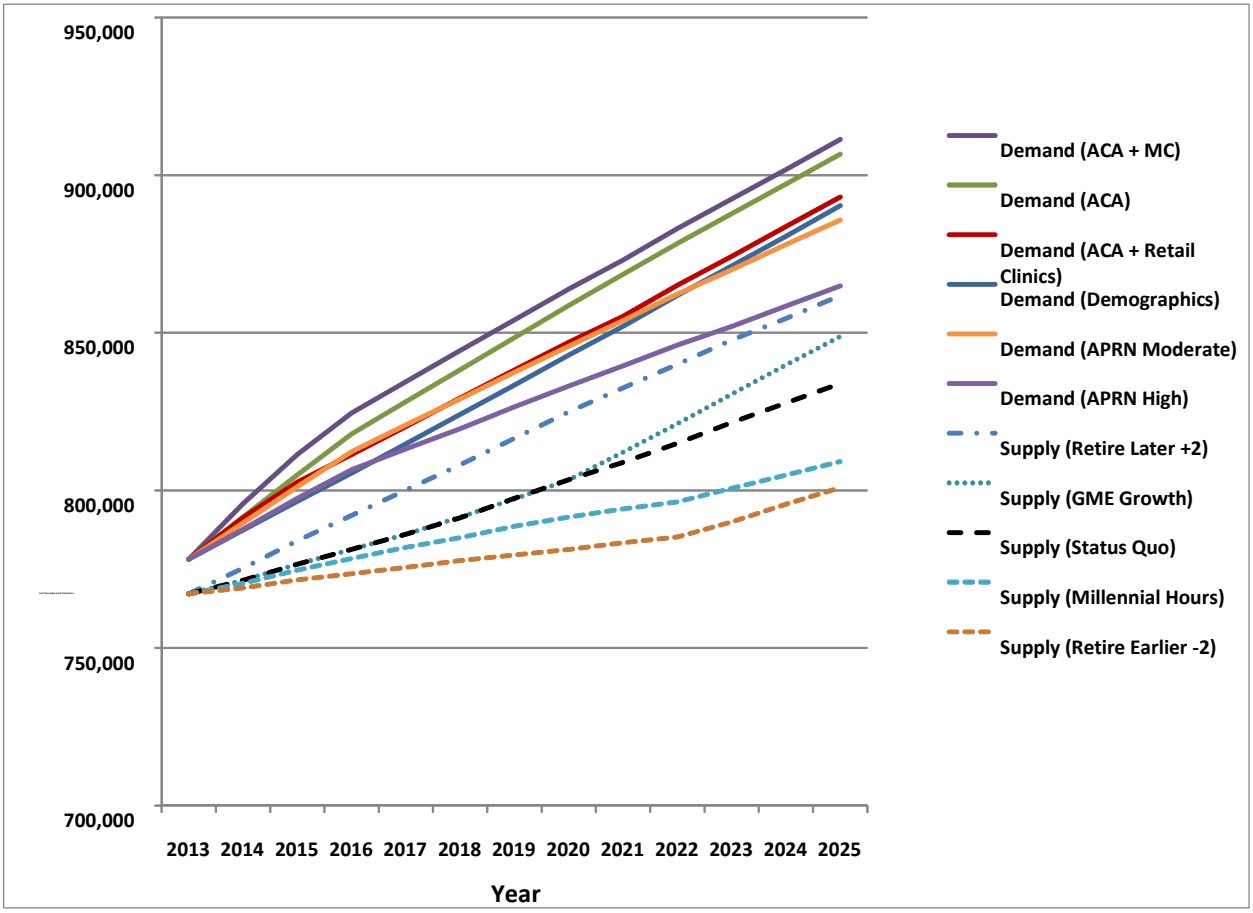
with a range of 33,700 to 94,600 (4-12%), reflecting uncertainty regarding future retirement and hours-worked patterns.

- **Projected shortfalls in primary care will range between 12,500 and 31,100 physicians by 2025, while demand for non-primary care physicians will exceed supply by 28,200 to 63,700 physicians.** The shortfall range reflects comparisons of all the supply scenarios to all the demand scenarios, and uses the 25th to 75th percentiles of projected shortages across the comparisons. These percentiles reflect that the extreme shortage/surplus projections are least likely to occur as the extreme shortage/surplus projections compare the highest/lowest demand projections to the lowest/highest supply projections.
- **Expanded medical coverage achieved under ACA once fully implemented will likely increase demand by about 16,000 to 17,000 physicians (2.0%) over the increased demand resulting from changing demographics**. The Congressional Budget Office estimates that 26 million people who otherwise would be uninsured in the absence of ACA eventually will have medical insurance. Taking into consideration the health and risk factors of the population likely to gain insurance and estimated changes in care utilization patterns associated with gaining medical insurance, the projected increase in demand for physician services is about 2.0%. The increase is highest (in percentage terms) for surgical specialties (3.2%), followed by primary care (2.0%), medical specialties (1.7%), and "all other" specialties (1.5%). Within these broad categories there are differences in the impact of ACA for individual specialties.
- **The lower ranges of the projected shortfalls reflect the rapid growth in supply of advanced practice clinicians and the increased role these clinicians are playing in patient care delivery; even in these scenarios, physician shortages are projected to persist**. New payment methodologies, including bundled payments and risk-sharing arrangements, and innovations in technology, suggest that the work of health professionals may be restructured in the coming years. Given the number of nurse practitioners, certified nurse midwives, and certified registered nurse anesthetists graduating each year, if labor force participation patterns remain unchanged then the supply of advanced practice nurses (APRNs) will grow more rapidly than is needed to keep pace with growth in demand for services at current APRN staffing levels. These trends suggest that an additional 114,900 APRNs could be available to absorb into the health care system to both expand the level of care currently provided to patients and help offset shortages of physicians. Similarly, the supply of physician assistants (PAs) is projected to increase substantially between 2013 and 2025, though additional research is needed to quantify the expected impact. While this rapid growth in supply of APRNs and PAs could help reduce the projected magnitude of the physician shortage, the extent to which some specialties (e.g., surgery specialties) can continue to absorb more APRNs and PAs given limited physician supply growth is unclear.
- **Due to new data and the dynamic nature of projected assumptions, the projected shortfalls of physicians in 2025 are smaller than shortfalls projected in the earlier study.** We project that demand for physicians in 2025 will exceed supply by 46,100 to 90,400. This compares with a 130,600 shortfall projected in the 2010 study. Current projections suggest primary care physician demand in 2025 will exceed supply by 12,500 to 31,100 physicians (the 2010 study projected a 65,800 shortfall, about half the overall shortage). The projected shortfall for non-primary care is 28,200 to 63,700

(versus a projected shortfall of 64,800 in the 2010 study). Factors explaining differences between the 2015 and 2010 projections include:

- The U.S. Census Bureau revised downward its 2025 population projections by about 10.2 million people (from 357.5 million to 347.3 million). This downward revision equates to approximately 24,000 lower FTE demand for physicians.
- The number of physicians completing their graduate medical education has risen from about 27,000 to about 29,000 annually.
- The new projections more closely reflect implementation of ACA, growth in supply of advanced practice clinicians, and trends in use of health care services.
- The 2010 study assumed that supply and demand were in equilibrium in 2008 for all specialties except primary care, whereas this update assumes supply and demand were in equilibrium in 2013 for all specialties except primary care and psychiatry. Hence, the new demand projections extrapolate a "2013" level of care delivery compared with the "2008" level of care delivery extrapolated by the earlier 2010 projections.

Exhibit ES-1: Projected Total Supply and Demand for Physicians, 2013-2025



Conclusions

Projections of future supply and demand for physicians suggest a shortfall of 46,100 to 90,400 physicians, including a shortfall of 12,500 to 31,100 primary care physicians and a shortfall of 28,200 to 63,700 non-primary care physicians.[3] In percentage terms the shortfall is greatest among surgical specialties (excluding obstetrics and gynecology) reflecting little projected growth in supply of surgeons and limitations on the ability to augment staffing with other types of clinicians.

Uncertainties regarding how emerging care delivery models and changing care practices might affect physician supply and demand, together with uncertainties regarding how clinicians and care settings will respond to economic and other trends, underscore the importance of ongoing research on potential implications of the evolving health care system for the nation's physicians. The large range for the shortage projections reflects uncertainty about key supply and demand determinants, reflecting important areas for future research. These include: 1) how physician retirement patterns might change over time based on economic factors, work satisfaction, trends in health and mortality, and cultural norms regarding retirement; 2) whether younger physicians will continue to have similar work-life balance expectations as older cohorts; 3) how clinician staffing patterns are likely to evolve over time; and 4) the effects of different payment models.

Differences in projections between this 2015 report and the 2008 and 2010 reports reflect updates to key supply and demand drivers (e.g., population projections) and acceleration in the pace of change in health care delivery. These differences in projections highlight the importance of continually monitoring projected adequacy of supply to incorporate the latest trends in supply and demand determinants, the latest research on care delivery models (e.g., Accountable Care Organizations), and changing technology and economic conditions.

[3] The shortage range for physicians overall is smaller than the sum of the ranges for primary and non-primary care, reflecting that future demand for health care services will be provided by physicians, but in some instances it is uncertain whether that care will be provided by a primary care physician or by a specialist.

I. INTRODUCTION

Training the right number and mix of health professionals is vital to ensuring the nation's goals of access to high quality, affordable health care services. The use of health care services, the available supply of services, and how care is delivered is determined by the choices made by consumers, practicing health professionals, health care facilities, payers, employers, and federal and state regulatory and payment policies. In their capacity of diagnosing and managing patient care, physicians play a vital role in achieving these national goals. Having an accurate picture of the current and projected future size, specialty mix and characteristics of the nation's physician workforce and an accurate picture of future demand for services is essential to inform policy and planning initiatives; to guide medical school and graduate medical education residency training priorities; and to ensure that the nation has a future physician workforce that can continue to provide access to high quality and affordable care.

The AAMC Center for Workforce Studies published a 2008 study (updated in 2010) that documented the adequacy of future physician supply and summarized the implications of selected trends and policies likely to impact physician supply and demand. The report concluded that by 2025 demand would likely exceed supply by about 130,600 physicians. Primary care accounted for about half of this projected shortage. Since the 2010 report, the number of physicians trained annually has increased, the size of the nurse practitioner (NP) and physician assistant (PA) workforce has increased, the nation has experienced turbulent economic conditions that have affected supply and demand for health care services, the ACA was enacted with ongoing implementation of policies and new requirements, and new data have become available on the characteristics and projected changing demographics of the U.S. population. Furthermore, the use of services and care delivery patterns continue to evolve based on emerging care delivery models such as ACOs, shifts in value-based payment models, and advances in medical and information technology.

Between 2013 and 2025, the nation's population is projected to grow from 316.5 million to 347.3 million (10%). During this period the population aged 65 and over is projected to grow 46%, while the population under age 18 is projected to grow only 5%.[4] Changing demographics portend rapid growth in health care service needs for the elderly, while demand for pediatric services will grow more slowly.

Expanded health insurance coverage under the ACA is projected to increase demand for a wide range of medical services. Hofer et al. (2011) project that demand for primary care physicians in the U.S. will rise by between 4,310 and 6,940 as a result of the ACA.[5] Estimates of the ACA insurance expansion impact by

[4] U.S. Census Bureau. 2014 National Population Projections. http://www.census.gov/population/projections/data/national/2014.html

[5] Hofer AN, Abraham JM. and Moscovice I. Expansion of Coverage under the Patient Protection and Affordable Care Act and Primary Care Utilization. *Milbank Quarterly*, 2011; 89: 69–89.

Dall et al. (2013) suggest the nation will experience approximately a 2% increase in demand for adult primary care physicians—with the ACA impact higher for select medical specialties.[6]

The AAMC engaged IHS Inc. (IHS, www.ihs.com) to conduct a new study, incorporating the latest modeling methods and available data on trends and factors affecting the physician workforce. IHS is a publically traded company providing comprehensive economic modeling and forecasting services covering more than 170 industries in over 200 countries. The Life Sciences team at IHS conducts health economic and workforce studies for federal and state governments, trade and professional associations, for-profit Life Sciences companies, hospital systems, and non-profit organizations. The principal IHS consultant for this project, Tim Dall, helped develop the AAMC's workforce projections for the 2008 and 2010 reports.

Working with the AAMC Center for Workforce Studies, IHS identified key trends likely to affect the supply and demand for health care services and physicians over the next decade and projected future national adequacy of physician supply through 2025 under multiple scenarios. While the modeling took place at the detailed specialty level, projections for individual specialties were aggregated into four broad categories for reporting: primary care, medical specialties, surgical specialties, and "other" specialties.[7] To reflect uncertainties in future health policy, care use and delivery patterns, as well as the complexities inherent in modeling, ranges are presented for the projected shortage of physicians rather than a specific shortage number.

The remainder of this report is organized to present an overview of supply data and modeling methods and supply projections (Section II) followed by a similar overview of physician demand (Section III). Then, the report compares supply and demand to discuss current and projected future adequacy of physician supply (Section IV). Conclusions are discussed in Section V. Appendix A provides additional detail on modeling data and methods, while Appendix B contains additional supply and demand projections.

II. CURRENT AND PROJECTED FUTURE SUPPLY OF PHYSICIANS

This study used a microsimulation approach to project the future supply of physicians based on the number and characteristics of the current supply, the number and characteristics of new entrants to the physician workforce, hours worked patterns, and retirement patterns. This model has been used to

[6] Dall TM, Gallo PD, Chakrabarti R, West T, Semilla AP, Storm, MV. An Aging Population and Growing Disease Burden Will Require A Large and Specialized Health Care Workforce By 2025. *Health Affairs*, 2013; 32:2013-2020. http://content.healthaffairs.org/content/32/11/2013.abstract

[7] **Primary care** consists of general & family practice, general internal medicine, general pediatrics, and geriatric medicine. **Medical specialties** consist of allergy & immunology, cardiology, critical care, dermatology, endocrinology, gastroenterology, hematology & oncology, infectious diseases, neonatal-perinatal medicine, nephrology, pulmonology, and rheumatology. **Surgical specialties** consist of general surgery, colorectal surgery, neurological surgery, obstetrics & gynecology, ophthalmology, orthopedic surgery, otolaryngology, plastic surgery, thoracic surgery, urology, and vascular surgery. The **Other specialties** category consists of anesthesiology, emergency medicine, neurology, pathology, physical medicine & rehabilitation, psychiatry, radiology, and all other specialties.

project the future supply of health professionals at the national, state, and sub-state levels.[8] The model simulates the labor force participation patterns of physicians currently practicing and a constructed simulation population representative of physicians projected to enter the workforce after completing their graduate medical education through 2025.

Current Physician Workforce

The supply modeling starts with the 2013 American Medical Association (AMA) Physician Masterfile to identify the size and characteristics of the current workforce. In 2013 there were approximately 767,100 physicians under age 75 in active practice and who had completed their graduate medical education. Women comprised close to a third (31%) of the workforce. Physician between age 65 and 75 comprised 10% of the active workforce, and these physicians are within the traditional retirement age (Exhibit 1). Physicians between age 55 and 64 comprise 26% of the active workforce and many in this age group will retire within the next decade. Therefore, it is likely that up to a third or more of all physicians could retire within the next decade.

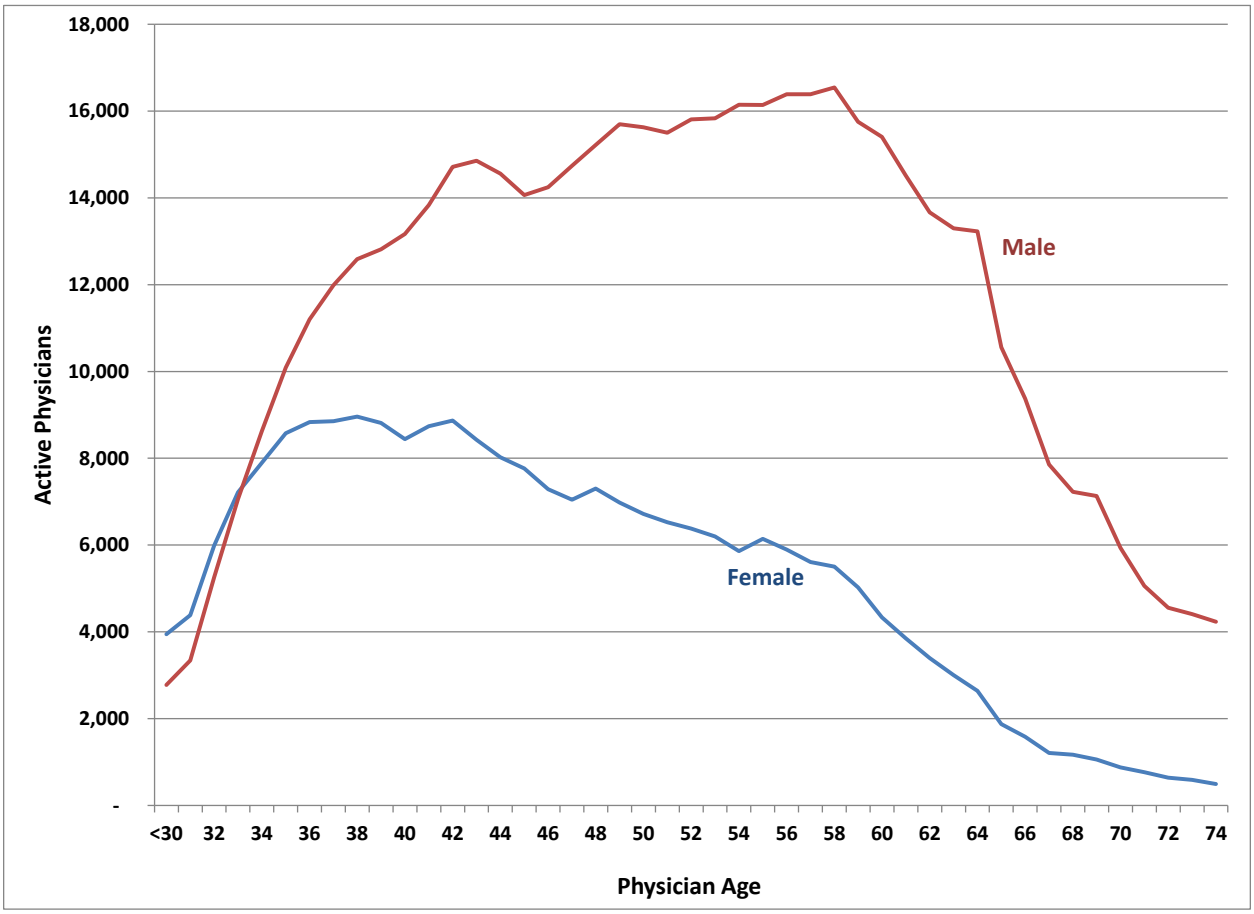
[8] Dall TM, Storm MV, and Chakrabarti R. Supply and demand analysis of the current and future US neurology workforce. *Neurology*. 2013; 81(5): 470-478. http://www.neurology.org/content/early/2013/04/17/WNL.0b013e318294b1cf.short.

Dall TM, Storm MV, and Chakrabarti R. The Primary Care workforce in Arkansas: current and Future Supply and Demand. The Arkansas Center for Health Improvement. September, 2012.

Dall TM, West TW, Semilla, A, and Chakrabarti R. Florida Statewide and Regional Physician Workforce Analysis: Estimating Current and Forecasting Future Supply and Demand. Safety-Net Hospital Alliance of Florida. February 2015.

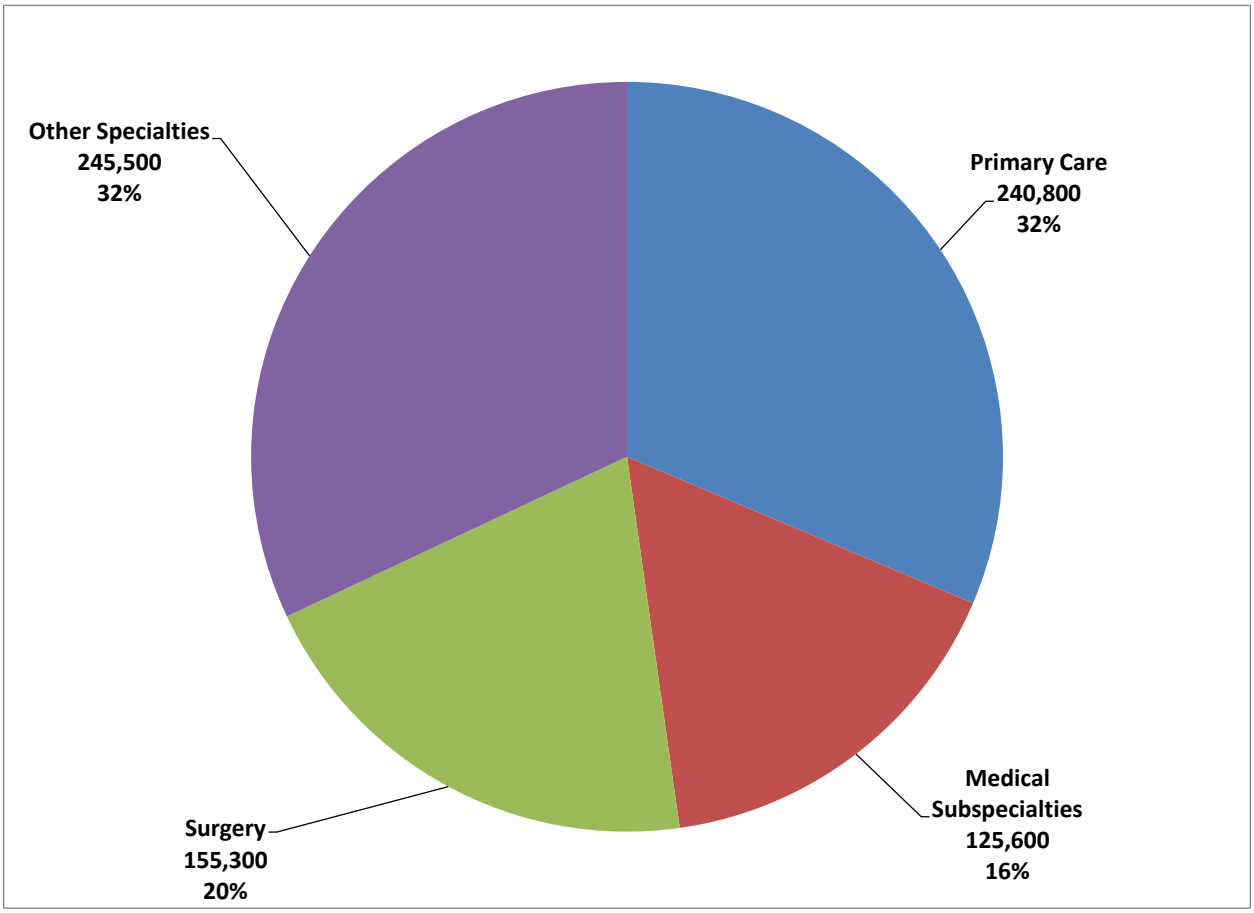
Health Resources and Services Administration. The Future of the Nursing Workforce: National-and-State-Level Projections, 2012-2025. Bureau of Health Workforce National Center for Health Workforce Analysis. December 2014. http://bhpr.hrsa.gov/healthworkforce/supplydemand/nursing/workforceprojections/index.html

Exhibit 1: Age Distribution of Active Physicians, 2013



The approximately 240,800 active primary care physicians comprised 32% of the workforce, with another 125,600 (16%) in medical specialties, 155,300 (20%) in surgical specialties, and 245,500 (32%) in the remaining specialties (Exhibit 2).

Exhibit 2: Specialty Distribution of Active Physicians, 2013



New Entrants

Under the Status Quo supply scenario, we model the number of physicians completing their graduate medical education (GME) each year remaining at current levels - approximately 29,000. Data to estimate the number, specialty distribution, age distribution, and sex distribution of physicians completing GME were derived from analysis of the 2013 AMA Physician Masterfile and published data from the AMA and Board members of the American Board of Medical Specialties.[9] Annually, this includes approximately 8,500 (29%) physicians entering primary care specialties, 5,200 (18%) entering medical subspecialties, 5,200 (18%) entering surgical specialties, and 10,100 (35%) entering other specialties.

[9] Brotherton SE, Etzel SI. Graduate Medical Education, 2013-2014. *JAMA*. 2014;312(22):2427-2445. http://jama.jamanetwork.com/article.aspx?articleid=2020352

See, for example, the American Board of Internal Medicine (ABIM). Resident & Fellow Workforce Data. http://www.abim.org/about/examInfo/data-workforce.aspx

We modeled one scenario to reflect the possible expansion of federally-funded GME slots. The GME expansion scenario is based on the proposed Resident Physician Shortage Reduction Act of 2013 and assumes increasing Medicare supported GME slots by 3,000 annually between 2017 and 2021. It is unknown which specialties might gain residency slots, so for modeling purposes we assume that all specialties will gain the same proportion of slots. A 3,000 increase in slots is a 10.3% increase from current levels of 29,000 GME graduates. Therefore, under this scenario slots are increased by 10.3% for all specialties. This scenario is shown when comparing supply and demand to illustrate the potential implications of expanding GME. However, this policy scenario was not included for purposes of computing the magnitude of the projected shortfall of physicians.

Hours Worked Patterns

Supply projections take into consideration differences in average hours per week spent in patient care by physician age, sex, and specialty. Analysis of year 2012-2013 survey data (n=18,016) of physicians in Florida who renewed their license and who work at least 8 hours per week in professional activities found that controlling for age and sex, patient care hours per week ranged from a low of 35.3 hours preventive medicine to a high of 54.3 for neonatal & perinatal medicine (Exhibit A-5). Controlling for specialty, hours worked per week were relatively constant through age 59 for men, but decreased beyond age 60 (especially after age 65). Female physicians worked about 5 hours fewer per week than their male counterparts through age 54, but among those age 55 and older worked only about 1-2 fewer hours per week than males of similar age and specialty. Analysis of survey data for physicians in Maryland showed similar patterns by age, sex, and specialty though average hours worked were slightly lower than hours worked in Florida. For modeling purposes, we used the Florida survey data because it is a robust sample size, includes current data on physician characteristics and is reviewed annually by the Florida Department of Health to ensure quality. We divided projected patient care hours per week for a physician of a given age, sex, and specialty by the average patient care hours across all physicians currently in that specialty to calculate a full time equivalent (FTE) rate for each age and sex. One FTE is defined as the average patient care hours worked per week, so older physicians tended to count as slightly less than one FTE while younger physicians tended to count as slightly more than one FTE. Using this approach to counting FTEs facilitates comparisons of FTEs over time as all estimates are relative to 2012-2013.

Millennial Hours Worked Patterns

Within the broader labor force (i.e., beyond the physician workforce) there is some indication of a possible “cohort effect.” Namely, younger workers might desire to work fewer hours than their older counterparts. However, within the physician workforce there are counterbalancing factors. Younger physicians might prefer to work fewer hours and maintain a better work-life balance. On the other hand, rising debt levels for graduating physicians could spur increased hours worked. Analysis by the AAMC’s Center for Workforce Studies comparing self-reported hours worked per week from the 1980 Census to hours reported in the 2009-2011 files of the American Community Survey suggest that male physicians age 26-35 worked 5.4 fewer hours per week in 2010 relative to 1980. Hours worked per week for physicians above age 35 were similar between 2010 and 1980. A 3.5 decline in hours worked per week

was observed among women physicians age 26 to 35 when comparing 1980 to 2010 hours worked patterns, though among female physicians above age 35 hours worked were higher in 2010 versus 1980. This may reflect more women entering surgery and other specialties that traditionally have worked more hours per week.

The supply scenarios modeled all use current patterns of hours worked to model the implications of changing demographics among the physician workforce, with the exception of the Millennial Hours scenario which assumes that physicians currently under age 35 will continue to work approximately 7% fewer hours per week relative to earlier cohorts.

Workforce Attrition Patterns

The supply model used age-sex-specialty dependent annual attrition probabilities to simulate providers leaving the workforce. These attrition probabilities include probability of leaving the workforce due to career change or retirement and mortality probability. Retirement patterns are based on analysis of the combined 2012 and 2013 Florida Physician Workforce Surveys) data on whether the respondents plan to retire within the next five years. These responses were generally consistent with historical retirement patterns generated from analysis of a 2006 survey of physicians age 50 and older conducted by the AAMC and used in the 2008 and 2010 study projections.[10] Included in that AAMC survey sample was a population of retired physicians who were asked at what age they had retired.

Mortality rates by age and sex come from the Centers for Disease Control and Prevention. These rates account for people in professional occupations having lower mortality rates through age 65 relative to national average mortality rates. Johnson et al. estimate age-adjusted mortality rates for professional and technical occupations are approximately 25% lower than national rates for men and 15% lower for women.[11] A summary of workforce participation rates is provided in the appendix (Exhibit A-6), and shows how many physicians are likely to still be in the workforce from an initial cohort of 100 physicians. Patterns for male and female physicians are similar within specialties, but differ slightly by specialty. For example, a cohort of 100 physicians in allergy & immunology will have about 68 still in active practice by age 65 and 45 still in practice by age 70. Emergency physicians have a much higher attrition rate. From a cohort of 100 emergency physicians age 50, only 47 are still active at age 65 and 23 are still active at age 70 (with many in this older age working reduced hours). Specialties with the highest attrition rates are emergency medicine, anesthesiology, radiology, and general surgery.

[10] These 2006 retirement patterns were used to develop U.S. physician supply projections for the following reports:

Dill MJ and Salsberg ES. *The Complexities of Physician Supply and Demand: Projections through 2025*. Association of American Medical Colleges, November 2008.

U.S. Department of Health and Human Services. *The Physician Workforce: Projections and Research into Current Issues Affecting Supply and Demand*. 2008.

[11] Johnson NJ, Sorlie PD, Backlund E. The Impact of Specific Occupation on Mortality in the U.S. National Longitudinal Mortality Study. *Demography*. 1999; 36(3):355-367.

All supply scenarios model current attrition rates. However, reflecting uncertainty about when physicians might retire in the future we model scenarios where physicians retire two years earlier or two years later, on average, relative to current patterns. The delayed retirement scenario reflects that physicians might decide to delay retirement for financial and health reasons (i.e., living longer) and the raising of eligibility age for programs like Social Security (which may have less influence on physicians relative to other occupations).

Supply Projections

Projections for total FTE supply are summarized by scenario (Exhibit 3 and Exhibit 5) and specialty category (Exhibit 4), with annual projections by specialty category summarized in Appendix B. Under the Status Quo scenario, total physician supply increases from 767,200 in 2013 to 833,900 FTEs in 2025, a 9% increase which is slightly less than the growth rate for the overall U.S. population. By 2025, total projected FTE supply is higher relative to Status Quo under the Delayed Retirement scenario (+27,900) and GME Expansion scenario (+14,900). Supply will be lower if younger physicians reduce their average patient care hours worked relative to current patterns (-20,800), or if physicians start to retire earlier than current patterns (-33,000).

These scenarios show the implications of changing one supply determinant in isolation. Under a combined scenario (e.g., retire later and Millennials work fewer hours) the supply impacts are additive (as the impact of retirement primarily affects older physicians while the hours worked impact affects younger physicians). Therefore, average delays in retirement of two years combined with Millennials working fewer hours equates to about a 3,100 increase (=27,900-24,800) in supply relative to the Status Quo Scenario.

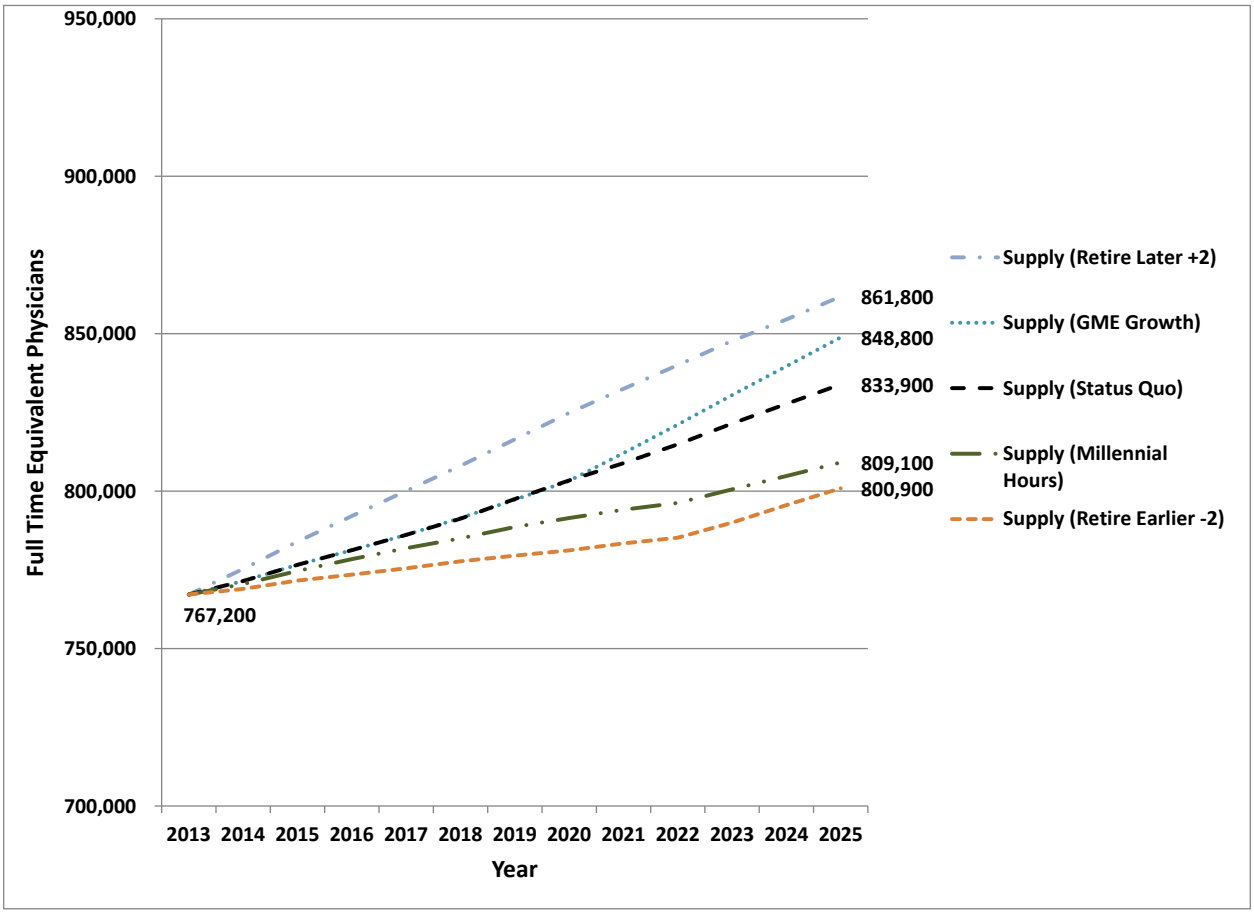
Exhibit 3: Total FTE Supply, 2013-2025

	Workforce Participation Scenarios				Policy Scenario
Year	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Millennial Hours	GME Expansion
2013	767,200	767,200	767,200	767,200	767,200
2014	771,500	769,000	775,300	770,500	771,500
2015	776,600	771,600	784,000	774,700	776,600
2016	781,300	773,500	792,100	778,400	781,300
2017	786,100	775,500	800,100	781,900	786,100
2018	791,300	777,700	808,100	785,000	791,500
2019	797,500	779,500	816,500	788,600	797,300
2020	803,400	781,200	824,900	791,500	803,300
2021	808,900	783,400	832,500	794,100	812,100
2022	814,900	785,200	840,000	796,300	821,100
2023	821,500	790,000	847,700	800,600	830,500
2024	827,700	795,600	854,500	804,800	839,700
2025	833,900	800,900	861,800	809,100	848,800
% growth 2013-2025	9%	4%	12%	5%	11%

Exhibit 4: FTE Supply Projection Summary by Specialty Category, 2013-2025

	Workforce Participation Scenarios				Policy Scenario
Year	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Millennial Hours	GME Expansion
2013					
Total	767,200				
Primary Care	240,800				
Non-primary Care	526,400				
Medical Specialties	125,600				
Surgical Specialties	155,300				
Other Specialties	245,500				
2025					
Total	833,900	800,900	861,800	809,100	848,800
Primary Care	266,700	256,700	275,600	259,500	271,200
Non-primary Care	567,200	544,200	586,200	549,600	577,600
Medical Specialties	142,500	137,000	146,700	138,100	144,900
Surgical Specialties	155,100	148,100	160,500	150,600	157,600
Other Specialties	269,600	259,100	279,000	260,900	275,100
Growth 2013 to 2025					
Total	66,700	33,700	94,600	41,900	81,600
Primary Care	25,900	15,900	34,800	18,700	30,400
Non-primary Care	40,800	17,800	59,800	23,200	51,200
Medical Specialties	16,900	11,400	21,100	12,500	19,300
Surgical Specialties	-200	-7,200	5,200	-4,700	2,300
Other Specialties	24,100	13,600	33,500	15,400	29,600

Exhibit 5: Projected Supply of Physicians, 2013-2025



III. CURRENT AND PROJECTED FUTURE DEMAND FOR PHYSICIANS

This section briefly describes the demand modeling approach for health care services and physicians, and presents study findings. Additional information about the modeling approach is provided in Appendix A, and information about the model and model validation activities has been published elsewhere.[12]

[12] Dall TM, Gallo PD, Chakrabarti R, West T, Semilla AP, Storm, MV. An Aging Population and Growing Disease Burden Will Require A Large and Specialized Health Care Workforce By 2025. *Health Affairs*. 2013; 32:2013-2020. http://content.healthaffairs.org/content/32/11/2013.abstract

Dall TM, Chakrabarti R, Storm MV, Elwell EC, and Rayburn WF. Estimated Demand for Women's Health Services by 2020. *Journal of Women's Health*. 2013; 22(7): 643-8. http://www.ncbi.nlm.nih.gov/pubmed/23829185

Demand for health care services is defined as the level and mix of services that consumers are able and willing to purchase at current prices given epidemiological and economic considerations. Demand for physicians is calculated based on demand for health care services and staffing patterns for care delivery. For example, if demand for emergency visits increased by 15% and staffing patterns remained unchanged, then one would project that demand for emergency physicians would increase by approximately 15% (assuming that patient acuity levels remained relatively constant over time). For modeling purposes, at the national level we quantify current demand for health care services (and physicians) as equivalent to the level of health care services actually utilized (and current physician supply) with two exceptions. One, the federal government estimates that in 2013 the nation required approximately 8,200 additional primary care physicians to de-designate the federally designated primary care health professional shortage areas (HPSA). Two, the federal government estimates approximately 2,800 psychiatrists were needed in 2013 to de-designate the federally designated mental health professional shortage areas.[13] For modeling, we assume that these 8,200 and 2,800 numbers reflect national shortfalls. As discussed in the next section, the assumption that supply and demand are roughly in equilibrium in 2013 is a conservative assumption in terms of the demand for physicians, in that there is evidence of national shortfalls for some medical specialties but, unlike the federal HPSA designation, no systematic study has been conducted to quantify current shortfalls (or current excess supply) across medical specialties.

Demand Model Overview

This study used a microsimulation approach that simulates the demand for health care services for a nationally representative sample of the current U.S. population projected to 2025. Then, demand for physicians is modeled to meet the demand for services. The model has three major components.

- **Population database**: A representative sample of the U.S. population was constructed by combining data from the U.S. Census Bureau's 2013 American Community Survey, the Centers for Disease Control and Prevention's (CDC) 2011 and 2013 Behavioral Risk Factor Surveillance System files, and CDC's 2004 National Nursing Home Survey. The resulting database has approximately two million individuals, and for each person contains demographics (age, sex, race/ethnicity); socioeconomic characteristics (household income, medical insurance type); health risk factors (body weight category, current smoking status); disease presence (diagnosed with arthritis, asthma, cardiovascular disease, diabetes, or hypertension; history of heart attack, history of stroke); and residence in a metropolitan or non-metropolitan area. Using Census Bureau population projections,

Dall TM, Storm MV, and Chakrabarti R. Supply and demand analysis of the current and future US neurology workforce. *Neurology*. 2013; 81(5): 470-478. http://www.neurology.org/content/early/2013/04/17/WNL.0b013e318294b1cf.short

Health Resources and Services Administration. *The Future of the Nursing Workforce: National-and-State-Level Projections, 2012-2025*. Bureau of Health Workforce National Center for Health Workforce Analysis. December 2014. http://bhpr.hrsa.gov/healthworkforce/supplydemand/nursing/workforceprojections/index.html

[13] Health Resources and Services Administration. *Shortage Designation: Health Professional Shortage Areas & Medically Underserved Areas/Populations*. http://www.hrsa.gov/shortage/

the sample weights for individuals in the population database were scaled to reflect projections of the number and demographic characteristics of the population each year through 2025.

- **Health care use forecasting equations:** Patterns of health seeking behavior were generated by regression analysis using data from approximately 169,000 participants in the pooled 2008-2012 files of the Medical Expenditure Panel Survey and the 2012 Nationwide Inpatient Sample. The prediction equations model use of health care services based on patient characteristics. As shown in Exhibit A-2, for example, controlling for other patient risk factors adults with medical insurance have over twice as many cardiologist office visits relative to a similar uninsured person, with no statistically different use patterns in emergency visits and hospitalizations associated with having medical insurance. Use of cardiology services is highly correlated with patient age, presence of cardiovascular disease, presence of diabetes and other chronic conditions, and living in a metropolitan (vs non-metropolitan) area. Separate prediction equations were estimated for adults versus children, by care delivery setting (office, outpatient, emergency, inpatient), and by medical specialty.
- **Provider staffing patterns**: Demand for physicians is linked to demand for health care services, taking into account estimates of the portion of time that physicians spend providing care in different delivery settings. Data on provider productivity to estimate the portion of a physician FTE associated with patient encounters in different care settings came from numerous sources—including the Medical Group Management Association's Physician Compensation and Production Survey, the American Board of Internal Medicine Practice Characteristics Survey, and surveys and workforce studies conducted for individual medical specialties. The approach estimates how each health care encounter (by delivery setting) translates to a portion of a physician FTE demanded.

Demand Scenarios

We projected demand under six scenarios that reflect different assumptions regarding use of health care services and care delivery. All scenarios reflect changing demographics from 2013 to 2025. With the exception of the first scenario that reflects only changing demographics, all other scenarios include the projected impact of expanded medical insurance coverage under ACA. Additional scenarios explore the potential implications of greater use of integrated care delivery models, retail clinics and APRNs. Scenarios not included in the demand projections but analyzed for informational purposes discuss the growth in supply of physician assistants, trends in concierge primary care practice, immigration reform and the potential implications for use of health care services, increased use of tele-health and other new technology developments and national goals to reduce hospital admissions for ambulatory sensitive conditions and readmissions.

Changes in technology, reimbursement policies, and other trends not modeled also could affect future demand for services. For example, efforts to control medical costs could lead to larger patient out-of-pocket expenses for items such as hip and knee replacements. Larger out-of-pocket expenses could dampen demand for services, resulting in slower projected growth in demand for orthopedic surgeons and other specialties. Medical and technological advances could increase demand for services by creating future treatment options currently unavailable, or could decrease demand for physicians by improving productivity or curing diseases.

Scenario 1: Changing demographics

This scenario first takes into account projected population growth and changing demographics from 2013 to 2025, but assumes the status quo in terms of care use and delivery patterns. A person with a given set of health risk factors is assumed to have the same health care use patterns in 2025 as a similar person in 2013.[14] Staffing mix and provider productivity are assumed unchanged between 2013 and 2025. This scenario simply shows how demand will change based on changing demographics.

The U.S. population is projected to grow by close to 10% during this period—from 316.5 million to over 347.3 million. The population under age 18 is projected to grow by only 5%, while the population aged 65 and over is projected to grow by 46%. Percentage growth in demand for services used by the elderly population, therefore, is projected to be much higher than percentage growth in demand for pediatric services. Analysis by the IMS Institute for Health Informatics suggests that between 2012 and 2013 office-based primary care visits declined by 0.7%, while demand for office-based specialist visits increased by 4.9%.[15] Over the next decade, because prevalence of chronic disease is highest among the elderly, changing demographics are likely to increase demand for specialty care at a faster rate than demand for primary care services.

Scenario 2: ACA expanded medical insurance coverage

In addition to modeling the implications of changing demographics, this scenario also models the anticipated change in health care use patterns as more people gain medical insurance under the Affordable Care Act. In April 2014, the Congressional Budget Office (CBO) projected that the number of uninsured would decline by about 12 million in 2014, 19 million in 2015, and 26 million in 2017 and beyond.[16] To model the demand implications of gaining medical coverage under ACA, we first simulated who is likely to gain coverage under ACA based on a person's citizenship status (as a proxy for citizen or legal immigrant), household income, health status, and demographics (reflecting that young, healthy individuals are less likely to seek coverage relative to individuals who are less healthy and will likely have greater medical needs). We then simulated how gaining coverage will likely affect use of services given the newly insured person's health risk factors. We assume that a newly insured person will use health care services at the same rate as their commercially insured peers (i.e., similar to a person with the same demographics, same household income, same weight and smoking status, and same in terms of presence of the chronic medical conditions modeled).

Previously published results from the microsimulation model are that expanded medical insurance coverage under ACA will have different magnitudes of effects based on by medical specialty and care

[14] U.S. Census Bureau. 2014 National Population Projections. http://www.census.gov/population/projections/data/national/2014.html

[15] Source: IMS Institute for Health Informatics, "Medicine Use and Shifting Costs of Healthcare: A Review of the Use of Medicines in the U.S. in 2013," April 2014.

[16] Congressional Budget Office. Insurance Coverage Provisions of the Affordable Care Act—CBO's April 2014 Baseline; Table 2. https://www.cbo.gov/sites/default/files/cbofiles/attachments/43900-2014-04-ACAtables2.pdf

delivery setting. Examples of increased visits to doctor offices include a 5.2% increase for otolaryngology, a 5.0% increase for both urology and dermatology, and a 4.7% increase for gastroenterology, with other specialties experiencing smaller increases.[17] For comparison, adult primary care specialties were projected to experience a 2.0% increase in demand for office visits.

The remaining scenarios below all build on Scenario 2 and reflect both changing demographics and expanded medical insurance coverage under ACA.

Scenario 3: Integrated care delivery model scenario

A variety of integrated care delivery models are being implemented for use with both publicly and privately insured populations. These models range in scope from integrated/holistic approaches to more targeted interventions. Under the integrated approach, consumers typically are enrolled in a coordinated care program offered by a private entity using a risk-based payment arrangement. These care coordination interventions include comprehensive medical models such as:

- **Advanced primary care practices**, or "medical homes," use a patient-centered team approach emphasizing prevention, health information technology, care coordination and shared decision making among patients and their providers.
- **ACOs** create incentives for providers to work together to care for a beneficiary across care settings. ACOs have a strong medical home component.

Integrated care delivery attempts to coordinate patient care across delivery settings. Goals include improving the coordination and quality of patient care, reducing inefficiencies and eliminating redundancy, shifting care to lower cost settings and providers as appropriate, improving preventive care efforts, and better controlling medical expenditures.

Provisions in ACA promote greater use of ACOs. An estimated 25-31 million Americans are currently part of an ACO, and this number is projected to continue growing.[18] ACOs are a relatively new care delivery model, so there is little data on their impact on patient use of services, how care is delivered, and the demand implications for physician services. The financial results of ACOs in their first years of operation have been mixed, but few ACOs have experienced substantial savings that suggest major shifts in how care is used or delivered. Recent work by Song et al. suggests that ACO participation had some effect on controlling medical spending growth. Medical spending grew 6.8% less as compared with a non-ACO control group during a four year period.[19] Approximately 40% of this reduction was associated with reduced volume of health care services and the remainder due to lower prices.

[17] Dall TM, Gallo PD, Chakrabarti R, West T, Semilla AP, Storm, MV. An Aging Population and Growing Disease Burden Will Require A Large and Specialized Health Care Workforce By 2025. *Health Affairs*, 2013; 32:2013-2020.

[18] http://www.accountablecarefacts.org/

[19] Song Z, Rose S, Safran DG, Landon BE, Day MP, Chernew ME. Changes in health care spending and quality 4 years into global payment. *N Engl J Med*, 2014; 371:1704-14.

Many of the goals of ACOs are similar to those of other risk-bearing organizations such as Health Maintenance Organizations (HMOs). Risk-bearing entities such as ACOs and HMOs incorporate financial incentives for patients and physicians to better manage utilization. Over 80 million people were enrolled in HMOs in 2013.[20] Because ACOs have similar goals as these plans have- and in particular HMOs-the enrollment increase in ACOs at the expense of HMO enrollment might have minimal impact on demand for physician services.

Looking historically at the effect of these delivery models on use of services provides insights on what might happen if ACOs gain greater prominence. This scenario models the physician demand implications if 100% of the population were enrolled in risk-based entities as a proxy for the possible implications of increased enrollment in ACOs. Predication equations in the microsimulation model used to model demand include enrollment in a managed care plan as a predictor of patient use of services. In the example of demand for cardiologist services (Exhibit A-2), participation in a managed care plan was associated with a 3% decline in office visits to a cardiologist, a 6% increase in outpatient visits to a cardiologist, and no change in use of emergency or inpatient services where the primary diagnosis was cardiology related.

Scenario 4: Expanded use of retail clinics scenario

Between 2007 and 2014, the number of retail clinics in operation increased from approximately 300 to 1,800.[21] The chief drivers of retail clinic utilization are convenience, after hour's accessibility, and cost-effectiveness. Increasingly, retail clinics are covered by insurance plans that encourage their use. As high-deductible insurance replaces first-dollar coverage in employer-sponsored plans, and as individual insurance plans' enrollment increases, retail clinics may be an alternative to traditional primary care.[22] The newly insured under ACA may drive additional future demand, particularly if wait times for physician office visits lengthen and retail clinics are available to immediately respond to need. Retail clinics predominately rely on staffing by nurse practitioners and the care provided in this setting is recognized to be considerably less costly than in a hospital emergency department, an urgent care facility or a physician's office.[23]

[20] http://www.mcol.com/factsheetindex

[21] Mehrotra A, Lave JR. Visits to Retail Clinics Grew Fourfold from 2007 to 2009, Although Their Share of Overall Outpatient Visits Remains Low. *Health Affairs*. September 2012. Vol 32. No. 9, pp.2123-2129. http://content.healthaffairs.org/content/31/9/2123.full.pdf+html

Merchant Medicine's industry Newsletter. November 1, 2014

http://www.merchantmedicine.com/CMSModules/Newsletters/CMSPages/GetNewsletterIssue.aspx

[22] http://www.hhnmag.com/display/HHN-news-article.dhtml?dcrPath=/templatedata/HF_Common/NewsArticle/data/HHN/Daily/2014/Mar/030314-keckley-retail-clinic-aap

[23] Burkle CM. The Advance of the Retail Health Clinic Market: The Liability Risk Physicians May Potentially Face When Supervising or Collaborating with Other Professionals. *Mayo Clinic Proceedings*. November 2011. 86(11) pp.1086-1091. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3202999/

This scenario explores the implications for primary care physician demand of shifting care from physician offices to retail clinics for 10 conditions typically treated at retail clinics.[24] Conditions modeled are:

1. upper respiratory infection (ICD-9 codes 460, 465)
2. sinusitis (461, 473)
3. bronchitis (490, 466)
4. otitis media (middle ear infection) (381, 382) and otitis externa (external ear infection) (380)
5. pharyngitis (462, 463, 034)
6. conjunctivitis (372)
7. urinary tract infection (599, 595)
8. immunization (V03–V06)
9. screening blood pressure check or lab test (V73–V82)
10. other preventive visit (V01, V70, V72, V29–V39)

This scenario assumes the following:

- Patients may receive care at a retail clinic for the above 10 reasons rather than at a primary care physician office and do not have the following chronic conditions: cardiovascular, diabetes, asthma, hypertension or history of stroke. This scenario assumes that patients with these chronic conditions will be seen by their regular primary care provider to ensure continuity of care.
- Care in retail clinics will primarily be provided by nurse practitioners and physician assistants (rather than physicians).
- For care provided in primary care physician offices, 77% of visits to a pediatrician office are handled primarily by a physician (reflecting that between nurse practitioners and physicians 77% of the pediatric workforce is a physician), and that 70% of adult primary care office visits will be handled primarily by a physician.
- The 10 categories of visits modeled tend to be less complex than the average office visit, so physicians will spend less than the average time per visit to handle these cases. To translate the reduction in office visits to demand for physicians, we used the Management Group Medical Association's estimates for the 75th percentile of annual ambulatory patient encounters.
- Approximately 90% of primary care physician encounters with patients are office visits.

[24] Mehrotra A, Margaret C. Wang, Lave JR, Adams JL, and McGlynn, EA. Retail Clinics, Primary Care Physicians, and Emergency Departments: A Comparison Of Patients' Visits. *Health Affairs*, 27, no.5 (2008):1272-1282.

- Together, these assumptions suggest that 7,970 visits by children to a retail clinic rather than a pediatrician office reduces demand for pediatricians by 1 FTE, with each 7,855 retail clinic visits by an adult offsetting the demand for an adult primary care physician by 1 FTE.

Scenarios 5 & 6: Increased use of Advanced Practice Nurses

For these scenarios we modeled increased use of certified registered nurse anesthetists (CRNAs), certified nurse midwives (CNMs), and nurse practitioners (NPs). Several trends suggest that the proportion of healthcare services provided by APRNs will continue to rise. One trend is the rapid growth in supply of APRNs. Other trends are states' willingness to expand the legal scope of practice for NPs, emerging models of care, and financial pressures to control rising medical costs. Nineteen states and the District of Columbia have enacted into law and implemented full practice authority for NPs. Two emerging models of care delivery, the patient-centered medical home and the nurse managed health center, use a provider mix that is richer in NPs and PAs than current models for care delivery.[25]

The Bureau of Labor Statistics estimates 35,430 CRNAs and 5,460 CNMs were employed in 2013.[26],[27] Of the estimated 154,000 licensed NPs in the U.S. in 2012, a Health Resources and Services Administration (HRSA) survey suggests that 127,200 were actively practicing as an NP and engaged in providing patient care (approximately 122,700 when excluding NPs working in patient care settings like school health and nursing facilities that tend not to employ physicians).[28] This estimate excludes the approximately 11,000 licensed NPs who were working as registered nurses. When looking at the specialty distribution of these active NPs, approximately 52,300 (43%) were in primary care; 25,000 (20%) in pediatric and internal medicine subspecialties; 6,400 (5%) in surgical specialties excluding obstetrics & gynecology; 11,700 (10%) in women's health/obstetrics & gynecology; 7,300 (6%) in psychiatry/mental health, and 20,000 (16%) in other specialties.[29]

The American Academy of Nurse Practitioners estimates that 15,000 new NPs completed their academic programs in 2012-2013.[30] From the HRSA NP survey, of those NPs who graduated between 2008 and 2012 close to 92% worked as an NP in 2012. Of these, 97% were actively practicing as an NP in direct patient care. Of these NPs engaged in patient care, 97% practiced in clinical settings where physicians

[25] Auerbach DI, Chen PG, Friedberg MW, Reid R, Lau C, Buerhaus PI, Mehrotra A. Nurse Managed Health Centers and Patient-Centered Medical Homes Could Mitigate Expected Primary Care Physician Shortage. *Health Affairs*. November 2013; 32(11):1933-1941.

[26] Bureau of Labor Statistics. Occupational Employment Statistics, May 2013. http://www.bls.gov/oes/current/oes291151.htm

[27] BLS statistics exclude self-employed nurse midwives.

[28] Health Resources and Services Administration. Highlights From the 2012 National Sample Survey of Nurse Practitioners. Bureau of Health Professions, National Center for Health Workforce Analysis, HRSA.
http://bhpr.hrsa.gov/healthworkforce/supplydemand/nursing/nursepractitionersurvey/npsurveyhighlights.pdf

[29] Health Resources and Services Administration. Highlights From the 2012 National Sample Survey of Nurse Practitioners. Bureau of Health Professions, National Center for Health Workforce Analysis, HRSA.
http://bhpr.hrsa.gov/healthworkforce/supplydemand/nursing/nursepractitionersurvey/npsurveyhighlights.pdf

[30] American Academy of Nurse Practitioners. 2013 NP Fact Sheet. http://www.aanp.org/images/documents/about-nps/npfacts.pdf

practice (e.g., excluding school health and long term care facilities). This suggests that about 13,000 new NPs graduating each year are going into patient care. Based on patterns of the type of work performed by NPs who graduated from an NP program between 2008 and 2012, about 45% (6,100) of these 13,000 NP graduates are projected to enter primary care with the remainder entering non-primary care specialties. Some organizations suggest that NPs provide a higher percentage of primary care services. If so, this would result in a more pronounced effect on demand for primary care physicians than projected in this study.

If this level of graduates from NP programs continues and labor force participation patterns as estimated from the 2012 HRSA NP survey and American Community Survey remain constant, then microsimulation analysis of the NP workforce suggests that FTE supply will grow by 83% between 2013 and 2025 (from 133,000 to 242,800). Among those NPs trained in primary care the projected growth rate is 93%. The growth rate in supply is lower for CRNAs (38%) and CNMs (24%). Overall, the supply of APRNs is projected to grow by 132,400 (66%) between 2013 and 2025.

Only 29,400 (16%) growth is needed to keep pace with the rate of growth in demand for health care services at current APRN staffing levels—suggesting that an additional 114,900 APRNs could be available to absorb into the health care system to both expand the level of care currently provided to patients and to help offset shortages of physicians. This level of supply growth, if sustained, would reduce the physician-to-APRN ratio from 3.8:1 in 2013 to 2.6:1 by 2025. While this rapid growth in APRN supply will help reduce the projected magnitude of the physician shortage, the extent to which some specialties (e.g., surgery specialties) can continue to absorb more APRNs given limited physician supply growth is unclear.

Due to uncertainty about the likely magnitude of this rapid growth in APRN supply on the physician workforce, we modeled scenarios with conservative and more ambitious assumptions regarding future APRN scope of practice relative to current patterns under a team-based care setting. These assumptions reflect that while physicians and NPs both diagnose, treat and manage patients with acute and chronic disease, physicians and NPs have distinct and unique expertise. For example, in surgery NPs (and PAs) assist with surgery while the physician takes the lead role in performing the surgery. In specialty care, a physician might take the lead on patient diagnosis; with NPs playing an important role in follow-up care and helping patients manage their disease. In primary care, NPs and physicians generally work in a collaborative role with clinical autonomy for NPs varying across states. As evidenced by smaller, average patient panel sizes for NPs compared with physicians in primary care, the role of NPs is different. The likely increase in use of medical homes (both within ACOs and independent of ACOs) suggests that primary care providers may take on an expanded role relative to current practices and that the training of NPs makes them ideally suited to fill this expanded role of care coordination.

These distinct roles present a challenge in quantifying the potential of other health professionals to mitigate physician demand. Based on the limited published information available to date, for modeling purposes the high APRN scenario assumes that each additional APRN in excess of supply needed to maintain current staffing patterns will offset demand for physicians in their specialty as follows: CRNAs

(60%), CNMs and NPs in women's health (40%), NPs in primary care (50%), NPs in medical subspecialties (30%), NPs in surgery (20%), and NPs in other medical specialties (30%). The moderate APRN scenario assumes the offset in physician demand is half of the above amounts.

Other trends and factors not included in the physician demand projections

Trends and factors not explicitly included in the scenarios above are the increasing supply of physician assistants, immigration reform, efforts to reduce avoidable hospitalizations, increased use of concierge medicine and evolving technology. Insufficient data are available currently to develop reliable projections of future physician supply and demand related to these trends and market factors. Potential modeling scenarios will be developed in the future as data become available.

Increasing supply of physician assistants

Approximately 95,600 PAs were active in the workforce in 2013, more than double (219%) the number from a decade earlier.[31] The PA workforce is younger than the physician workforce, with 77% of the workforce under age 50. Approximately 28% of PAs work in primary care; 19% work in surgical subspecialties; 8% work in internal medicine subspecialties, and the remainder work in other practice areas. Hooker et al. (2011) projected that supply of PAs would grow from about 74,500 in 2010 to 93,100 in 2015 and 127,800 by 2025.[32] The projections were based on training approximately 6,700 new graduates annually, the assumption that 97% would be clinically active, and an assumed 6% annual attrition rate. HRSA (2013) projected that supply of primary care PAs would grow about 58%, from 27,700 to 43,900 between 2010 and 2020.[33]

Analysis of the practice areas where PAs work suggests that between 2013 and 2025 the demand for health care services will rise by 17% (equivalent to the need for 16,400 more PAs to maintain current staffing levels). The 2025 supply projections by Hooker et al. (which are likely conservative given that the annual number of graduates from PA programs has continued to rise and the increase in PA programs seeking provisional accreditation) would suggest that by 2025 there will be an additional 16,000 PAs beyond what is needed to maintain current staffing levels. An increasing number of PA graduates are choosing to work in non-primary care settings (including assisting in surgery). Additional research is needed to quantify the implication of increasing PA-to-physician staffing ratios on physician productivity.

[31] National Commission on Certification of Physician Assistants. 2013 Statistical Profile of Certified Physician Assistants. http://www.nccpa.net/Upload/PDFs/2013StatisticalProfileofCertifiedPhysicianAssistants-AnAnnualReportoftheNCCPA.pdf

[32] Hooker RS, Cawley JF, and Everett CM. Predictive Modeling the Physician Assistant Supply: 2010–2025. Public Health Reports. September-October 2011. Vol.126: 708-716. http://www.publichealthreports.org/issueopen.cfm?articleID=2714

[33] Projecting the Supply and Demand for Primary Care Practitioners Through 2020. Health Resources and Services Administration. November 2013. http://bhpr.hrsa.gov/healthworkforce/supplydemand/usworkforce/primarycare/index.html

Immigration reform

In 2012, an estimated 11.4 million unauthorized immigrants were living in the U.S.[34] Approximately 10.9 million (95%) were under the age of 55, with 73% being working age adults between age 18 and 44. The health care use patterns of unauthorized immigrants are not well documented, but research suggests that immigrants have little access to publically funded health care programs and that immigrants seek care in emergency departments at higher rates than non-immigrants.[35] A 2009 California Health Interview Survey found that unauthorized immigrants had similar rates of heart disease, diabetes, and hypertension compared with documented immigrants and U.S. citizens.[36]

The Pew Research Center estimates that executive actions announced by President Obama in 2014 could result in 7 million unauthorized immigrants receiving deportation relief.[37] Current proposals could lead to a path to citizenship or other status for unauthorized immigrants that might (a) increase access to publically funded health care programs, (b) improve their economic circumstances, which could increase use of health care services, and (c) reduce deportation or other concerns that might reduce propensity to seek health care services in a professional setting.

Currently, there is insufficient information to model how immigration reform might affect the demand for health care services and physicians. However, given that 95% of the current unauthorized immigrant population is under age 55, the implications of immigration reform on the health care system are likely to be relatively modest over the next decade.

Reductions in avoidable hospitalizations

Reducing avoidable hospitalizations and re-hospitalizations has been a key goal in efforts to reduce growth in health care spending. The Department of Health and Human Services (HHS) released data in May 2014 showing that the all-cause 30-day hospital readmission rate for Medicare beneficiaries decreased from 18.5 percent in 2012 to 17.5 percent in 2013, a trend the government attributes in part to a new payment system that penalizes hospitals for readmissions. They note in particular a reduction in the number of readmission penalties for heart failure, acute Myocardial Infarction and pneumonia. That development follows a similar drop between 2011 and 2012. By way of comparison, readmission rates hovered between 19 percent and 19.5 percent between 2007 and 2011.[38] HHS credited ACA for

[34] Office of Immigration Statistics. Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2012. May 2013. http://www.dhs.gov/sites/default/files/publications/ois_ill_pe_2012_2.pdf

[35] Huang JZ, Yu SM, Ledsky R. Health Status and Health Service Access and Use Among Children in U.S. Immigrant Families. *American Journal of Public Health*. April 2006. 96(4):634-640.

[36] Wallace SP et al. Undocumented Immigrants and Health Care Reform. Final report to The Commonwealth Fund. August 2012. http://healthpolicy.ucla.edu/publications/Documents/PDF/undocumentedreport-aug2013.pdf

[37] PEW Research Center. Obama's expected immigration action: How many would be affected? November 14, 2014. http://www.pewresearch.org/fact-tank/2014/11/14/obamas-expected-immigration-order-how-many-would-be-affected/

[38] Cardiovascular Business, Hospital Re-Admissions Continue to Trend Down. May 2014. http://www.cardiovascularbusiness.com/topics/practice-management/hospital-readmissions-continue-trend-down

some of the reductions, which it said amounted to 150,000 fewer readmissions between 2012 and 2013. Centers for Medicare & Medicaid Services (CMS) initiatives to reduce readmissions among the Medicare population include funding hospital-level improvements, changing payment policies and implementing shared savings initiatives. The reductions in readmissions in recent years have primarily affected patients with selected conditions and procedures (heart failure, acute myocardial infarction, pneumonia, and coronary artery bypass grafting).

Preventable (ambulatory care sensitive) hospitalizations are defined as those hospitalizations that could have been avoided if the patient received appropriate ambulatory care and implemented appropriate self-management. Efforts to reduce preventable hospitalizations have focused on reducing diabetes-related complications, asthma, hypertension, chronic obstructive pulmonary disease, congestive heart failure, dehydration, urinary tract infection, bacterial pneumonia, and other conditions.

Currently, there are limited data for modeling the potential impact on demand for physician services associated with efforts to reduce hospitalizations, and this is an area for future research. While reducing hospitalizations/re-admissions will reduce demand for physicians practicing in hospital settings, to achieve these reductions might require greater use of physicians practicing in ambulatory settings.

Expanded use of concierge medicine model

Concierge medicine describes a contractual arrangement between physicians and patients wherein patients pay the physician an annual fee in exchange for enhanced services and amenities beyond insurance-reimbursed services. The physician's commitment to limit patient loads ensures adequate time and availability for each patient. Under this model, the primary care physician's patient panel size drops dramatically, often from 2,000-3,000 patients to 300-600 patients. Most concierge doctors treat six to eight patients per day. [39] This allows concierge physicians to promise patients same-day or next-day appointments and 24/7 access to their doctor.[40] Annual fees vary by practice location, size, and amenities offered. Most plans operating under the membership-fee model annually charge $500 to $4,000 per person.

The American Academy of Private Physicians (AAPP) reports that by 2012, there were 4,400 concierge doctors in the U.S., up 30 percent from the previous year and 756 in 2010. In 2014, it was estimated that the number of these physicians grew to about 12,000 in the United States. Assuming an average of roughly 350 patients per concierge doctor, more than 4.2 million Americans are currently under the care of a physician who provides an additional level of service in exchange for a fee.[41]

[39] Advisory Board Care Transformation Center Blog. Hybrid Concierge: the Best of Both Worlds? December 2013. http://www.advisory.com/research/care-transformation-center/care-transformation-center-blog/2013/12/hybrid-concierge-model

[40] DeMaria AN. Concierge medicine: for better or for worse? *J Am Coll Cardiol.* 2005; 46:377-8.

[41] Concierge Medicine Today. February 2014 http://conciergemedicinetoday.org/2014/02/20/concierge-medicines-best-kept-secret-the-price-revised/

In January 2013, Forbes reported on a study by Merritt Hawkins for The Physicians Foundation that "found that 9.6 percent of 'practice owners' were planning to convert to concierge practices in the next one to three years."[42] The most common specialty for these types of practices is general internal medicine (over 60%) with family medicine second.[43] The next top two specialties are cardiology and pediatrics.

According to a recent survey-based analysis by *Concierge Medicine Today,* the distribution of average annual household income of a Concierge Medicine or Direct Primary Care patient is:[44]

- 34% – earn less than $100,000 each year
- 39% – earn between $100k-200k per year
- 14% – earn between $200k-$300k per year
- 15% – earn over $300k per year

In 2013, nearly 28 million (22%) households in the U.S. earned $100,000 or more, suggesting the inability of a sizable segment of the population to afford concierge medicine.[45] Because the growth in concierge medicine is a fairly recent phenomenon, there is limited information for modeling the implications on adequacy of physician supply. While the average panel size under concierge medicine is about 10-30% the panel size in a typical non-concierge practice, it is uncertain whether patients participating in such a plan tend to have greater health problems relative to patients participating in a non-concierge arrangement and utilize physician services to a greater degree than the general population. Patients with greater health needs might be more likely to participate in a concierge arrangement.

New and evolving technology

Technologic innovation in medical and health information technology suggests that the work of physicians and other health professionals may be restructured in the coming years.[46] Historically, innovation has made physicians more productive but has also expanded opportunities to treat patients with medical conditions. Task shifting and "up tasking" may be facilitated by increasingly sophisticated

[42] http://www.forbes.com/sites/brucejapsen/2013/01/30/1-in-10-doctor-practices-flee-medicare-to-concierge-medicine/

[43] Concierge Medicine Today. Three Year Analysis of Concierge Medicine Shows Encouraging Signs For Boosting Primary Care Medicine In U.S. January 2013. http://conciergemedicinetoday.org/2013/01/08/three-year-analysis-of-concierge-medicine-shows-encouraging-signs-for-boosting-primary-care-medicine-in-u-s/

[44] Concierge Medicine Today. February 2014 http://conciergemedicinetoday.org/2014/02/20/concierge-medicines-best-kept-secret-the-price-revised/

[45] U.S. Census Bureau. Current Population Survey: 2013 Household Income. http://www.census.gov/hhes/www/cpstables/032014/hhinc/hinc01_000.htm

[46] Deloitte. The new health care workforce: Looking around the corner to future talent management. March 20, 2012. http://www.deloitte.com/assets/Dcom UnitedStates/Local%20Assets/Documents/Health%20Reform%20Issues%20Briefs/us_chs_NewHealthCareWorkforce_032012.pdf.

medical technology. Clinical innovation and information technology also may increase the productivity of the existing physician workforce and change the mix of professionals delivering care.

Technological innovation also influences service demand, pushing it downward in some instances and up in others. Improved imaging technologies, for example, often eliminate the need for exploratory surgery but could identify opportunities to help patients. Similarly, the impacts of health IT on the future demand for physicians will depend on how rapidly electronic systems are adopted and how fully care delivery is transformed by its digitalization.[47]

By 2025, as comprehensive health IT and e-health spread to the majority of care settings in the United States, some evidence suggests that efficiency gains will enable physicians to meet the demands of about 8–15 percent more patients than would be the case without health IT.[48] For example, Kaiser Permanente reported preliminary evidence on the potential effects of information technology on physician workforce needs in its report on the introduction of a comprehensive electronic health record system in Hawaii, including a multi-purpose patient interface, or portal. Patients had access to their lab results, e-prescribing, and e-mail to providers, among other functions. The organization reported a 25 percent reduction in office visits from 2004 to 2007.[49]

Currently, there are limited data for modeling the potential impact on physician demand associated with telemedicine, health IT and other new and evolving medical and IT technologies, particularly as these technologies intersect with emerging models of care. This is an important area for future research. While potentially reducing service utilization and demand for physicians practicing in some settings (e.g., hospitals), new technologies might support greater use of physicians practicing in other care settings (e.g., free-standing ambulatory surgery centers) and has the potential to increase or decrease demand depending upon the specific technologies deployed.

Service and Physician Demand Projections

The key dynamic affecting future service demand (and thus future physician demand) is rapidly changing population demographics. High rates of projected population growth, especially among the elderly "Baby Boomer" population, portend rapidly growing demand for health care services with highest growth expected for those specialties that disproportionately serve the elderly. Demographic shifts in

[47] Health Resources and Services Administration. The physician workforce: projections and research into current issues affecting supply and demand [Internet]. Rockville (MD): HRSA; 2008 Dec [cited 2013Oct 2]. Available from: http://bhpr .hrsa.gov/health workforce/reports/ physwfissues.pdf

[48] Weiner, JP, Blumenthal, D, Yeh, S. The Impact of Health Information Technology and e-Health on the Future Demand for Physician Services. Health Affairs. November 2013. 32:11 http://www.michigan.gov/documents/mdch/The_Impact_of_Health_Information_Technology_and_e-Health_on_the_Future_Demand_for_Physician_Services_441001_7.pdf

[49] Catherine Chen *et al*., "The Kaiser Permanente Electronic Health Record: Transforming And Streamlining Modalities Of Care," *Health Affairs*, 28, no. 2, (March/April 2009): pp. 323-333, http://content.healthaffairs.org/content/28/2/323.full.

race and ethnicity also inform projected changes over time in population characteristics related to chronic disease prevalence and other health risk factors that are determinants of health care service use.

Projected demand growth varies across delivery settings and sources of growth (Exhibit 6). Demand projections suggest that the effects of changing demographics will have a much greater influence on future service demand than will the effects of expanded health insurance coverage under ACA and will vary across care settings. For example, based on changing demographics alone, demand for hospital inpatient care is projected to grow by 23% nationally between 2013 and 2025 compared with 12% for emergency department visits, 14% for physician office visits and 15% for outpatient visits.

Expansion of medical coverage under ACA is projected to impact service demand to a much lesser extent across care delivery settings modeled. Expanded healthcare coverage under ACA is projected to increase demand by about another 16,400 FTEs (+2%) once fully implemented. Service demand growth by care setting is projected to range from 4% in office settings to no growth in emergency departments. Demand for emergency care is projected to be largely unaffected by ACA, with the projected increase in use of emergency care due to lower out-of-pocket expenditures offset by non-emergent care shifting from emergency departments to other ambulatory settings.

Exhibit 6: Projected Growth in Service Demand by Care Setting and Source, 2013-2025

Care Setting	Growth from Changing Demographics	Growth from ACA Coverage Expansion
Office visits	+14%	+4%
Outpatient visits	+15%	+2%
Emergency visits	+12%	+0%
Hospital inpatient days	+23%	+1%

Between 2013 and 2025, changing demographics are projected to increase national demand for physicians by 112,100 FTEs (+14%) (Exhibit 7and Exhibit 8). Projected growth in physician demand ranges from 20,000 FTEs (+13%) among surgical specialties to 24,700 FTEs (+20%) among medical subspecialties. Simulation results suggest substantial variation in growth rates across specialties, with geriatric medicine (+42%) and vascular surgery (+34%) experiencing the highest growth and pediatric-related specialties and obstetrics and gynecology experiencing the slowest growth (in the 4-6% growth range). Because these demographic trends are inevitable, they are incorporated into the other five "demand" scenarios as well.

The managed care scenario had little impact on total physician demand, with national demand rising by only 4,700 physicians relative to the previous scenario. However, there was a large shift in the mix of specialties demanded. Simulation results suggest that demand for primary care physicians would rise by an additional 9,300 FTEs; demand for medical subspecialties would decline by 6,300 FTEs; demand for surgical specialties would rise by 2,800 (with growth in obstetrician and gynecology care, general

surgery, and ophthalmology accounting for most of the increase, offset by declines in the other surgical specialties modeled); and demand for other specialties would decline by 1,100 (much of this from a decline in demand for anesthesiology services).

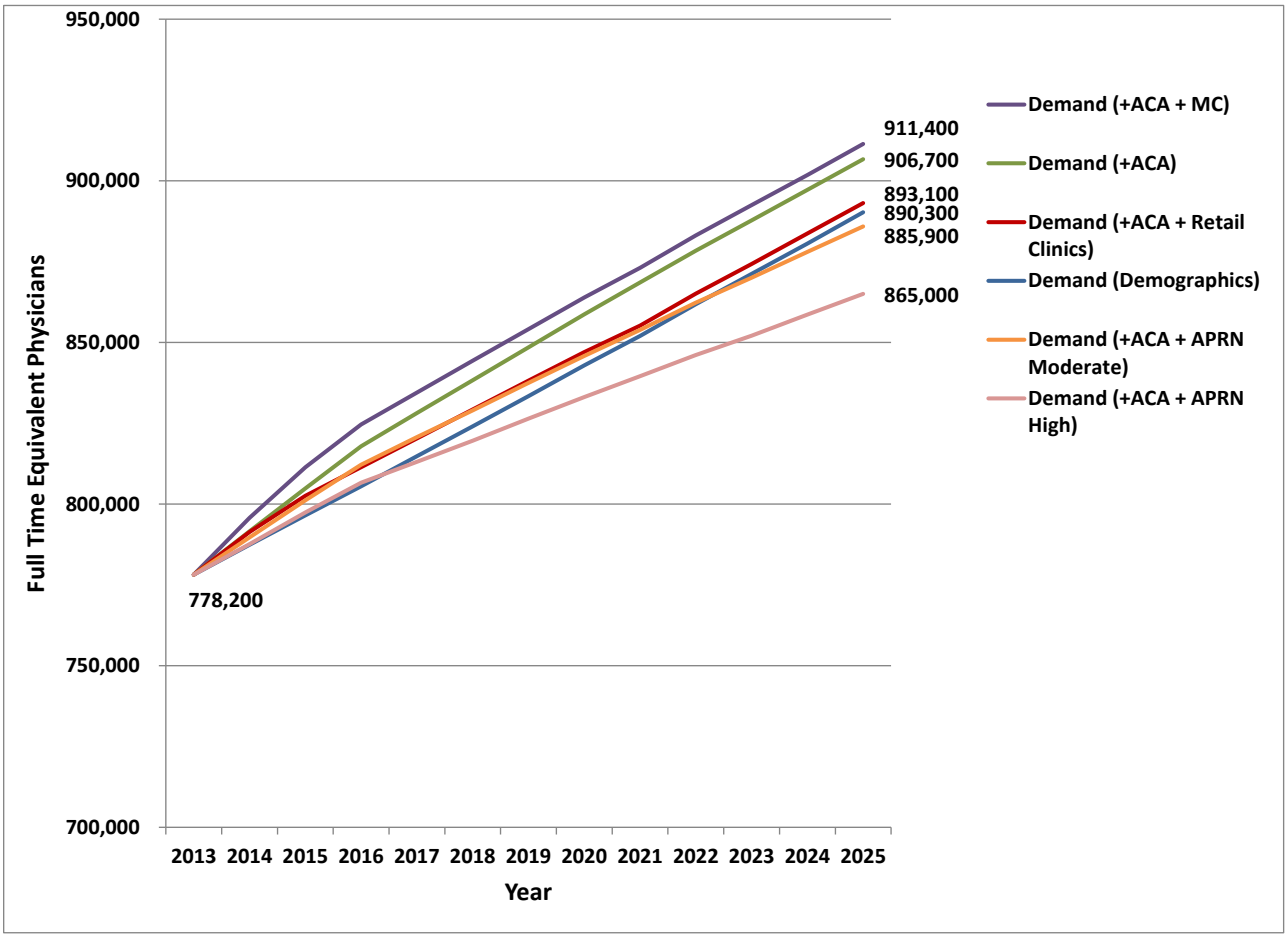
Simulated increased use of retail clinics only affected demand for primary care services for purposes of this analysis, with demand for primary care physicians declining by 13,600 FTEs in 2025 relative to Scenario 2. The impact was larger for general pediatrics (-10,800 FTEs) than for adult primary care (-2,800 FTEs).

The impacts of increased use of APRNs are potentially significant and will vary depending upon physician specialty and assumptions regarding the future level and scope of care delivery practiced by APRNs. Relative to Scenario 2 (ACA plus changing demographics) the projected shortfall of physicians declines by 20,900 to 41,800 FTEs in 2025 associated with increased use of APRNs. This includes a 10,700 to 21,500 decline in the shortfall of primary care physicians; 2,600 to 5,200 decline in the shortfall of physicians in pediatric and internal medicine subspecialties; 700 to 1,300 decline in the shortfall of surgeons; and 6,900 to 13,800 decline in the shortfall of physicians classified in the “all other” category.

Exhibit 7: Physician Demand Summary by Scenario, 2013-2025

	2013	2025	Growth 2013 to 2025	% Growth 2013 to 2025
Scenario 1: Changing Demographics				
Total	**778,200**	**890,300**	**112,100**	**14%**
Primary Care	249,000	287,100	38,100	15%
Non-primary Care	529,200	603,200	74,000	14%
Medical Subspecialties	125,600	150,300	24,700	20%
Surgery	155,300	175,300	20,000	13%
Other Specialties	248,300	277,600	29,300	12%
Scenario 2: Changing Demographics + ACA Medical Insurance Expansion				
Total	**778,200**	**906,700**	**128,500**	**17%**
Primary Care	249,000	292,300	43,300	17%
Non-primary Care	529,200	614,400	85,200	16%
Medical Subspecialties	125,600	152,500	26,900	21%
Surgery	155,300	180,500	25,200	16%
Other Specialties	248,300	281,400	33,100	13%
Scenario 3: Changing Demographics + ACA + Managed Care				
Total	**778,200**	**911,400**	**133,200**	**17%**
Primary Care	249,000	301,600	52,600	21%
Non-primary Care	529,200	609,800	80,600	15%
Medical Subspecialties	125,600	146,200	20,600	16%
Surgery	155,300	183,300	28,000	18%
Other Specialties	248,300	280,300	32,000	13%
Scenario 4: Changing Demographics + ACA + Increased Use of Retail Clinics				
Total	**778,200**	**893,100**	**114,900**	**15%**
Primary Care	249,000	278,700	29,700	12%
Non-primary Care	529,200	614,400	85,200	16%
Medical Subspecialties	125,600	152,500	26,900	21%
Surgery	155,300	180,500	25,200	16%
Other Specialties	248,300	281,400	33,100	13%
Scenario 5: Changing Demographics + ACA + Increased Use of Advanced Practice Nurses (moderate practice level)				
Total	**778,200**	**885,900**	**107,700**	**14%**
Primary Care	249,000	281,600	32,600	13%
Non-primary Care	529,200	604,300	75,100	14%
Medical Subspecialties	125,600	149,900	24,300	19%
Surgery	155,300	179,800	24,500	16%
Other Specialties	248,300	274,600	26,300	11%
Scenario 6: Changing Demographics + ACA + Increased Use of Advanced Practice Nurses (high practice level)				
Total	**778,200**	**865,000**	**86,800**	**11%**
Primary Care	249,000	270,800	21,800	9%
Non-primary Care	529,200	594,200	65,000	12%
Medical Subspecialties	125,600	147,300	21,700	17%
Surgery	155,300	179,200	23,900	15%
Other Specialties	248,300	267,700	19,400	8%

Exhibit 8: Projected Demand for Physicians, 2013-2025



IV. CURRENT AND PROJECTED FUTURE ADEQUACY OF PHYSICIAN SUPPLY

The modeling assumption that current supply and demand are roughly in equilibrium at the national level, with the exception of primary care (8,200 physician shortfall) and psychiatry (2,800 shortfall), is conservative. This assumption means that in 2013 overall demand exceeds supply by 11,000 physicians. However, recent specialty studies suggest a shortfall of neurologists[50] and endocrinologists.[51] Other

[50] Dall TM, Storm MV, and Chakrabarti R. Supply and demand analysis of the current and future US neurology workforce. *Neurology*. 2013; 81(5): 470-478. http://www.neurology.org/content/early/2013/04/17/WNL.0b013e318294b1cf.short

[51] Vigersky R, Fish L, Hogan P, et al. The Clinical Endocrinology Workforce: Current Status and Future Projections of Supply and Demand. *The Journal of Clinical Endocrinology & Metabolism*. 2014

studies report long wait times for patients trying to obtain appointments[52] with physicians or long delays hiring physicians.[53] To the extent that current national shortages and surpluses exist for certain specialties, then the demand projections are underestimated or overestimated from 2013 through 2025 by roughly the size of the current national shortage or surplus.

The range of supply and demand scenarios summarized in Exhibit 9 reflects that the environment within which physicians practice is complex and evolving. Therefore, one scenario alone is inadequate to convey the associated uncertainty. As depicted in Exhibit 9, projections under each demand scenario modeled exceed supply under each supply scenario modeled.

We compared each supply scenario with each demand scenario to estimate the magnitude of the shortfall when looking at each scenario in isolation. The extreme high and low scenarios are least likely to happen—as multiple factors are likely to mitigate highs and lows. For example, if physicians were to delay retirement by an average of two years physician supply would grow by the equivalent of 27,900 FTEs by 2025. Under the scenario of Millennials working fewer hours the 2025 supply would be 24,800 lower than if Millennials worked similar hours as older cohorts. If both trends occurred simultaneously the impacts would be offsetting and supply would be about 3,100 higher than the Status Quo scenario (=27,900-24,800). We think the 25th to 75th percentile of the shortage projections (as illustrated in Exhibit 10) reflects a likely range for the projected shortage of physicians. This suggests a shortfall of between 46,100 and 90,400 physicians in 2025 (Exhibit 11 and Exhibit 20). This shortfall is nearly 40,000 lower than the shortfall projected in the 2010 study, with the new lower shortfall projection reflecting:

- The U.S. Census Bureau revised downward its 2025 population projections by about 10.2 million people (from 357.5 million to 347.3 million). This downward revision equates to an approximately 24,000 lower demand for physicians.
- The number of physicians completing their graduate medical education has risen from about 27,000 to about 29,000.
- The new projections more closely reflect implementation of ACA, growth in supply of advanced practice clinicians, and trends in use of health care services.
- The 2010 study assumed that supply and demand were in equilibrium in 2008 for all specialties except primary care, whereas this update assumes supply and demand were in equilibrium in 2013 for all specialties except primary care and psychiatry.
- The new demand projections extrapolate a “2013” level of care delivery compared with a “2008” level of care delivery extrapolated by the earlier 2010 projections.

Exhibit 12 and Exhibit 13 summarize the projected supply, demand, and shortfall range for primary care physicians. Please note that summing the individual ranges for each physician specialty category will not

[52] Merritt Hawkins and Associates. Survey for Physician Appointment Wait Times; 2009. http://www.merritthawkins.com/pdf/mha2009waittimesurvey.pdf

[53] Children's Hospital Association. Pediatric Specialist Physician Shortages Affect Access to Care; 2012. Available from: URL: http://www.childrenshospitals.net/AM/Template.cfm?Section=Surveys&Template=/CM/ContentDisplay.cfm&ContentID=63293

equal the shortage range for total physicians. The demand scenarios modeled project future demand for physicians, but scenarios can differ in terms of whether future demand will be provided by primary care or non-primary care physicians. The demand projections exceed supply projections with the exception that supply is roughly in balance when comparing the two scenarios with the lowest demand projections to the two scenarios with the highest supply projections. Under the most plausible combination of scenarios modeled, the estimated shortfall range is 12,500 to 31,100.

Exhibits 14 through 18 depict the overall range of supply and demand growth and shortfalls for non-primary care physicians by specialty category. Under the scenarios modeled, we project a shortfall of between 30,600 and 64,100 non-primary care physicians by 2025.

The demand for physicians in medical subspecialties is growing rapidly, but many physicians are choosing internal medicine and pediatric subspecialties so physician supply is also growing (Exhibit 14). Under the scenarios modeled, we project a shortfall of about 5,100 to 12,300 physicians (Exhibit 15).

The supply of surgeons is not projected to grow base based on current trends, yet there continues to be strong projected growth in demand (Exhibit 16). Under the scenarios modeled, we project a shortfall of between 23,100 and 31,600 surgeons by 2025 (Exhibit 17).

For the Other Specialties category, the demand projections are relatively similar but the supply projections vary substantially for the scenarios modeling changes in retirement patterns (Exhibit 18). Consequently, the projected shortfall of physicians in this category is highly sensitive to trends in retirement—with a wide projected shortfall ranging between 2,400 and 20,200 physicians by 2025 (Exhibit 19). Within this physician category there is substantial variation across individual specialties in projected adequacy of supply.

Exhibit 20 summarizes the distribution of projected gaps between supply and demand across physician specialty categories at the 25th and 75th percentiles of projected shortfalls. Although beginning in near equilibrium in 2013, by 2025 non-primary care shortages will likely range between 28,200 and 63,700. By comparison, at the 25th and 75th percentiles of projected shortfalls we project a smaller shortage of between 12,500 and 31,100 primary care physicians.

Exhibit B-6 summarizes the estimated physician gap when comparing each supply scenario modeled against each demand scenario. The shortfall is highest when comparing the early retirement supply scenario to the managed care demand scenario (110,500), and lowest when comparing the delayed retirement supply scenario to the high level of practice APRN scenario (3,100). Shortfall estimates between the 25th and the 75th percentiles range from 46,100 to 90,400 physicians.

Exhibit 9: Projected Total Supply and Demand for Physicians, 2013-2025

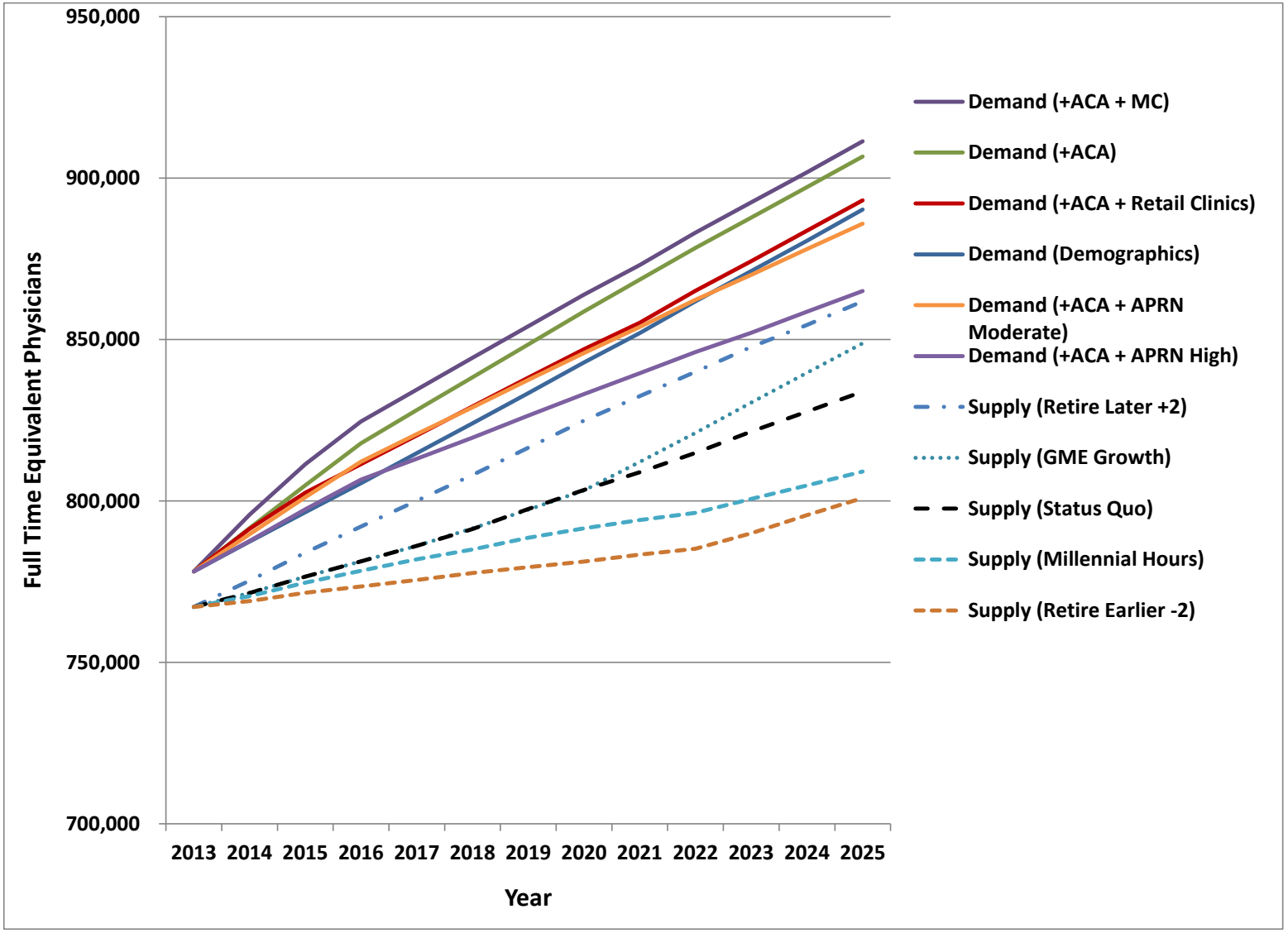


Exhibit 10: Summary of Total Physician Shortfalls across Scenarios, 2013-2025

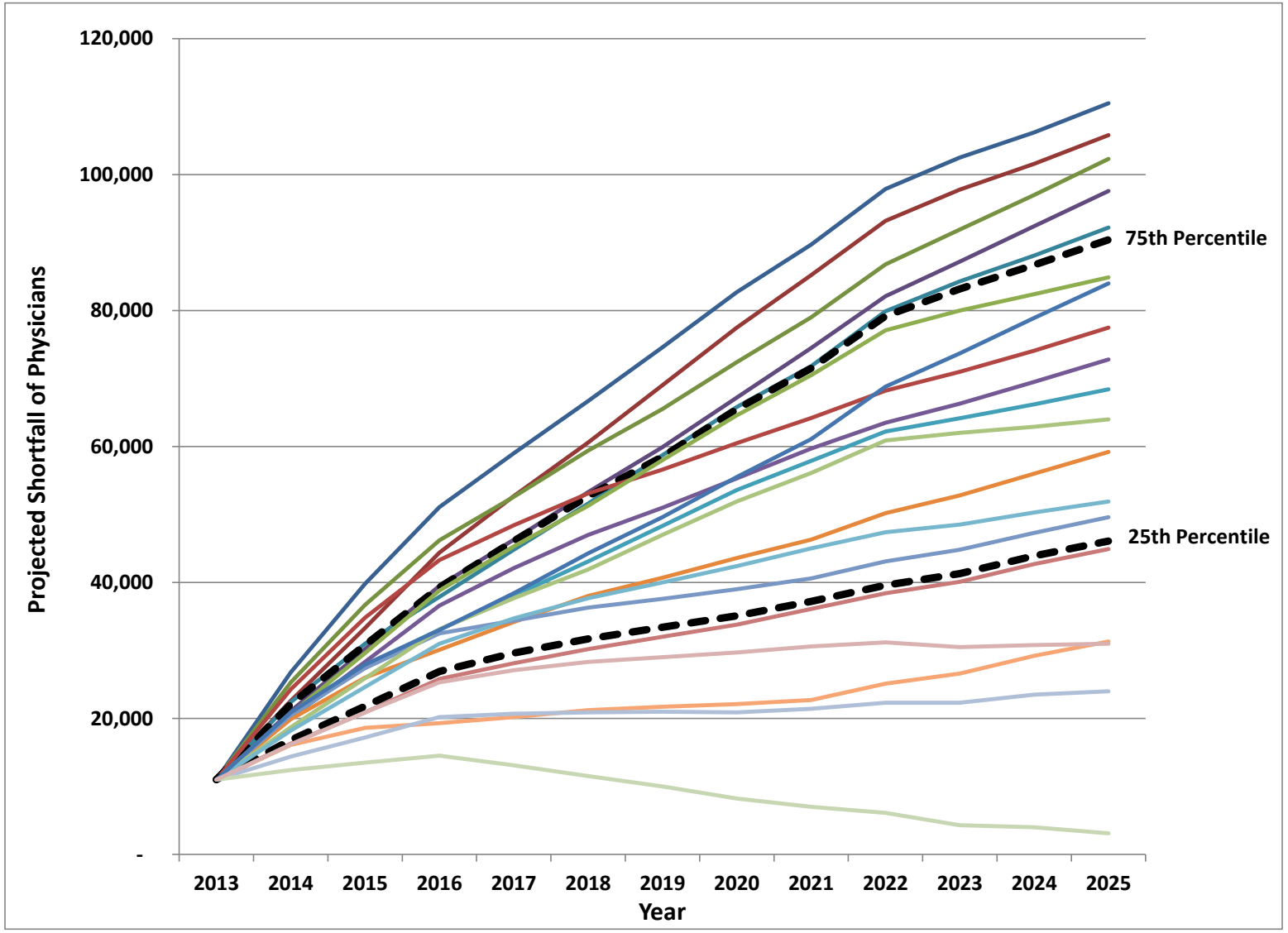


Exhibit 11: Projected Total Physician Shortfall, 2013-2025

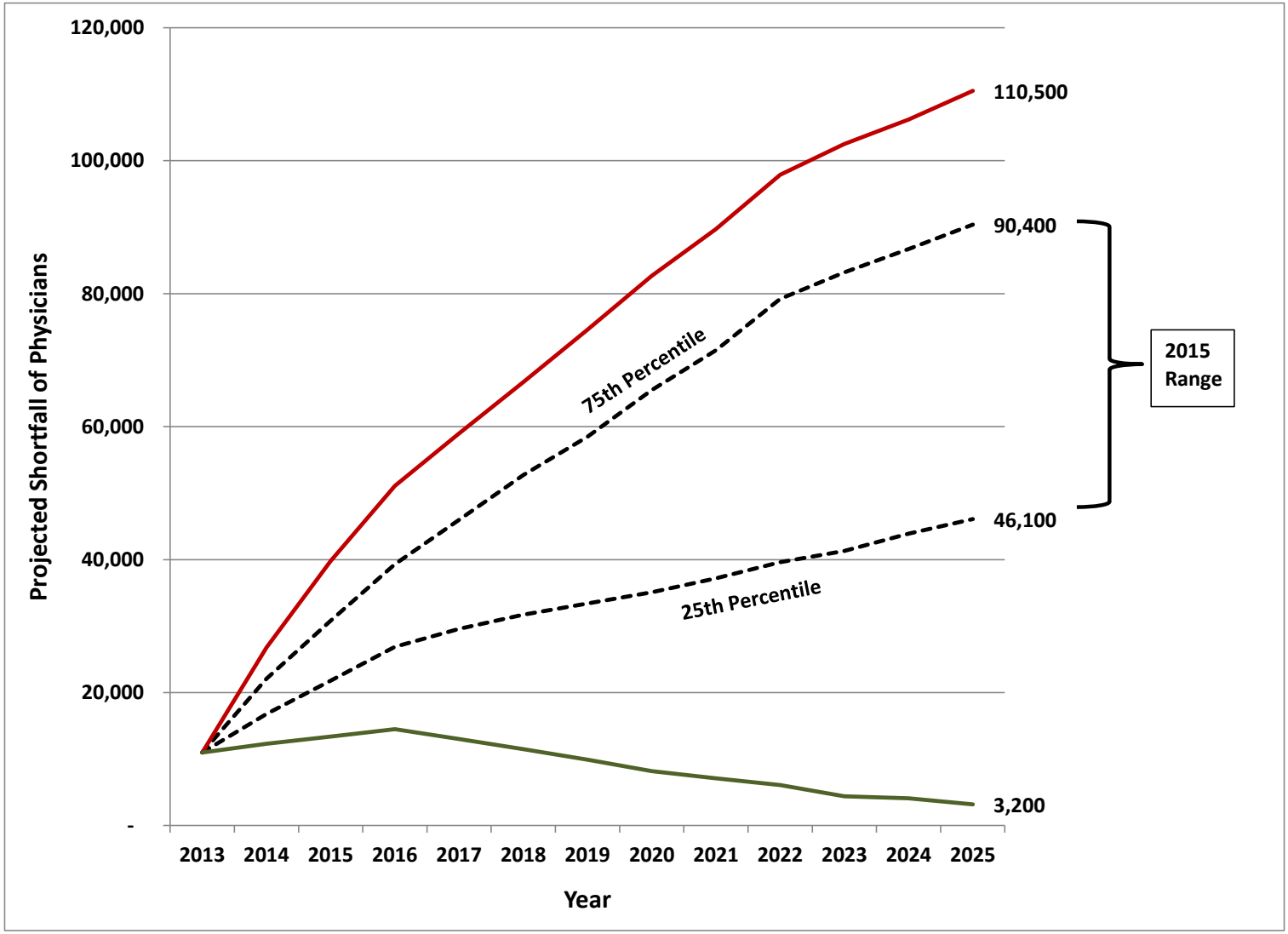


Exhibit 12: Projected Supply and Demand for Primary Care Physicians, 2013-2025

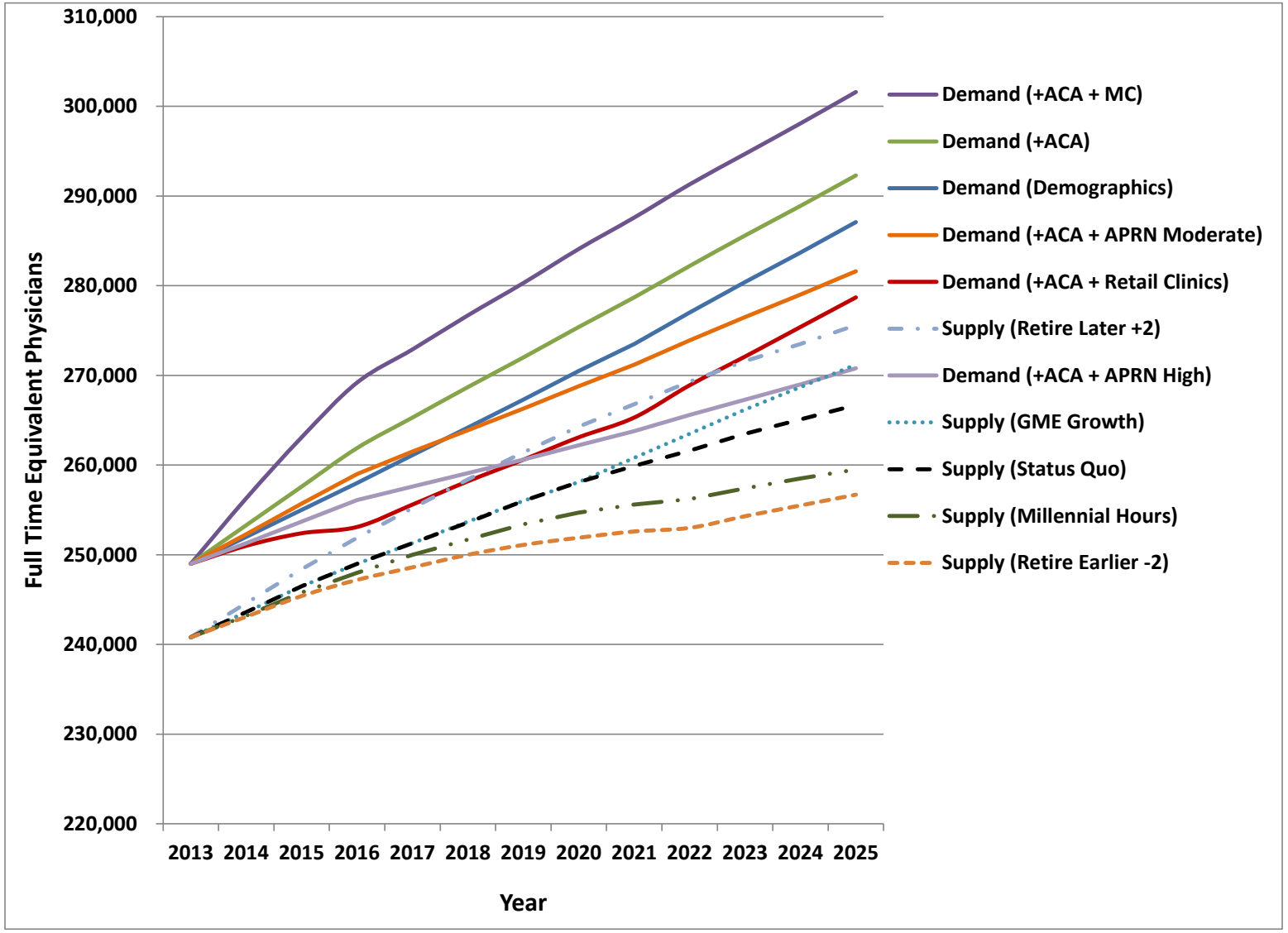


Exhibit 13: Projected Primary Care Physician Shortfall, 2013-2025

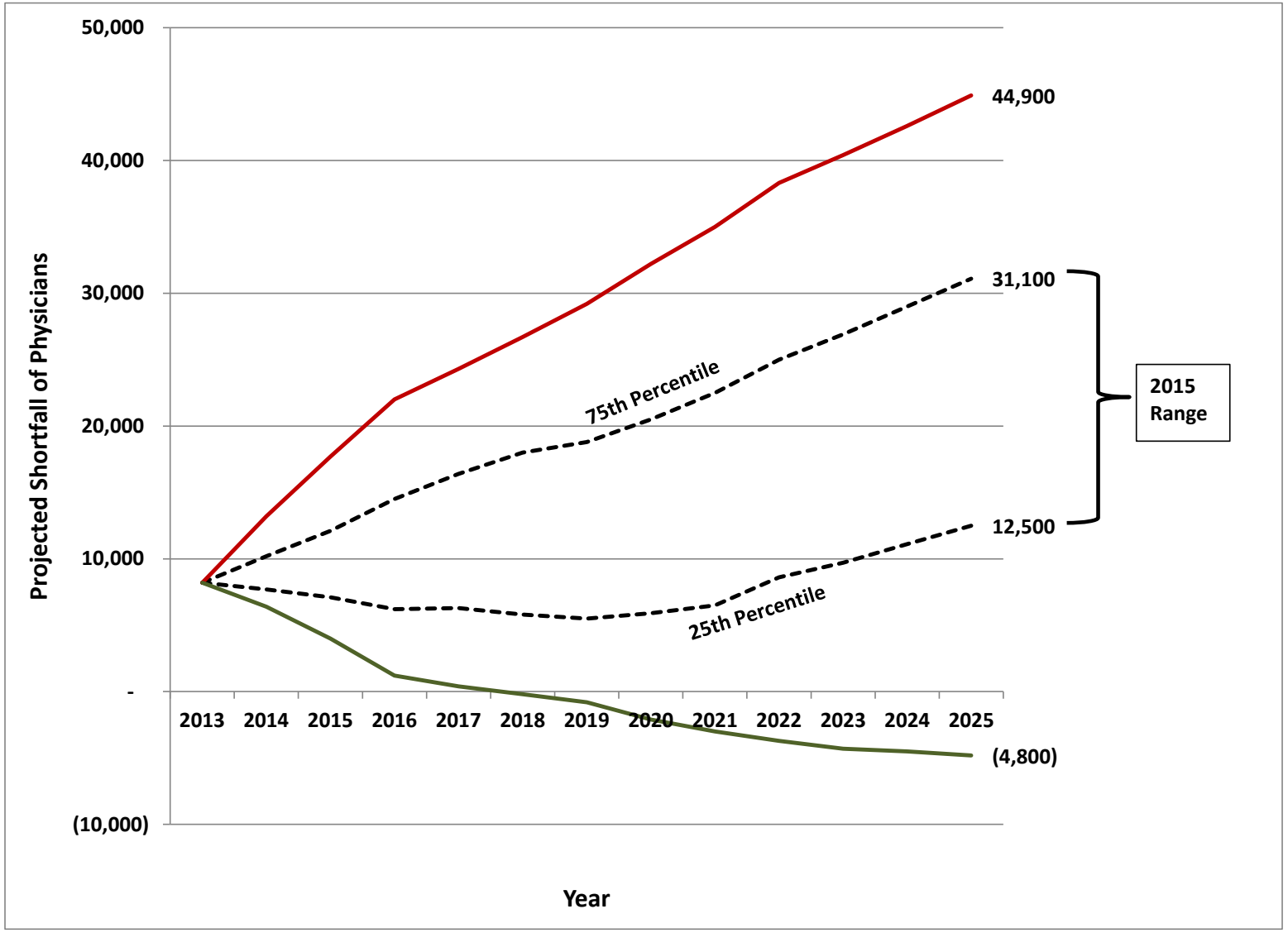


Exhibit 14: Projected Supply and Demand for Medical Subspecialist Physicians, 2013-2025

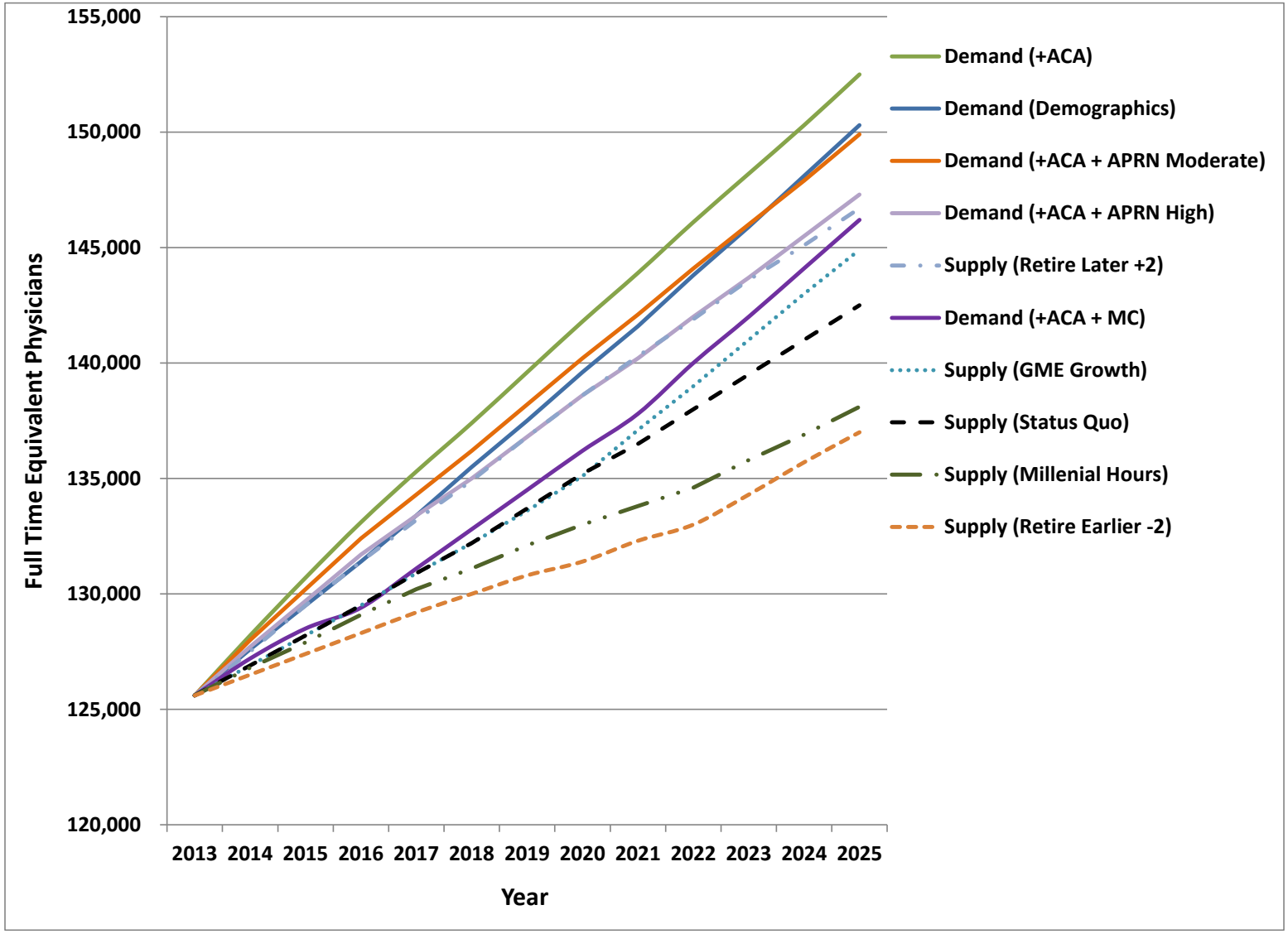


Exhibit 15: Projected Medical Sub-Specialist Physician Shortfall, 2013-2025

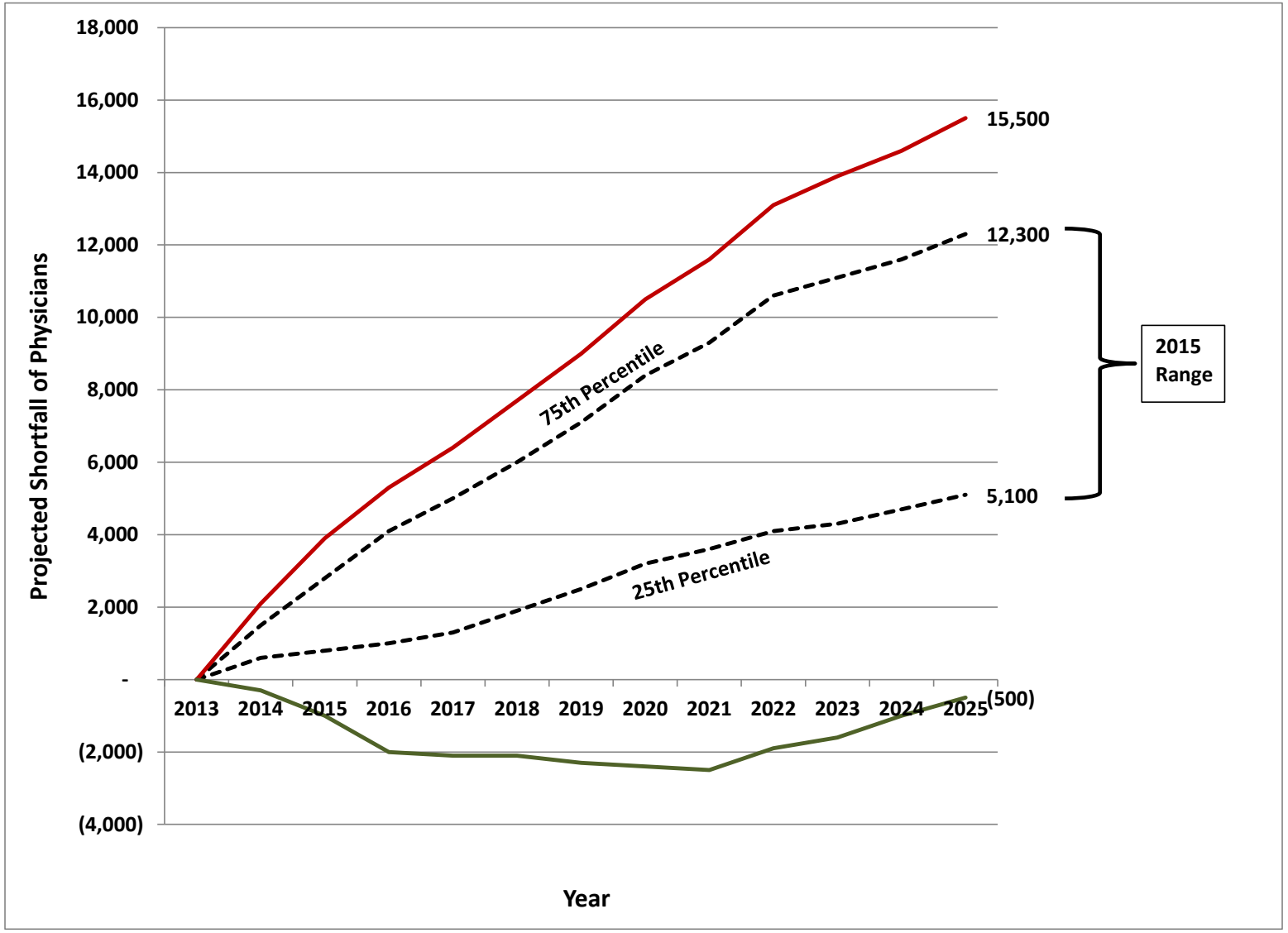


Exhibit 16: Projected Supply and Demand for Surgeons, 2013-2025

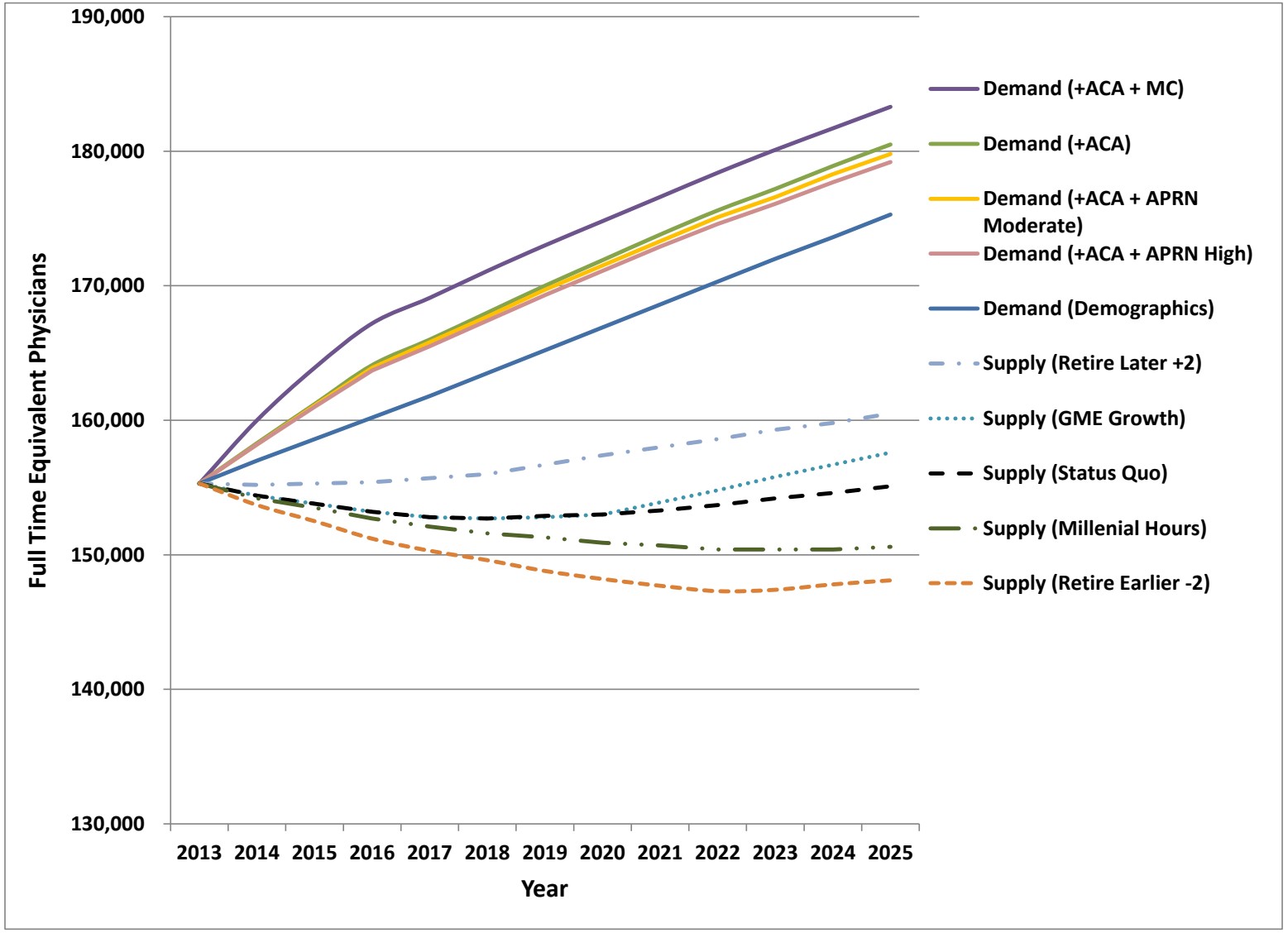


Exhibit 17: Projected Surgical Physician Shortfall, 2013-2025

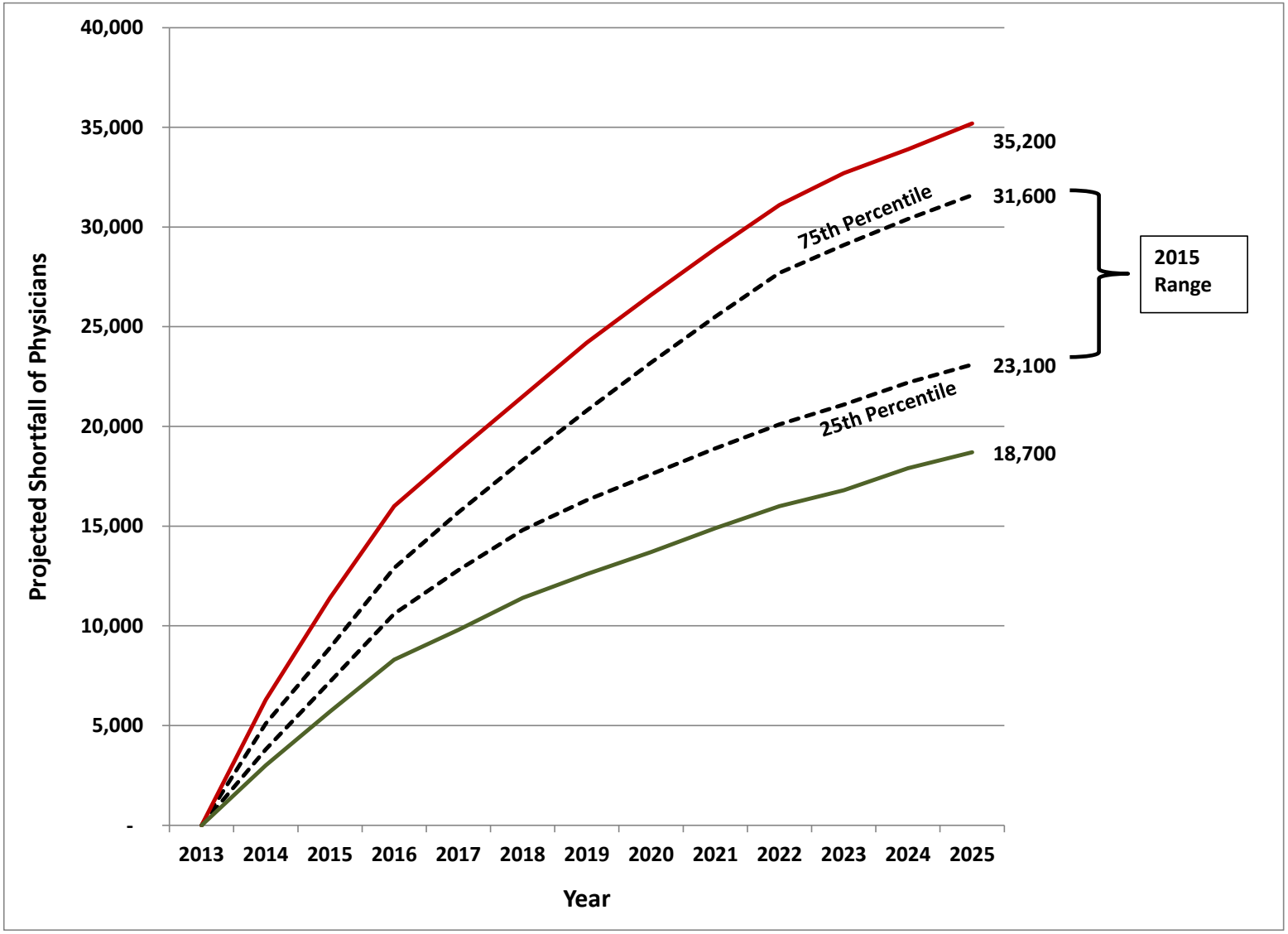


Exhibit 18: Projected Supply and Demand for Other Specialties, 2013-2025

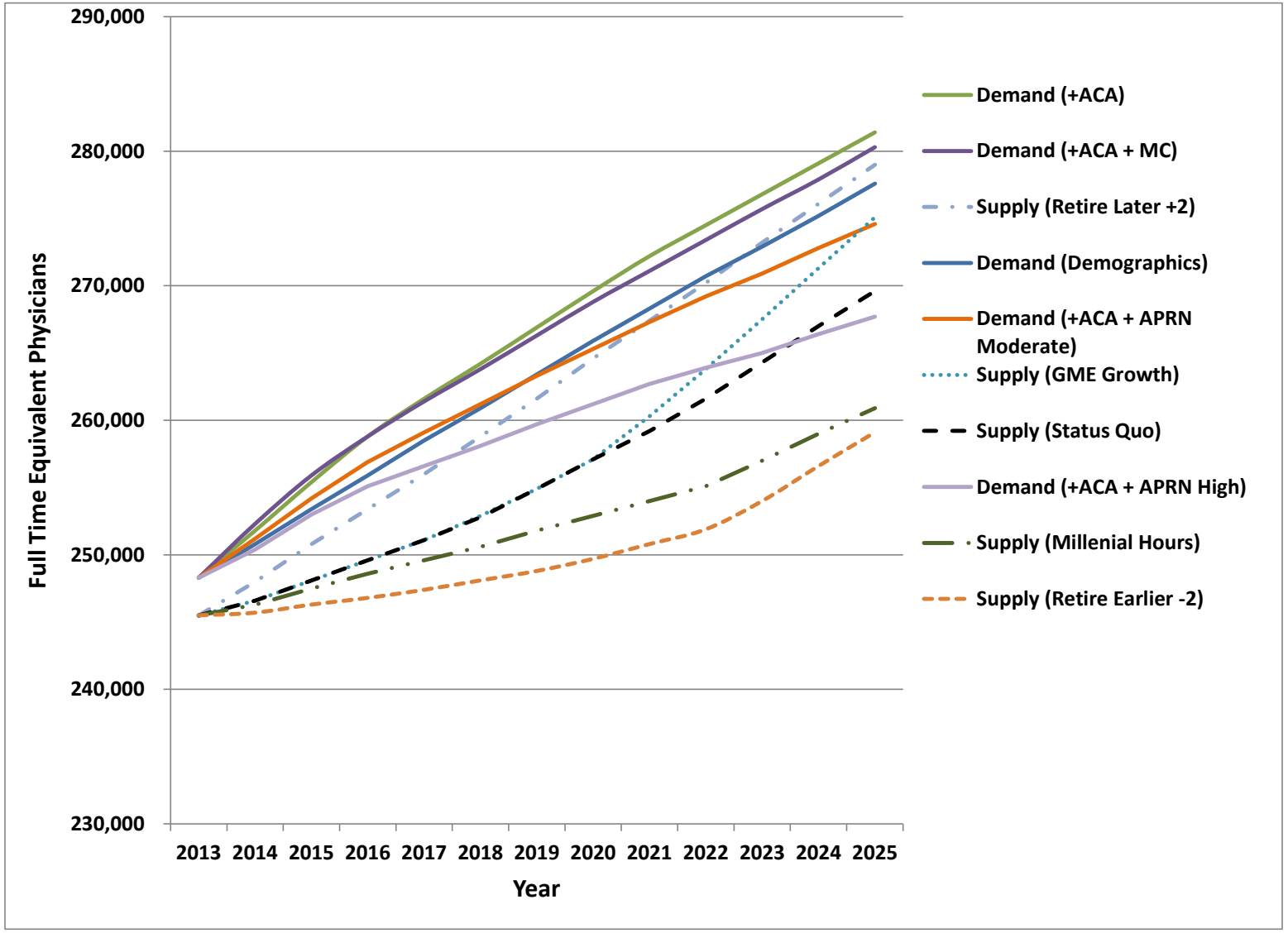


Exhibit 19: Projected Other Specialists Physician Shortfalls by Scenario, 2013-2025

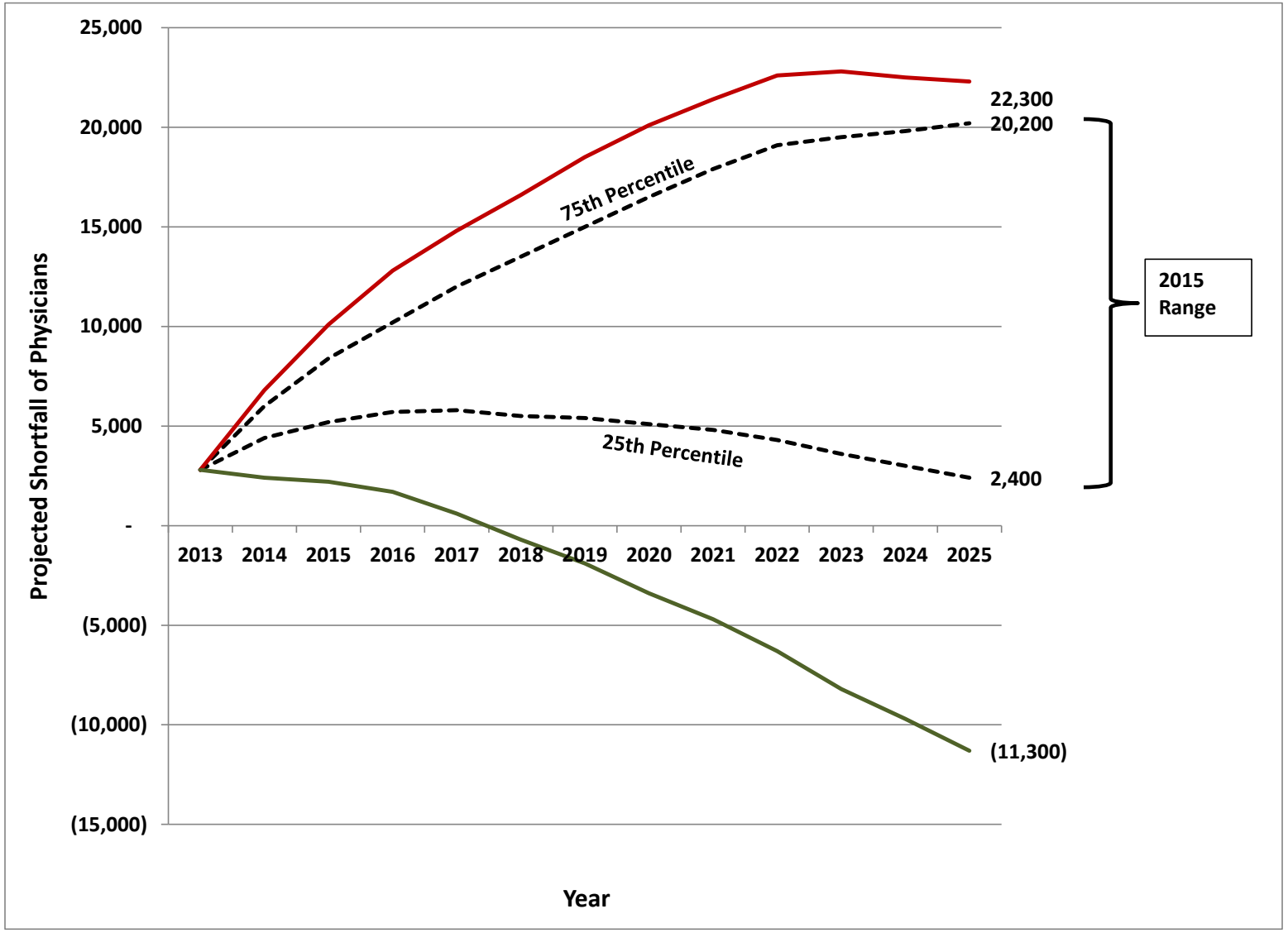


Exhibit 20: Summary of Projected Gap between Supply and Demand

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total Physicians													
75th Percentile	11,000	22,100	30,800	39,300	46,100	52,700	58,500	65,500	71,500	79,200	83,200	86,700	90,400
25th Percentile	11,000	16,800	21,800	26,900	29,600	31,700	33,400	35,100	37,200	39,600	41,300	43,900	46,100
Primary Care													
75th Percentile	8,200	10,200	12,100	14,500	16,400	18,000	18,800	20,500	22,500	25,000	26,900	29,000	31,100
25th Percentile	8,200	7,700	7,100	6,200	6,300	5,800	5,500	5,900	6,500	8,600	9,700	11,100	12,500
Non-Primary Care													
75th Percentile	2,800	12,400	19,900	26,700	32,000	37,100	42,100	47,000	51,400	56,100	58,700	61,200	63,700
25th Percentile	2,800	9,000	13,900	18,100	20,000	21,800	23,000	23,900	24,900	25,900	26,300	27,300	28,200
Medical Subspecialties													
75th Percentile	-	1,500	2,800	4,100	5,000	6,000	7,100	8,400	9,300	10,600	11,100	11,600	12,300
25th Percentile	-	600	800	1,000	1,300	1,900	2,500	3,200	3,600	4,100	4,300	4,700	5,100
Surgical Specialties													
75th Percentile	-	5,100	8,900	12,900	15,700	18,300	20,800	23,200	25,500	27,700	29,100	30,400	31,600
25th Percentile	-	3,800	7,200	10,600	12,800	14,800	16,300	17,600	18,900	20,100	21,100	22,200	23,100
Other Specialties													
75th Percentile	2,800	9,000	8,400	10,200	12,000	13,500	15,000	16,500	17,900	19,100	19,500	19,800	20,200
25th Percentile	2,800	10,750	5,200	5,700	5,800	5,500	5,400	5,100	4,800	4,300	3,600	3,000	2,400

Note: The shortage range for total physicians is smaller than the sum of the ranges for the specialty categories. The demand scenarios modeled project future demand for physician services, but scenarios can differ in terms of whether future demand will be provided by primary care or non-primary care physicians. Likewise, the range for total non-primary care is smaller than the sum of the ranges for the specialty categories.

V. CONCLUSIONS

This study combined data on the national physician workforce; data on the demographics, socioeconomics, and health risk factors of the population; data from national sources on patient care use and delivery patterns; and health workforce simulation models of supply and demand to estimate the current and future demand and supply of physicians through 2025. In this section we summarize key findings and conclusions, discuss study strengths and limitations, and identify areas where future research is needed to improve workforce projections.

Key Findings and Conclusions

The following are key study findings and conclusions.

- **Demand for physicians continues to grow faster than supply, leading to a projected shortfall of between 46,100 and 90,400 physicians by 2025**. Although physician supply is projected to increase modestly between 2013 and 2025, demand will grow more steeply. Across scenarios modeled, total physician demand is projected to grow by 86,700 to 133,200 (11-17%), with population growth and aging accounting for 112,100 (14%) in growth. By comparison, physician supply will likely increase by 66,700 (9%) if labor force participation patterns remain unchanged, with a range of 33,700 to 94,600 (4-12%), reflecting uncertainty regarding future retirement and hours worked patterns.
- **Projected shortfalls in primary care will range between 12,500 and 31,100 physicians by 2025, while demand for non-primary care physicians will exceed supply by 28,200 to 63,700 physicians.** The shortfall range reflects comparisons of all the supply scenarios to all the demand scenarios and uses the 25th to 75th percentiles of projected shortages across the comparisons. These percentiles reflect that the extreme shortage/surplus projections are least likely to occur – as the extreme shortage/surplus projections compare the highest/lowest demand projections to the lowest/highest supply projections.
- **Expanded medical coverage achieved under ACA once fully implemented will likely increase demand by about 16,000 to 17,000 physicians (2.0%) over the increased demand resulting from changing demographics**. The Congressional Budget Office estimates that eventually 26 million people will have medical insurance that would otherwise be uninsured in the absence of ACA. Taking into consideration the health and risk factors of the population likely to gain insurance and estimated changes in care utilization patterns associated with gaining medical insurance, the estimated increase in demand for physician services is about 2.0%. The increase is highest (in percentage terms) for surgical specialties (3.2%), followed by primary care (2.0%), medical specialties (1.7%) and "all other" specialties (1.5%). Within these broad categories, there are differences in the impact of ACA for individual specialties.
- **The lower ranges of the projected shortfalls reflect the rapid growth in supply of advanced practice nurses and the increased role these clinicians are playing in patient care delivery; even in these scenarios, physician shortages are projected to persist**. New payment methodologies, including bundled payments and risk sharing arrangements, and innovations in technology suggest that the work of health professionals may be restructured in the coming years. Given the number of

NPs, CNMs, and CRNAs graduating each year, if labor force participation patterns remain unchanged, the supply of APRNs will grow more rapidly than is needed to keep pace with demand for services at current APRN staffing levels. These trends suggest that 114,900 additional APRNs could be available to absorb into the health care system to both expand the level of care currently provided to patients and help offset shortages of physicians. Similarly, the supply of PAs is projected to increase substantially between 2013 and 2025. While this rapid growth in supply of APRNs and PAs could help reduce the projected magnitude of the physician shortage, the extent to which some specialties (e.g., surgery specialties) can continue to absorb more APRNs and PAs given limited physician supply growth is unclear.

- **Due to new data and the dynamic nature of projected assumptions, the projected shortfalls of physicians in 2025 are smaller than shortfalls projected in the earlier study.** We project that demand for physicians in 2025 will exceed supply by 46,100 to 90,400. This compares to a 130,600 shortfall projected in the 2010 study. Current projections suggest primary care physician demand in 2025 will exceed supply by 12,500 to 31,100 physicians (the 2010 study projected a 65,800 shortfall). The projected shortfall for non-primary care is 28,200 to 63,700 (versus a projected shortfall of 64,800 in the 2010 study). Factors explaining differences between the 2015 and 2010 projections include:
    - The U.S. Census Bureau revised downward its 2025 population projections by about 10.2 million people (from 357.5 million to 347.3 million). This downward revision equates to demand for approximately 24,000 fewer physicians.
    - The number of physicians completing their graduate medical education has risen from about 27,000 to about 29,000.
    - The new projections more closely reflect implementation of ACA, growth in supply of advanced practice clinicians, and trends in use of health care services.
    - The 2010 study assumed that supply and demand were in equilibrium in 2008 for all specialties except primary care, whereas this update assumes supply and demand were in equilibrium in 2013 for all specialties except primary care and psychiatry. Hence, the new demand projections extrapolate a “2013” level of care delivery compared with a “2008” level of care delivery extrapolated by the earlier 2010 projections.

Study Strengths and Limitations

The primary strengths of this study are the use of the latest data and modeling methods for health workforce analysis. The study reflects the most recent population projections published by the U.S. Census Bureau, and recent data on the health risk characteristics of the population and the relationship between these risk characteristics and use of health care services. Compared with the 2010 study, the potential implications of ACA have become clearer (though there continues to be uncertainty from the political climate surrounding ACA and how provisions such as medical exchanges might be implemented in some states). It is important to note that the report looks only at national data, not local or regional data.

The nature of physician workforce projections requires a reliance on assumptions about a changing and complex environment. There are three key areas where data limitations increase uncertainty in the projected adequacy of physician supply.

1. **The potential impact of emerging care delivery models is unclear**. The goal of emerging care delivery models such as ACOs is to improve quality of care while controlling medical expenditures. Improving quality of care sometimes requires more health care services initially (e.g., preventive care) with a potential future payoff in terms of a healthier population and reduced use of expensive hospital services. Using historical data on managed care as a guide to what might happen if ACOs gain greater traction, the overall demand for physicians might not change but there could be a shift from specialty to primary care. However, the prevalence of chronic diseases such as diabetes and cardiovascular disease continue to rise suggesting strong continued growth for specialists regardless of the care delivery model used. This is an area for continued research.
2. **Supply projections are sensitive to assumptions about physician retirement patterns**. Physician intentions to retire can be affected by short term factors (such as changes in the economic environment that affect wealth), as well as long term trends such as increased longevity and changes in cultural norms regarding traditional retirement age and eligibility ages for government programs (e.g., Medicare). Periodic surveys provide snapshots of current retirement patterns (or patterns of intention to retire), but additional research is needed to better understand the factors influencing retirement patterns of physicians.
3. **The implications of the continued rapid growth of the advanced practice clinician workforce are unclear.** Historically, a large proportion of nurse practitioners and physician assistants have worked in primary care settings. This distribution across specialties has continued to shift to a larger portion of APCs entering non-primary care specialties. As the number of APCs increases and the ratio of physicians-to-APCs declines, it is unclear how these ratios will affect the productivity of physicians. Is there an optimal ratio of physicians-to-APCs that will maximize the productivity of physicians while allowing APCs to practice at the top of their license? Additional empirical research is needed to better understand the implications of growth in the PA and APRN workforce across different specialties and the implications for future adequacy of provider supply.

The projections in this analysis are based on the data available to date in these areas, opting for the more conservative assumptions in cases where evidence may be scarce. Further, in recognition of the uncertainty inherent to this exercise, the study compares a variety of scenarios, resulting in a projected range of shortages, rather than a single estimate of the expected supply and demand.

Conclusion

Study findings suggest that demand for physician services is growing faster than physician supply and that by 2025 demand will exceed supply by 46,100 to 90,400 physicians. The lower range of this shortfall reflects the rapidly growing supply of APRNs, with the rapid growth in supply of PAs also helping to

mitigate the shortfall of physicians. The projected shortfall is especially acute for surgical specialties (excluding obstetrics and gynecology where demand is projected to grow slowly).

The projected range for the shortage reflects uncertainties regarding how emerging care delivery models might change health care use and delivery patterns, as well as uncertainties regarding physician labor force participation patterns (i.e., retirement and work-life balance decisions). Together, this uncertainty combined with continued research and updated data on supply and demand determinants underscores the importance of continually monitoring the state of the physician workforce to ensure access to high quality and affordable care.

APPENDIX A: DATA AND METHODS FOR PHYSICIAN DEMAND AND SUPPLY MODELING

This study utilized a Healthcare Demand Microsimulation Model (HDMM) to estimate current and future demand for health care services and providers, and a Health Workforce Supply Model (HWSM) to forecast future supply. Both models use a microsimulation approach, where a person is the unit of analysis. Additional information about these models and model validation activities has been published elsewhere.[54]

The basic framework for modeling supply and demand is the same across health professions. For supply modeling at the national level, the major components include:

1. The size and characteristics of the current supply.
2. The annual number and characteristics of those leaving the workforce.
3. The annual number and characteristics of newly trained professionals entering the workforce, and
4. Workforce participation decisions (e.g., hours worked) for those in the workforce.

For demand modeling, the major components include:

1. Demand for healthcare services. This is determined by patient epidemiological needs; cultural, socioeconomic, and price factors that affect ability and willingness to use services; technological considerations that define what services are possible to provide; and care delivery norms.
2. Demand for healthcare providers. This is determined by care delivery patterns to meet the demand for services.

Physician Demand Modeling

Whereas traditional models for healthcare demand extrapolate patterns of care delivery for broad population groups, the HDMM models demand for each individual from a representative sample of the population of interest. Using information on each person's demographic and socioeconomic characteristics, insurance type, health-related behavior, and presence of select chronic conditions, the HDMM simulates use of healthcare services by delivery setting. The model then simulates the number and mix of medical specialties required to meet the demand for services.

As depicted in Exhibit A-1, the major components of the demand model include: 1) a population database that contains characteristics and health risk factors for a representative sample of the

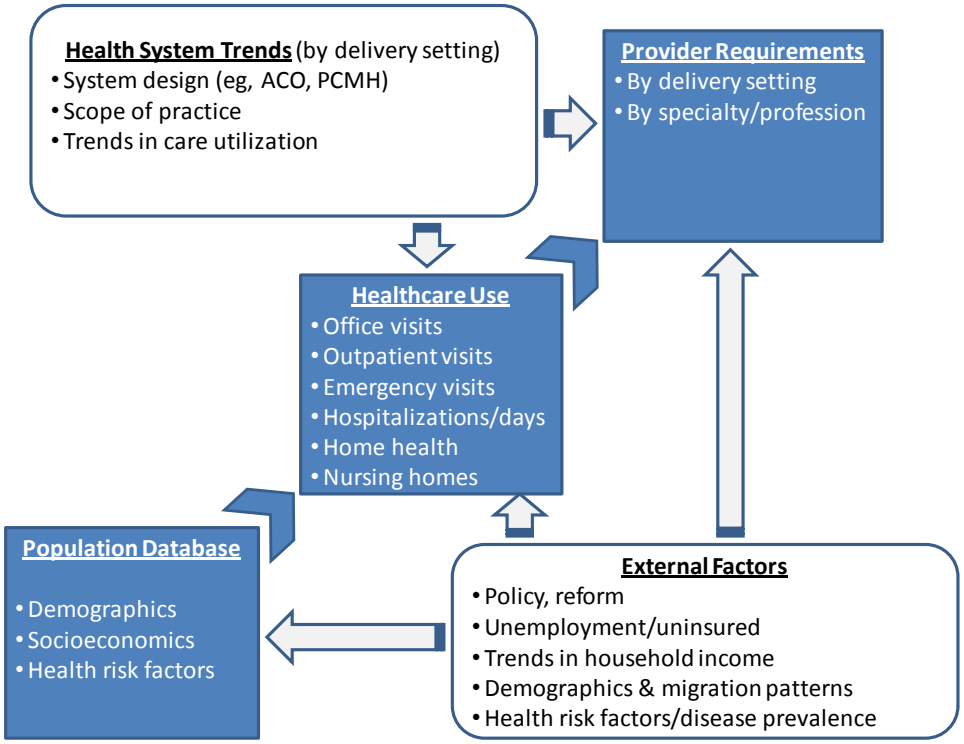
[54] Dall TM, Gallo PD, Chakrabarti R, West T, Semilla AP, Storm, MV. An Aging Population and Growing Disease Burden Will Require A Large and Specialized Health Care Workforce By 2025. *Health Affairs*. 2013; 32:2013-2020. http://content.healthaffairs.org/content/32/11/2013.abstract

Dall TM, Chakrabarti R, Storm MV, Elwell EC, and Rayburn WF. Estimated Demand for Women's Health Services by 2020. *Journal of Women's Health*. 2013; 22(7): 643-8. http://www.ncbi.nlm.nih.gov/pubmed/23829185

Dall TM, Storm MV, and Chakrabarti R. Supply and demand analysis of the current and future US neurology workforce. *Neurology*. 2013; 81(5): 470-478. http://www.neurology.org/content/early/2013/04/17/WNL.0b013e318294b1cf.short

population, 2) regression equations based on national data that relate a person's characteristics to his or her demand for healthcare services by care delivery setting, and 3) national care delivery patterns that convert demand for healthcare services to demand for FTE physicians. For purposes of physician workforce modeling the relevant settings are physician offices, outpatient clinics, hospital emergency departments, and hospital inpatient settings.

Exhibit A-1: Health Care Demand Microsimulation Model Overview



Creating the Population Database

The demand model contains health, demographic, and socioeconomic characteristics for each person in a stratified random sample of the population with information gathered from the United States Census Bureau, the 2013 American Community Survey (ACS), and the 2012 and 2013 Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System (BRFSS) files. Information from the 2004 National Nursing Home Survey (NNHS) is also used in the model. Information for each individual in this population database used to model demand for health care services includes:

- **Demographics**: Age group (0-2, 3-5, 6-13, 14-17 years for children; 18-34, 35-44, 45-64, 65-74, 75+ years for adults), Sex, Race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic other, Hispanic).
- **Health-related lifestyle indicators**: Body weight status (unknown, normal, overweight, obese), Current smoker status.

- **Socioeconomic indicators**: Household annual income (<$10,000, $10,000 to <$15,000, $15,000 to < $20,000, $20,000 to < $25,000, $25,000 to < $35,000, $35,000 to < $50, 000, $50,000 to < $75,000, $75,000+),Medical insurance type (private, public, self-pay).
- **Chronic conditions**: Diagnosed with arthritis, asthma, cardiovascular disease, diabetes, or hypertension, History of heart attack, or history of stroke.
- **Geographic location**: Living in a metropolitan area.

Creating a representative population sample involved several steps. We first employed a statistical matching process that combined demographic and socioeconomic data from about three million people in the Census Bureau's 2013 ACS, health risk factors and chronic conditions from over 1 million people in the combined 2012 and 2013 files of the BRFSS covering the non-institutionalized population, and health data from approximately 16,000 nursing home residents in the 2004 NNHS.

Using information on residence type, we then divided the ACS population into those in nursing facilities to be matched to people in the NNHS, and those not in nursing facilities to be matched to people in the BRFSS. For the non-institutionalized population, each ACS individual was randomly matched with someone in the BRFSS with the same sex, age group, race/ethnicity, insured/uninsured status, and household income level.

Individuals categorized as residing in a nursing home were randomly matched to a person in the NNHS in the same age group, sex and race-ethnicity strata. The final matched ACS-BRFSS-NNHS database includes a sample weight for each person. This weight reflects the number of people he or she represents among the general population.

Using population estimates and projections from the Census Bureau, we recalibrated the sample weights in the ACS-BRFSS-NNHS matched population file, by demographic, such that the sum of the sample weights were consistent with population projections for each year through 2025 by age, sex, and race/ethnicity. This process created a health and socioeconomic profile for each individual in a representative sample of the population.

Developing Health Care Use Forecasting Equations

Patterns of health seeking behavior were generated by regression analysis using data from approximately 169,000 participants in the pooled 2008-2012 files of the Medical Expenditure Panel Survey (MEPS). There are several hundred prediction equations in the simulation model. We estimated each equation using either Poisson regression (to model annual number of physician office and outpatient visits with a particular provider type); or logistic regression (to model annual probability of hospitalization or emergency department visit for one of approximately 30 diagnosis categories (e.g., hospitalization for a cardiovascular condition). The dependent variable reflected annual use of health care services, while the explanatory variables consisted of the demographic characteristics, health risk factors, medical conditions, and socioeconomic factors described previously. We pooled multiple years of data to provide a sufficient sample size for regression analysis. Applying the health forecasting equations estimated through regression analysis to the population data described above provided projections of health care use by care delivery setting and type of care provided.

For hospitalizations, MEPS provides no information on medical discipline or specialty of the providers delivering patient care. Using logistic regression we quantify the relationship between patient characteristics and whether the person had a hospitalization for each of 17 major diagnostic categories of medical conditions (e.g., diseases of the circulatory system, diseases of the respiratory system, diseases of the digestive system, etc.) based on ICD-9 primary diagnosis codes. To model length of stay for patients hospitalized, we use Poisson regression with discharge records for over 8 million hospital stays in the 2012 Nationwide Inpatient Sample. Length of stay for each of condition category is the dependent variable. Explanatory variables include patient age group, sex, race/ethnicity, insurance type, presence of diabetes among the diagnosis codes, and lives in a metropolitan area. Combining information on hospitalization risk and length of stay per hospitalization we compute each person's expected inpatient days during the year.

An example of the regressions is provided in Exhibit A-2 where findings are presented for adult cardiology services. Controlling for other patient characteristics, men had 11% more office visits and 48% more outpatient visits to a cardiologist relative to women. Hispanics had only 88% as many office visits and non-Hispanic blacks had only 85% as many office visits as the comparison group (non-Hispanic other race), while non-Hispanic whites had 9% more office visits relative to the comparison group. Use of cardiology services is highly correlated with older age. The presence of endocrine and cardiovascular conditions is correlated with significantly higher use of cardiology services.

Applying the prediction equations to the current and projected future population produced estimates of the growth in demand for health care services by specialty and care delivery setting (Exhibit A-3). For primary care specialties, the growth estimates for care delivered in hospital inpatient settings represents potential growth in hospital rounds. The American Medical Association Masterfile lists few physicians as hospitalists. A large portion of these physicians are trained as general internists or other specialties, and both the supply and demand projections list these physicians by their trained specialty.

Exhibit A-2: Health Care Use Regression Example (Adult Cardiology Services)

	Parameter	Office Visits	Outpatient Visits	Emergency Visits	Hospitalization
Race-Ethnicity	Hispanic	0.88**	0.89**	0.95	0.83**
	Non-Hispanic Black	0.85**	1.2**	1.33**	1.34**
	Non-Hispanic White	1.09**	1.23**	0.92	0.95
	Non-Hispanic Other race	1.00	1.00	1.00	1.00
	Male	1.11**	1.48**	0.97*	1.07
Age	18-34 years	0.12**	0.13**	0.63**	0.37**
	35-44 years	0.23**	0.52**	0.98	0.8**
	45-64 years	0.52**	0.74**	1.1	1.14*
	65-74 years	0.87**	0.95*	1.12	1.57**
	75+ years	1.00	1.00	1.00	1.00
	Smoker	0.74**	0.75**	1.11	1.06
Diagnosed with	Hypertension	1.56**	1.15**	3.85**	2.71**
	Coronary heart disease	8.54**	9.6**	2.93**	3.96**
	History of heart attack	1.69**	1.63**	2.41**	2.59**
	History of stroke	1.11**	1.18**	3.11**	2.97**
	Diabetes	1.11**	1.37**	1.01	1.16*
	Arthritis	1.09**	1.23**	1.02	0.99
	Asthma	1.08**	1.1**	0.95	1.08
	History of cancer	1.08**	0.98	0.99	0.93
	Insured	2.48**	1.88**	0.89	1.02
	Medicaid	1.35**	1.42**	1.64**	1.71**
	Managed Care	0.97**	1.06**	1.01	0.99
Household Income	<$10,000	0.84**	1.05	1.2**	1.16*
	$10,000 to <$15,000	0.89**	0.72**	1.1	1.11
	$15,000 to < $20,000	0.9**	1.06	0.86	1.02
	$20,000 to < $25,000	0.84**	0.72**	1.15	1.09
	$25,000 to < $35,000	0.89**	1.08**	1.18**	1.05
	$35,000 to < $50,000	0.89**	0.96	0.92	0.94
	$50,000 to < $75,000	0.93**	1.24**	0.89	0.82**
	$75,000 or higher	1.00	1.00	1.00	1.00
Body Weight	Normal	0.94**	0.98	0.86**	0.82**
	Obese	1.04**	1.06**	0.97	1.03
	Overweight	1.00	1.00	1.00	1.00
	Metro Area	1.31**	1.02	1.04	0.89

[a] Rate ratios estimated by Poisson regression using annual visits as the dependent variable. [b] Odds ratios estimated by logistic regression using any emergency visit or hospitalization where the primary ICD-9 diagnosis code indicated a cardiovascular condition as the primary diagnosis. * Indicates statistically significant at the 0.05 level. ** Indicates statistically significant at the 0.01 level.

FTE Physician Staffing to Meet Demand for Health Care Services

Estimates of provider time per encounter convert estimates of demand for services into demand for providers. The number and mix of physicians by specialty required to provide the level of health care services demanded is influenced by how the care system is organized and care is reimbursed, provider scope of practice requirements, economic constraints, technology, and other factors. To convert projected demand for services into demand for physicians we determined how each unit of service demanded (e.g., psychiatrist office visits and hospital inpatient days) translates into demand for a partial FTE provider (i.e., the fraction of an FTE provider's time to provide care during that one patient encounter).

Demand for psychiatrists, for example, was linked to projected numbers of office and outpatient visits to a psychiatrist, and emergency department visits and hospitalizations requiring psychiatry related services and procedures (e.g., ICD-9 CM codes 290-319). The Status Quo demand estimates provided in this report are based on the current care delivery model and do not reflect emerging care delivery models.

Data on provider productivity to estimate the portion of a physician FTE associated with patient encounters in different care settings came from numerous sources. These included the Medical Group Management Association's (MGMA) Physician Compensation and Production Survey.[55], the American Board of Internal Medicine (ABIM) Practice Characteristics Survey, and surveys and workforce studies conducted for individual medical specialties.

The following examples illustrate how provider demand varies by patient characteristics:

- The population of non-Hispanic, black, females, age 75+, insured, obese, and with diabetes and hypertension requires about 26 FTE providers in traditional primary care specialties (family practice, internal medicine, geriatric medicine) per 10,000 population.
- The population of non-Hispanic, black, females, age 75+, insured, normal weight, without diabetes or hypertension requires about 8.6 FTE primary care providers per 10,000 population.
- The population of non-Hispanic, black, females, age 18-34, insured, normal weight, without diabetes or hypertension requires about 2.4 FTE primary care providers per 10,000 population.

These estimates are based on patterns of how patient health risk factors affect the level of health care services by medical specialty and care delivery setting, and how the health care system is currently staffed to meet the demand for services.

Modeling Supply of Physician Specialties

The HWSM is a microsimulation model designed to simulate the career choices of health professionals from the time they enter training through retirement or mortality. The unit of analysis is the individual provider. The conceptual framework for modeling the future supply of physicians starts with the current physician workforce, adds new entrants, and subtracts those who leave the workforce due to retirement

[55] Medical Group Management Association, Physician Compensation and Production Survey, 2012.

or out-of-state migration to arrive at next year's supply. The level of workforce participation for each physician is then modeled as a function of his or her age, gender, and specialty. The cycle repeats each year to simulate next year's supply based on the previous year's supply taking into account expected entrants and exits. The HWSM simulates both the number of active providers as well as a measure of full time equivalent (FTE) providers. For purposes of this study one FTE is defined as the current national average number of direct patient care hours worked per week for providers in each profession or medical specialty.

The primary data source for modeling current supply is a 2013 data extract from the AMA Masterfile. The file contains information on all physicians licensed and active in providing patient care. Information on this list (including self-reported medical specialty) was compared with the American Medical Association's specialty codes to help group physicians by specialty category.

The mechanism for adding new entrants to the workforce is done via the creation of a "synthetic" population. This population is created such that the age, gender, and specialty distribution for each new cohort of providers reflects the demographic and specialty distribution seen in recent years. For each year from 2013 through 2025, "representative" physicians are created by the model to represent each new physician entering the workforce. Each new physician is assigned an age, gender, and specialty that reflect current distributions for newly licensed physicians. The primary sources of data on new graduates are the AAMC 2012-2013 Graduate Medical Education Census completed by residency program directors and administrators, the 2013 AMA Master File and the American Board of Medical Specialties (ABMS) for physician specialties.

Patient Care Hours Worked

Supply projections take into consideration changing demographic composition of the physician workforce, and that average patient care hours worked differ by physician age, gender, and specialty. We used ordinary least squares regression analysis to analyze direct patient care hours per week utilizing Florida's physician licensure files. We limited our analysis to the 18,016 physicians who in 2012-2013 reported direct patient care hours worked per week, and worked at least 8 hours per week in professional activities.

As shown in Exhibit A-3, hours worked patterns differed systematically by specialty. Compared with vascular surgery (the comparison specialty), physicians in allergy & immunology and in dermatology work about 11 fewer patient care hours per week. Physicians in cardiology, obstetrics & gynecology, and many of the surgical specialties have about the same number of patient care hours per week as vascular surgeons. From age 55 onward, patient care hours per week start to decline. Female physicians tend to work about 3.3 hours fewer per week in patient care activities compared with their male peers (controlling for specialty and age). Women under age 55 work about 5 hours per week less than their male peers, while women over age 55 work about two hours per week less than their male peers.

Exhibit A-3: OLS Regression of Weekly Patient Care Hours Worked

	Parameter (Hours)	Probability
Intercept	49.5	<.0001
Specialty (Vascular Surgery is reference category)		
Allergy & Immunology	(11.0)	<.0001
Anesthesiology	(2.6)	0.099
Cardiology	0.5	0.739
Colon & Rectal Surgery	(0.9)	0.726
Critical Care Medicine	(0.8)	0.720
Dermatology	(10.8)	<.0001
Emergency Medicine	(10.6)	<.0001
Endocrinology	(3.7)	0.051
Gastroenterology	(0.8)	0.614
General & Family Practice	(6.9)	<.0001
General Internal Medicine	(3.5)	0.022
General Surgery	0.5	0.775
Geriatric Medicine	(6.7)	0.000
Hematology & Oncology	(1.3)	0.452
Infectious Diseases	(2.4)	0.194
Neonatal & Perinatal Medicine	4.8	0.143
Nephrology	2.7	0.129
Neurological Surgery	1.5	0.446
Neurology	(3.9)	0.019
Obstetrics & Gynecology	(1.4)	0.392
Ophthalmology	(8.8)	<.0001
Orthopedic Surgery	(3.7)	0.022
Otolaryngology	(5.4)	0.003
Pathology	(8.3)	<.0001
Pediatrics	(6.8)	<.0001
Physical Medicine & Rehab	(6.5)	0.001
Plastic Surgery	(7.8)	<.0001
Preventive Medicine	(14.2)	<.0001
Psychiatry	(8.1)	<.0001
Pulmonology	3.0	0.085
Radiation Oncology	(6.0)	0.002
Radiology	(5.4)	0.001
Rheumatology	(3.4)	0.087
Thoracic Surgery	1.7	0.413
Urology	(0.5)	0.769
Age (<40 is reference category)		
Age 40 to 44	0.3	0.615
Age 45 to 49	0.2	0.777
Age 50 to 54	0.6	0.290
Age 55 to 59	(0.4)	0.390
Age 60 to 64	(1.7)	0.001
Age 65 to 69	(5.5)	<.0001
Age 70+	(11.4)	<.0001
Female	(3.3)	<.0001
Female x Age 40 to 44	(1.9)	0.030
Female x Age 45 to 49	(1.8)	0.046
Female x Age 50 to 54	(1.4)	0.119
Female x Age 55 to 59	1.6	0.077
Female x Age 60 to 64	0.6	0.530
Female x Age 65 to 69	1.4	0.294
Female x Age 70+	4.1	0.010
Summary statistics: n=18,016; R^2=0.101; Mean hours worked=42.5		

Modeling Workforce Attrition

The supply model uses age-sex-specialty dependent annual attrition probabilities to simulate providers leaving the workforce. These attrition probabilities were created by summing (1) the probability of leaving the workforce due to career change or retirement, and (2) mortality probability. The model simulates whether a particular physician will remain in the workforce each year by generating a random number which is compared with the probability of retirement for a physician of his or her age, sex, and specialty.

Retirement patterns generated using the combined 2012 and 2013 Florida Physician Workforce Surveys are based on responses to the question of whether the respondent plans to retire within the next five years. These responses were generally consistent with historical retirement patterns generated from analysis of a 2006 survey of physicians age 50 and older conducted by the Association of American Medical Colleges.[56] Included among this AAMC survey sample was a population of retired physicians who were asked at what age they retired.

Mortality rates by age and sex come from the Centers for Disease Control and Prevention. The rates used in the HWSM take into consideration that people in professional occupations tend to have lower mortality rates through age 65 compared with national average mortality rates for men and women. Johnson et al. estimate age-adjusted mortality rates for professional and technical occupations are approximately 25% lower than national rates for men and 15% lower for women.[57]

Exhibit A-4 shows results of this analysis for male physicians, summarizing how many physicians are likely to still be in the workforce from an initial cohort of 100 physicians age 50. (Patterns for female physicians are similar.) For example, a cohort of 100 physicians in allergy & immunology will have about 68 still in active practice by age 65 and 45 still in practice by age 70. Emergency physicians have a much higher attrition rate. From a cohort of 100 emergency physicians age 50, only 47 are still active at age 65 and 23 are still active at age 70 (with many in this older age working reduced hours).

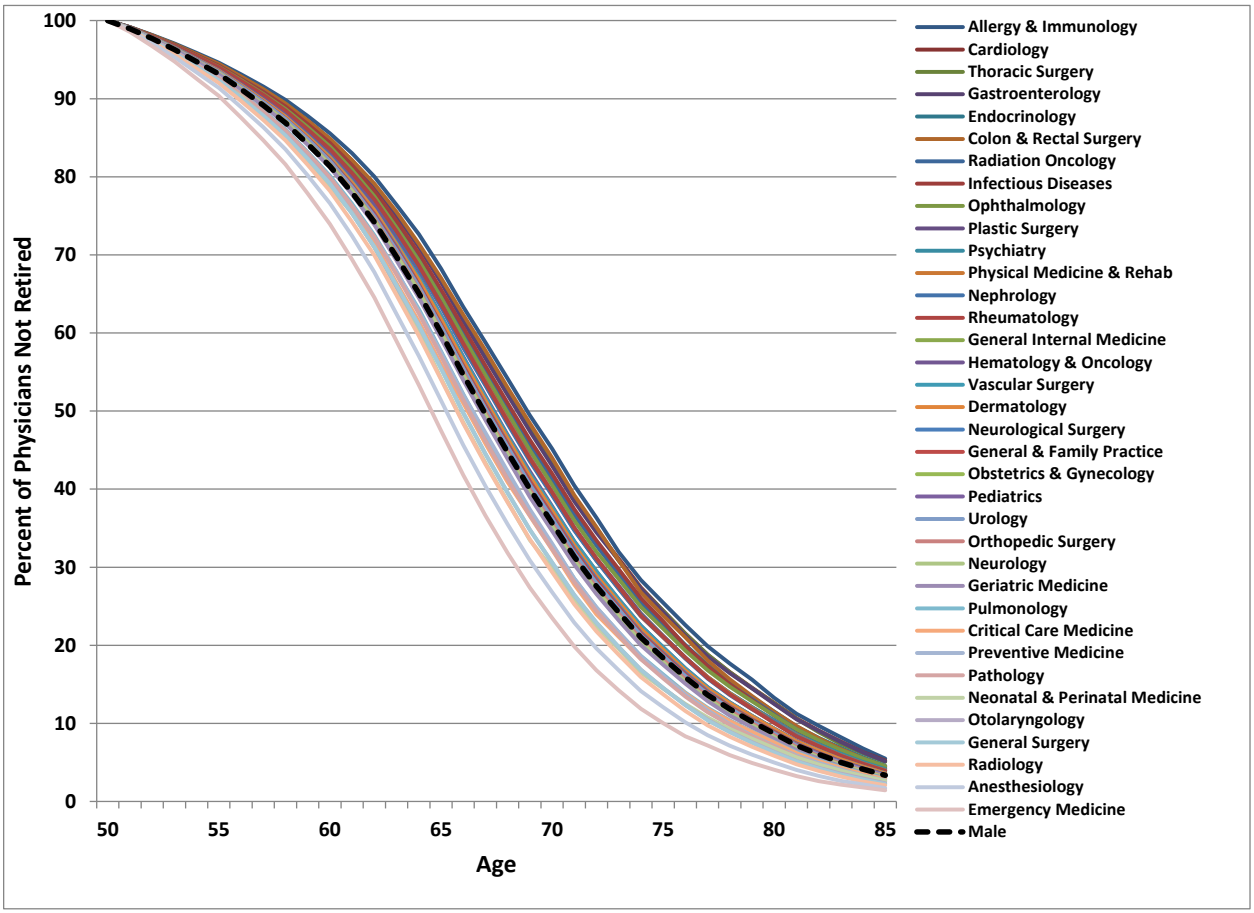
[56] These retirement patterns have been used to develop U.S. physician supply projections. See, for example,

Dill MJ and Salsberg ES. *The Complexities of Physician Supply and Demand: Projections through 2025*. Association of American Medical Colleges, November 2008.

U.S. Department of Health and Human Services. *The Physician Workforce: Projections and Research into Current Issues Affecting Supply and Demand*. 2008.

[57] Johnson NJ, Sorlie PD, Backlund E. The Impact of Specific Occupation on Mortality in the U.S. National Longitudinal Mortality Study. *Demography*. 1999; 36(3):355-367.

Exhibit A-4: Male Physician Retirement Patterns by Specialty and Age Cohort



APPENDIX B: ADDITIONAL FINDINGS

Exhibit B-1: Primary Care FTE Supply, 2013-2025

	Workforce Participation Scenarios				Policy Scenario
Year	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Millennial Hours	GME Expansion
2013	240,800	240,800	240,800	240,800	240,800
2014	243,600	243,100	244,600	243,200	243,600
2015	246,500	245,400	248,400	245,800	246,500
2016	249,000	247,200	251,900	248,000	249,000
2017	251,300	248,600	255,200	250,000	251,300
2018	253,600	250,000	258,400	251,700	253,700
2019	256,000	251,100	261,400	253,400	256,000
2020	258,100	251,900	264,300	254,700	258,100
2021	259,900	252,600	266,800	255,600	260,800
2022	261,600	253,000	269,300	256,200	263,500
2023	263,500	254,300	271,600	257,400	266,200
2024	265,100	255,500	273,500	258,500	268,700
2025	266,700	256,700	275,600	259,500	271,200
% growth 2013-2025	11%	7%	14%	8%	13%

Exhibit B-2: Medical Specialties FTE Supply, 2013-2025

	Workforce Participation Scenarios				Policy Scenario
Year	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Millennial Hours	GME Expansion
2013	125,600	125,600	125,600	125,600	125,600
2014	126,900	126,500	127,500	126,800	126,900
2015	128,200	127,400	129,500	127,900	128,200
2016	129,500	128,300	131,400	129,100	129,500
2017	130,900	129,200	133,200	130,200	130,900
2018	132,200	130,000	134,900	131,100	132,200
2019	133,700	130,800	136,800	132,100	133,600
2020	135,200	131,400	138,600	133,000	135,100
2021	136,500	132,300	140,300	133,800	137,100
2022	138,000	133,000	141,900	134,600	139,000
2023	139,500	134,300	143,600	135,800	141,000
2024	141,000	135,700	145,100	136,900	143,000
2025	142,500	137,000	146,700	138,100	144,900
% growth 2013-2025	13%	9%	17%	10%	15%

Exhibit B-3: Surgical Specialties FTE Supply, 2013-2025

	Workforce Participation Scenarios				Policy Scenario
Year	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Millennial Hours	GME Expansion
2013	155,300	155,300	155,300	155,300	155,300
2014	154,400	153,700	155,200	154,200	154,400
2015	153,800	152,500	155,300	153,500	153,800
2016	153,200	151,200	155,400	152,700	153,200
2017	152,800	150,300	155,700	152,100	152,800
2018	152,700	149,600	156,000	151,600	152,700
2019	152,900	148,800	156,700	151,300	152,800
2020	153,000	148,200	157,400	150,900	153,000
2021	153,300	147,700	158,000	150,700	153,900
2022	153,700	147,300	158,600	150,400	154,800
2023	154,200	147,400	159,300	150,400	155,800
2024	154,600	147,800	159,800	150,400	156,700
2025	155,100	148,100	160,500	150,600	157,600
% growth 2013-2025	0%	-5%	3%	-3%	1%

Exhibit B-4: Other Specialties FTE Supply, 2013-2025

	Workforce Participation Scenarios				Policy Scenario
Year	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Millennial Hours	GME Expansion
2013	245,500	245,500	245,500	245,500	245,500
2014	246,600	245,700	248,000	246,300	246,600
2015	248,100	246,300	250,800	247,500	248,100
2016	249,600	246,800	253,400	248,600	249,600
2017	251,100	247,400	256,000	249,600	251,100
2018	252,800	248,100	258,800	250,600	252,900
2019	254,900	248,800	261,600	251,800	254,900
2020	257,100	249,700	264,600	252,900	257,100
2021	259,200	250,800	267,400	254,000	260,300
2022	261,600	251,900	270,200	255,100	263,800
2023	264,300	254,000	273,200	257,000	267,500
2024	267,000	256,600	276,100	259,000	271,300
2025	269,600	259,100	279,000	260,900	275,100
% growth 2013-2025	10%	6%	14%	6%	12%

Exhibit B-5: Demand Projection Summary by Year, 2013-2025

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Changing Demographics													
Total	778,200	787,400	796,500	805,500	814,800	824,100	833,400	842,900	852,000	861,800	871,200	880,600	890,300
Primary Care	249,000	252,000	255,000	258,000	261,100	264,200	267,300	270,500	273,500	277,000	280,400	283,700	287,100
Medical Subspecialties	125,600	127,600	129,500	131,400	133,400	135,500	137,500	139,600	141,600	143,800	145,900	148,100	150,300
Surgery	155,300	157,000	158,600	160,200	161,800	163,500	165,200	166,900	168,600	170,300	172,000	173,600	175,300
Other Specialties	248,300	250,800	253,400	255,900	258,500	260,900	263,400	265,900	268,300	270,700	272,900	275,200	277,600
Changing Demographics + ACA Medical Insurance Expansion													
Total	778,200	791,600	804,900	817,900	828,200	838,300	848,500	858,700	868,600	878,400	887,800	897,200	906,700
Primary Care	249,000	253,300	257,600	261,900	265,300	268,700	272,000	275,400	278,700	282,200	285,600	288,900	292,300
Medical Subspecialties	125,600	128,200	130,700	133,100	135,300	137,400	139,600	141,800	143,900	146,100	148,200	150,300	152,500
Surgery	155,300	158,300	161,200	164,100	166,000	168,000	170,000	171,900	173,800	175,600	177,200	178,900	180,500
Other Specialties	248,300	251,800	255,400	258,800	261,600	264,200	266,900	269,600	272,200	274,500	276,800	279,100	281,400
Changing Demographics + ACA + Managed Care													
Total	778,200	795,800	811,400	824,600	834,500	844,400	854,100	863,900	873,100	883,100	892,500	901,800	911,400
Primary Care	249,000	256,300	263,100	269,200	272,900	276,700	280,300	284,100	287,600	291,300	294,700	298,100	301,600
Medical Subspecialties	125,600	127,200	128,500	129,400	131,100	132,800	134,500	136,200	137,800	140,000	142,000	144,100	146,200
Surgery	155,300	160,000	163,900	167,200	169,100	171,100	173,000	174,800	176,600	178,400	180,100	181,700	183,300
Other Specialties	248,300	252,300	255,900	258,800	261,400	263,800	266,300	268,800	271,100	273,400	275,700	277,900	280,300
Changing Demographics + ACA + Increased Use of Retail Clinics													
Total	778,200	791,400	802,600	811,400	820,300	829,300	838,200	847,000	855,200	865,100	874,300	883,700	893,100
Primary Care	249,000	251,000	252,400	253,100	255,600	258,200	260,600	263,100	265,300	268,900	272,100	275,400	278,700
Medical Subspecialties	125,600	128,600	131,300	133,600	135,600	137,700	139,800	141,900	143,900	146,100	148,200	150,300	152,500
Surgery	155,300	159,300	162,500	165,100	166,900	168,700	170,500	172,200	173,800	175,600	177,200	178,900	180,500
Other Specialties	248,300	252,500	256,400	259,600	262,200	264,700	267,300	269,800	272,200	274,500	276,800	279,100	281,400
Changing Demographics + ACA + Increased Use of Advanced Practice Nurses (Moderate staffing)													
Total	778,200	789,700	801,200	812,300	820,800	829,000	837,500	845,800	853,900	862,300	870,000	878,000	885,800
Primary Care	249,000	252,300	255,700	259,000	261,500	263,900	266,300	268,800	271,200	273,900	276,500	279,000	281,600
Medical Subspecialties	125,600	128,000	130,200	132,400	134,300	136,200	138,200	140,200	142,100	144,100	146,000	147,900	149,900
Surgery	155,300	158,200	161,100	163,900	165,800	167,700	169,700	171,500	173,300	175,100	176,600	178,300	179,800
Other Specialties	248,300	251,200	254,200	257,000	259,200	261,200	263,300	265,300	267,300	269,200	270,900	272,800	274,500
Changing Demographics + ACA + Increased Use of Advanced Practice Nurses (high staffing)													
Total	778,200	787,700	797,500	806,600	813,200	819,600	826,500	833,100	839,500	846,100	852,000	858,500	864,900
Primary Care	249,000	251,300	253,700	256,100	257,600	259,100	260,600	262,200	263,800	265,600	267,300	269,000	270,800
Medical Subspecialties	125,600	127,700	129,700	131,700	133,400	135,000	136,800	138,600	140,200	142,000	143,700	145,500	147,300
Surgery	155,300	158,200	161,000	163,700	165,500	167,400	169,300	171,100	172,900	174,600	176,100	177,700	179,200
Other Specialties	248,300	250,500	253,100	255,100	256,700	258,100	259,800	261,200	262,600	263,900	264,900	266,300	267,600

Exhibit B-6: Total Physician Gap by Scenario Combination, 2013-2025

Demand vs Supply Scenario	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
MC vs Retire Early	11,000	26,800	39,800	51,100	59,000	66,700	74,600	82,700	89,700	97,900	102,500	106,200	110,500
ACA vs Retire Early	11,000	22,600	33,300	44,400	52,700	60,600	69,000	77,500	85,200	93,200	97,800	101,600	105,800
MC vs Millennial Hours	11,000	25,300	36,700	46,200	52,600	59,400	65,500	72,400	79,000	86,800	91,900	97,000	102,300
ACA vs Millennial Hours	11,000	21,100	30,200	39,500	46,300	53,300	59,900	67,200	74,500	82,100	87,200	92,400	97,600
Retail vs Retire Early	11,000	22,400	31,000	37,900	44,800	51,600	58,700	65,800	71,800	79,900	84,300	88,100	92,200
75th Percentile	**11,000**	**22,100**	**30,800**	**39,300**	**46,100**	**52,700**	**58,500**	**65,500**	**71,500**	**79,200**	**83,200**	**86,700**	**90,400**
APRN Low vs Retire Early	11,000	20,700	29,600	38,800	45,300	51,300	58,000	64,600	70,500	77,100	80,000	82,400	84,900
Retail vs Millennial Hours	11,000	20,900	27,900	33,000	38,400	44,300	49,600	55,500	61,100	68,800	73,700	78,900	84,000
MC vs Status Quo	11,000	24,300	34,800	43,300	48,400	53,100	56,600	60,500	64,200	68,200	71,000	74,100	77,500
ACA vs Status Quo	11,000	20,100	28,300	36,600	42,100	47,000	51,000	55,300	59,700	63,500	66,300	69,500	72,800
APRN High vs Retire Early	11,000	18,700	25,900	33,100	37,700	41,900	47,000	51,900	56,100	60,900	62,000	62,900	64,000
Retail vs Status Quo	11,000	19,900	26,000	30,100	34,200	38,000	40,700	43,600	46,300	50,200	52,800	56,000	59,200
APRN Moderate vs Status Quo	11,000	18,200	24,600	31,000	34,700	37,700	40,000	42,400	45,000	47,400	48,500	50,300	51,900
MC vs Retire Later +2	11,000	20,500	27,400	32,500	34,400	36,300	37,600	39,000	40,600	43,100	44,800	47,300	49,600
25th Percentile	**11,000**	**16,800**	**21,800**	**26,900**	**29,600**	**31,700**	**33,400**	**35,100**	**37,200**	**39,600**	**41,300**	**43,900**	**46,100**
ACA vs Retire Later +2	11,000	16,300	20,900	25,800	28,100	30,200	32,000	33,800	36,100	38,400	40,100	42,700	44,900
Retail vs Retire Later +2	11,000	16,100	18,600	19,300	20,200	21,200	21,700	22,100	22,700	25,100	26,600	29,200	31,300
APRN High vs Status Quo	11,000	16,200	20,900	25,300	27,100	28,300	29,000	29,700	30,600	31,200	30,500	30,800	31,000
APRN Moderate vs Retire Later +2	11,000	14,400	17,200	20,200	20,700	20,900	21,000	20,900	21,400	22,300	22,300	23,500	24,000
APRN High vs Retire Later +2	11,000	12,400	13,500	14,500	13,100	11,500	10,000	8,200	7,000	6,100	4,300	4,000	3,100