AAMC
Tomorrow's Doctors, Tomorrow's Cures®

The Complexities of Physician Supply and Demand: Projections From 2018 to 2033

Learn
Serve
Lead

June 2020

Prepared for the AAMC by IHS Markit Ltd.

Association of
American Medical Colleges

The Complexities of Physician Supply and Demand: Projections From 2018 to 2033

June 2020

Prepared for the AAMC by IHS Markit Ltd.

Association of American Medical Colleges

Washington, D.C.

This report was prepared for the AAMC by IHS Markit Ltd.:
Tim Dall, Executive Director
Ryan Reynolds, Senior Consultant
Ritashree Chakrabarti, PhD, Senior Consultant
Kari Jones, PhD, Director
Will Iacobucci, Senior Consultant

IHS Markit Ltd.
1300 Connecticut Ave., NW, Suite 800
Washington, DC 20036

CONTENTS

EXHIBITS

EXECUTIVE SUMMARY

Assessing the capacity of the nation's future physician workforce to meet expected demand provides critical information to both the public and the private sectors. The pace of change in health care coupled with the lead time required to train new physicians necessitates continuously updating and improving workforce projections. For these reasons, since 2015, the AAMC has commissioned annual reports of national physician workforce projections prepared by independent experts. The purpose of these updates is threefold:

- **Update and improve workforce projections:** The AAMC is committed to supporting ongoing efforts to use the most recent and best-quality data to update projections and to respond to constructive feedback received about previous projections.

- **Present new analyses:** The reports present new and updated research on the physician workforce and the implications of important issues such as the evolving health care system, the changing demographic composition of the workforce, and changing hours-worked and retirement patterns.

- **Identify future directions for research:** The process of modeling future supply and demand for physicians helps identify areas for future research, data collection, and analysis that will strengthen future projections and support decision-making to help align the nation's physician workforce with its health care needs.

This 2020 update was prepared before the COVID-19 crisis, so although it does not include any specific information or scenarios based on that crisis, it does include some lessons learned from the pandemic and critical shortages of health workers. Future editions will look at this topic more explicitly.

This report uses a modeling approach and data sources similar to those in previous reports. As in the past, this update projects future physician supply by considering trends in key physician supply determinants and the sensitivity of supply projections to changes in these determinants. The demand projections reflect changing demographics as the population grows and ages, the rapidly growing supply of advanced practice registered nurses (APRNs) and physician assistants (PAs), and other important trends in health care such as a growing emphasis on achieving population health goals. Because it is impossible to predict with certainty the degree to which any scenario will transpire, the projected shortages are presented as a range under the most likely scenarios rather than as a single number.

This year, we updated the workforce projections with new physician work-hours and retirement-intentions data from the AAMC 2019 National Sample Survey of Physicians (NSSP). Survey findings suggest that physicians intend to retire earlier than was assumed in previous supply projections. Consequently, projected future physician supply is lower than in past reports. This update extrapolates a 2018 level of care delivery to 2033 to project future demand under the Status Quo Scenario, whereas the previous report extrapolated a 2017 level of care delivery to 2032. The update also reflects the federal Health Resources and Services Administration's upward revision of the number of additional physicians required to remove Health Professional Shortage Area (HPSA) designations for primary care and mental health specialties; this information is used as a conservative proxy for national gaps between supply and demand in 2018.

Study findings offer stakeholders insights into changes expected in the physician workforce by 2033. All supply and demand projections are reported as full-time-equivalent (FTE) physicians, where an FTE is

defined for each specialty category as the average weekly patient-care hours for that specialty category. The projections include all active physicians who have completed their graduate medical education.

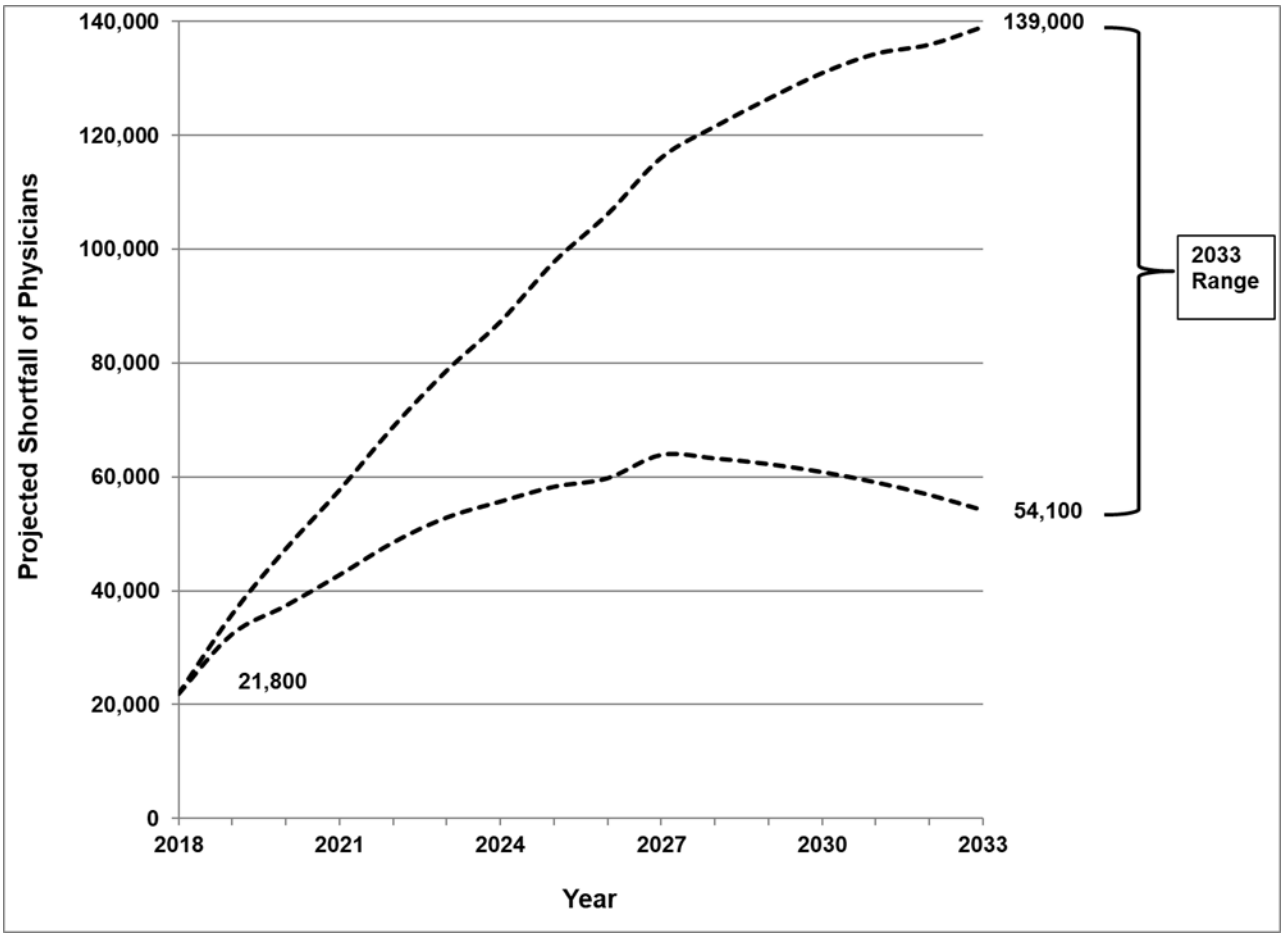
Key Findings

- **We continue to project that physician demand will grow faster than supply, leading to a projected total physician shortage of between 54,100 and 139,000 physicians by 2033** (Exhibit ES-1). This projected shortage range reflects updates to model inputs, including updated estimates of physicians' hours-worked patterns and retirement intentions and larger starting-year shortage estimates based on recently revised federal Health Professional Shortage Area (HPSA) designations for primary care and mental health.
    - **A primary care physician shortage of between 21,400 and 55,200 is projected by 2033**.
    - **A shortage of non-primary care specialty physicians of between 33,700 and 86,700 is projected by 2033**, including:
        - Between 17,100 and 28,700 for Surgical Specialties.
        - Between 9,300 and 17,800 for Medical Specialties.
        - Between 17,100 and 41,900 for the Other Specialties category.

> ***By 2033, we project:***
>
> ✓ ***A shortage of primary care physicians of between 21,400 and 55,200.***
>
> ✓ ***A shortage across the non-primary care specialties of between 33,700 and 86,700 physicians.***

- **Demographics — specifically, population growth and aging — continue to be the primary driver of increasing demand from 2018 to 2033.** During this period, the U.S. population is projected to grow by 10.4%, from about 327 million to 361 million. The population under age 18 is projected to grow by only 3.9%, which portends low growth in demand for pediatric specialties, while the population aged 65 and over is projected to grow by 45.1%, which portends high growth in demand for physician specialties that predominantly care for older Americans.
- **A large portion of the physician workforce is nearing traditional retirement age, and supply projections are sensitive to workforce decisions of older physicians.** More than two of five currently active physicians will be 65 or older within the next decade. Shifts in retirement patterns over that time could have large implications for physician supply. Growing concerns about physician burnout, documented in the literature, suggest physicians will be more likely to accelerate than delay retirement. On the other hand, economic uncertainty and any detrimental effect on physician wealth could contribute to delaying retirement.
- **If underserved populations had health care use patterns like populations with fewer access barriers, demand could rise by an additional 74,100 to 145,500 physicians.** Improved access to care is a national goal. We updated two hypothetical Health Care Utilization Equity Scenarios around the effects of removing access barriers. This analysis underscores the systematic differences in annual use of health care services by insured-uninsured status, urban-rural location, and race and ethnicity. These estimates, which are excluded from the shortage-projection ranges, help illuminate the magnitude of current barriers to care and provide an additional reference point when gauging the adequacy of the physician workforce to achieve national goals.

Exhibit ES-1: Total Projected Physician Shortfall Range, 2018-2033



Note: Because complex systems have internal checks and balances to avoid extremes, the upper and lower bounds of the shortage projections reflect the range of most likely outcomes. The divergence over time represents increasing uncertainty.

Future Directions in Physician Workforce Research

An ever-present challenge in making these workforce projections is the rapid pace of change in the health care system and the dearth of data available to quantify these changes. We have identified specific areas where additional data and research could improve health care workforce projections:

- **APRNs, PAs, and hospitalists — rapid growth, market saturation, and services needed:** This report explores the potential implications of continued rapid growth in the APRN and PA supply, and more information is needed. To what extent can the health care system continue to absorb this new supply of health care professionals? What are the implications of this supply on the demand for physicians? To what extent have APRNs and PAs reduced demand for physicians in some specialties, and to what extent are APRNs and PAs providing previously unfilled services and expanding access to care?

  Published research suggests that patients in primary care settings receive only 55% of recommended chronic and preventive services from their physicians — with perhaps much of the

gap between services provided and services recommended attributed to the time constraints that physicians face when meeting with patients. To what extent do APRNs and PAs partially substitute for physicians in providing the 55% of recommended services being provided, and to what extent will the increased supply of APRNs and PAs help deliver the 45% of recommended services not currently being provided? The hospitalist supply also continues to grow rapidly. Might market saturation be reached for hospitalists, and, if it does, at what point would employment growth slow to a level that matches growth trends in hospital inpatient care?

We have brought new data to bear on these issues in this report, but fully addressing the above questions to inform workforce modeling requires input from physicians, APRNs, and PAs, as well as the health systems that employ these providers. To help inform the modeling of the interprofessional effects of future workforce supply and the demand for other professions, a panel of physicians, APRNs, and PAs should be convened to compile an inventory of the data and research still needed to estimate the necessary model parameters and test the modeling assumptions currently in use. Such a panel should produce guidance on the specific research and data collection needed to assess (1) what proportion of APRN and PA time is for performing activities that physicians also provide and how that varies (e.g., by specialty and setting), (2) what proportion of APRN and PA time is spent in activities that complement physician efforts and expands the comprehensiveness of services provided to patients (e.g., conducting follow-up visits or providing care that otherwise would not have been provided to patients), and (3) what proportion of APRN and PA time is spent providing care to people who otherwise would not have received services (e.g., services provided in retail clinics or health clinics for patients who otherwise would not have sought physician services). We also need data and research on the labor market for hospitalists trained as primary care physicians to better understand and model their evolving role in hospital-based care delivery.

- **Current shortages and inefficiencies:** The demand projections start with the assumption that physician supply and demand are in equilibrium in 2018 — except for primary care and psychiatry, where federal government estimates for Health Professional Shortage Areas are used as a conservative proxy for the current shortage of physicians. How might we better measure current shortages in other specialties? To the extent that current national shortages (or surpluses) exist for other specialties, the projections underestimate (or overestimate) demand from 2018 to 2033 by roughly the size of the current national imbalance between supply and demand. This raises questions about how best to quantify current imbalances between supply and demand across specialties.

- **Priority issues in the physician workforce:** Along with the work needed to inform physician workforce projections, research is needed on topics of critical importance to physicians, their employers, and physician workforce planners, including the covariates of physician burnout, improving workforce diversity, the impact of medical education debt, the factors that drive decisions about where physicians practice, the role and impact of telehealth on physician practice, and physicians' experiences of harassment and discrimination.

- **COVID-19 impact:** The COVID-19 pandemic is likely to have short- and long-term consequences on the nation's physician workforce, including educational pipeline issues (e.g., interruption of education, cancellation of clinical rotations, changes in curriculum), regulatory issues (e.g., changes in licensure and reimbursement), how medicine is practiced (e.g., uptake of telehealth, small private practices being hit hard economically), workforce exits (due to death from COVID-19, early burnout-induced retirement or postponed retirement due to the economy), specialty mix (interest in some specialties, like infectious disease, may increase while interest in others, like emergency medicine, may decrease), and demand shifts (e.g., scope-of-practice changes for other professions, changes in demand due to delayed care, sudden need for critical care for COVID-19 cases, longer-term demand decreases due to COVID-19 deaths).

INTRODUCTION

Since 2015, the AAMC has published annual reports projecting future supply and demand for physicians. These studies build on earlier work published by the AAMC dating back to 2008.The primary purpose of these studies is to inform policies and strategies that help ensure the United States trains a sufficient number and specialty mix of physicians to further national goals of increased access to high-quality and affordable care. These studies also further discussion of unequal access to health care services and advance the field of health workforce research.

The title of this report, "Complexities of Physician Supply and Demand Modeling," reflects the data challenges and uncertainties of projecting future workforce supply and demand. There continue to be rapid growth in the supply of advanced practice registered nurses (APRNs) and physician assistants (PAs) and improved understanding of their value in care delivery and helping improve access to care for underserved populations.[1-3] The health workforce continues to age, and there is growing concern about provider burnout.[4-9] Efforts continue to improve health care delivery and control rising medical costs through alternative payment models such as accountable care organizations (ACOs) and value-based reimbursement; through alternative ways to deliver care such as team-based care, integrated care, patient-centered care, and telemedicine; and through efforts to encourage preventive care and improve population health.[10-14] There continue to be advances in medicine, medical equipment, and information technology that expand and improve prevention and treatment options, allow for faster and more accurate clinical diagnosis, and provide patients and clinicians with more data to inform their decisions.[15] Against this backdrop is a U.S. population that is growing, aging, and becoming more racially and ethnically diverse.

Mindful of the magnitude and speed of these changes, the AAMC contracted with IHS Markit to update physician workforce projections by incorporating the latest available data on trends and factors affecting physician supply and demand. Given the lead time required to adjust the nation's training capacity and train new physicians, projecting future adequacy of physician supply is essential. As with last year's report and other similar workforce reports, this study models a 15-year time horizon, 2018 to 2033.

This update continues to reflect the AAMC's commitment to regularly update projections and to refine scenarios that reflect the best available evidence on trends in health care delivery and the physician workforce. Key trends likely to affect the supply of and demand for health care services were identified and modeled under multiple supply and demand scenarios. Projections for individual specialties were aggregated into five broad categories for reporting, consistent with specialty groupings designated by the American Medical Association (AMA): Primary Care, Medical Specialties, Surgical Specialties, and Other Specialties, with Primary-Care-Trained Hospitalists reported as a fifth category to avoid confounding the Primary Care projections.

Each year, the updated demand projections shift to reflect new levels of care use. For example, data inputs and demand projections in the 2019 report extrapolated a "2017 national average" level of care,[16] while this 2020 report extrapolates a "2018 national average" level of care. The latest available data at the time this study was conducted were from 2018. The Status Quo Scenarios for demand and supply extrapolate current care-use and care-delivery patterns to future populations, while alternative scenarios model different assumptions about ongoing and future trends in care delivery. The alternative supply and demand scenarios form the basis of the projection ranges for supply and demand.

The supply projections use new data on physician hours worked and retirement intentions collected as part of the AAMC 2019 National Sample Survey of Physicians (NSSP). The AAMC contracted with Toluna, an external firm that recruited active physicians from their own and their partners' proprietary panels of health care professionals, to conduct the survey. NSSP contains data on a broad array of factors, including demographics, academic affiliations, continuing medical education, detailed work time and allocation, retirement plans, practice characteristics, well-being, and medical education debt. The

survey started on Feb. 25, 2019, and closed once the desired quota of 6,000 participants (*n* = 6,000) was reached on March 25, 2019. The sample was stratified by specialty group, gender, and age group. The data were weighted to be representative of all practicing physicians in the United States in terms of specialty group, gender, age group, and international medical graduate (IMG) status using data from the 2018 AMA Physician Masterfile. The sampling error for the survey was +/-1.3% at a 95% confidence level using a point estimate of 50%. Analysis of the 2019 NSSP data compared with the data used previously to model physician supply found (1) physician weekly hours worked are lower, but patterns in differences in weekly hours worked by physician age, sex, and specialty are similar, and (2) physicians plan to retire earlier than we estimated using older data.

The remainder of this update is organized similarly to past reports, presenting the comparison of updated physician supply and demand projections and describing the supply and demand scenarios and results. Updates to the Health Care Utilization Equity and Evolving Care Delivery System Scenarios are provided, along with more in-depth modeling of geographic variation in physician supply and demand. The final sections highlight key findings and conclusions and possible future directions in the field of health workforce research. Appendix 1 presents additional detail about modeling data and methods, and Appendix 2 contains additional tables and charts.

UPDATED PROJECTIONS

Demand continues to exceed supply, leading to a projected shortage of between 54,100 and 139,000 physicians by 2033 — higher than the previous projected shortage range for 2032 of between 46,900 and 121,900 physicians (2019 report).[16] The update reflects the following:

1. The demand projections have been recalibrated to reflect a 2018 level of care (rather than a 2017 level of care) using updated data on population demographics, disease prevalence, and health risk factors, as well as newer data on health care use and delivery patterns.
2. The federal government estimates an additional 14,900 primary care physicians and 6,894 psychiatrists were required in 2018 to provide a level of care that will remove the Health Professional Shortage Area (HPSA) designation for areas with primary care and mental health shortages. The designation is used as a conservative proxy for the current national shortage of physicians. These numbers are higher than estimates used in the previous report, indicating the government's recognition of growing shortages.
3. Supply projections for physicians, advanced practice registered nurses (APRNs), and physician assistants (PAs) have been updated using more recent data on the demographics and specialty mix of current supply, hours-worked patterns, and the characteristics and specialty mix of new graduates. This includes new survey data from the AAMC 2019 National Sample Survey of Physicians (NSSP), the Health Resources and Services Administration 2018 National Sample Survey of Registered Nurses (NSSRN), which collected workforce data on APRNs, and newly published data from the National Commission on Certification of Physician Assistants (NCCPA). The higher shortage projections in this year's report result mainly from updated data about physicians' retirement intentions, which indicate physicians are likely to retire at earlier ages than older data suggested.

The modeled scenarios used to calculate the shortage range remain the same as in last year's report.

The updated Primary Care physician shortage range for 2033 is between 21,400 and 55,200, which is similar to the range in last year's report. The projected 2033 shortage ranges for non-primary care physicians are between 17,100 and 28,700 for Surgical Specialties; between 17,100 and 41,900 for Other Specialties; and between 9,300 and 17,800 for Medical Specialties.[a] If the annual number of primary-care-trained physicians becoming hospitalists (Primary-Care-Trained Hospitalists) remains similar over time, then by 2033, general hospitalist supply will be between about 3,800 and 8,000 higher than current demand scenarios expect. If the nation reaches saturation in the supply of hospitalists, physicians who might otherwise choose to become hospitalists might choose other specialties.

The supply and demand scenarios used to calculate the shortage ranges reflect the uncertainty, complexity, and evolving nature of the environment within which physicians practice. One scenario alone is inadequate to convey the associated uncertainty. We examined four scenarios with different assumptions about key physician supply determinants and six scenarios with different assumptions about key physician-demand determinants. We compared each supply scenario with each demand scenario to generate 24 sets of projections of future adequacy of supply for physicians overall and for each specialty category. The extreme high and low scenarios are least likely to occur since multiple factors tend to mitigate highs and lows. For example, if physicians were to begin retiring earlier, the growing systemic stresses this could cause due to the growing shortage of physicians (including rising wages) might eventually lead some physicians to delay retirement. Given the propensity of such systems-level "checks and balances" to avoid extremes, we exclude the highest and lowest supply-adequacy projection quartiles and use the middle two quartiles to indicate a likely range. The ranges presented throughout this report thus represent the middle-most combinations of the supply and demand scenarios described in the "Supply Modeling" and "Demand Modeling" sections of the report. The growing divergence over time of the highest and lowest projections we present can, then, be interpreted as an increase in uncertainty as we project further and further out into the future.

The updated projections model 28,980 newly trained physicians entering the workforce each year and continued growth in the number of APRNs and PAs entering the workforce. The starting supply of physicians comes from analysis of the 2018 American Medical Association Physician Masterfile. The updated demand projections reflect new data from the 2017 Medical Expenditure Panel Survey on health care use patterns (using 2013-2017 data) and updated data on population characteristics and prevalence of health risk factors from the 2018 American Community Survey and the 2018 Behavioral Risk Factor Surveillance System. The most recent state and national population projections are used. The U.S. Census Bureau estimates the U.S. population was 327.2 million in 2018 and will grow to 361.1 million by 2033.[17] Of the estimated 33.9 million growth in the population, 23.6 million (70%) is growth in the number of people age 65 or older.

Total Physician Supply and Demand

Under most scenarios projected, the total projected demand for physicians exceeds the total projected supply (Exhibit 1). Looking at the 25th-to-75th-percentile projections for total physicians, demand will continue to grow faster than supply, leading to a projected shortage of between 54,100 and 139,000 physicians by 2033 (Exhibit 2).

Exhibit 1: Projected Physician Supply and Demand by Scenario, 2018-2033

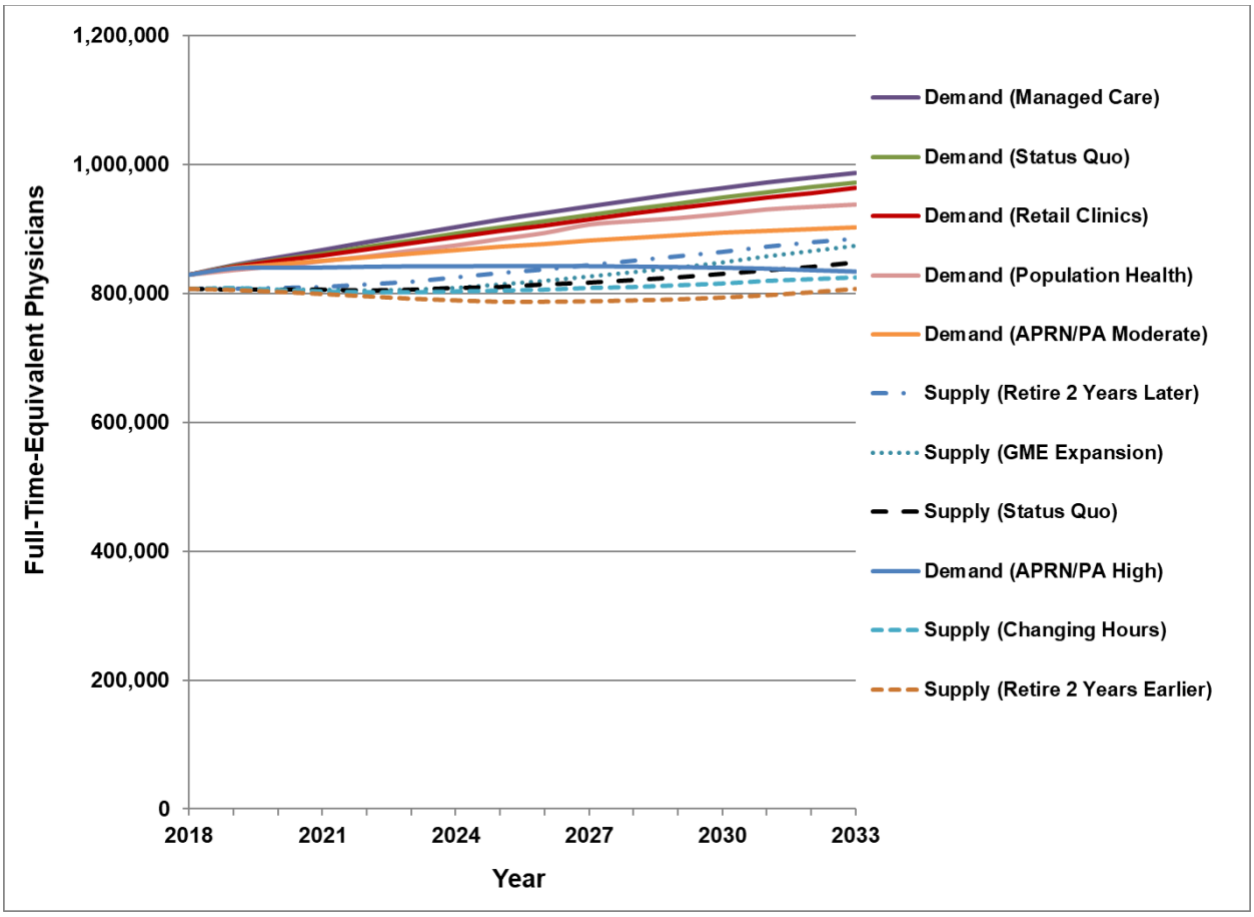
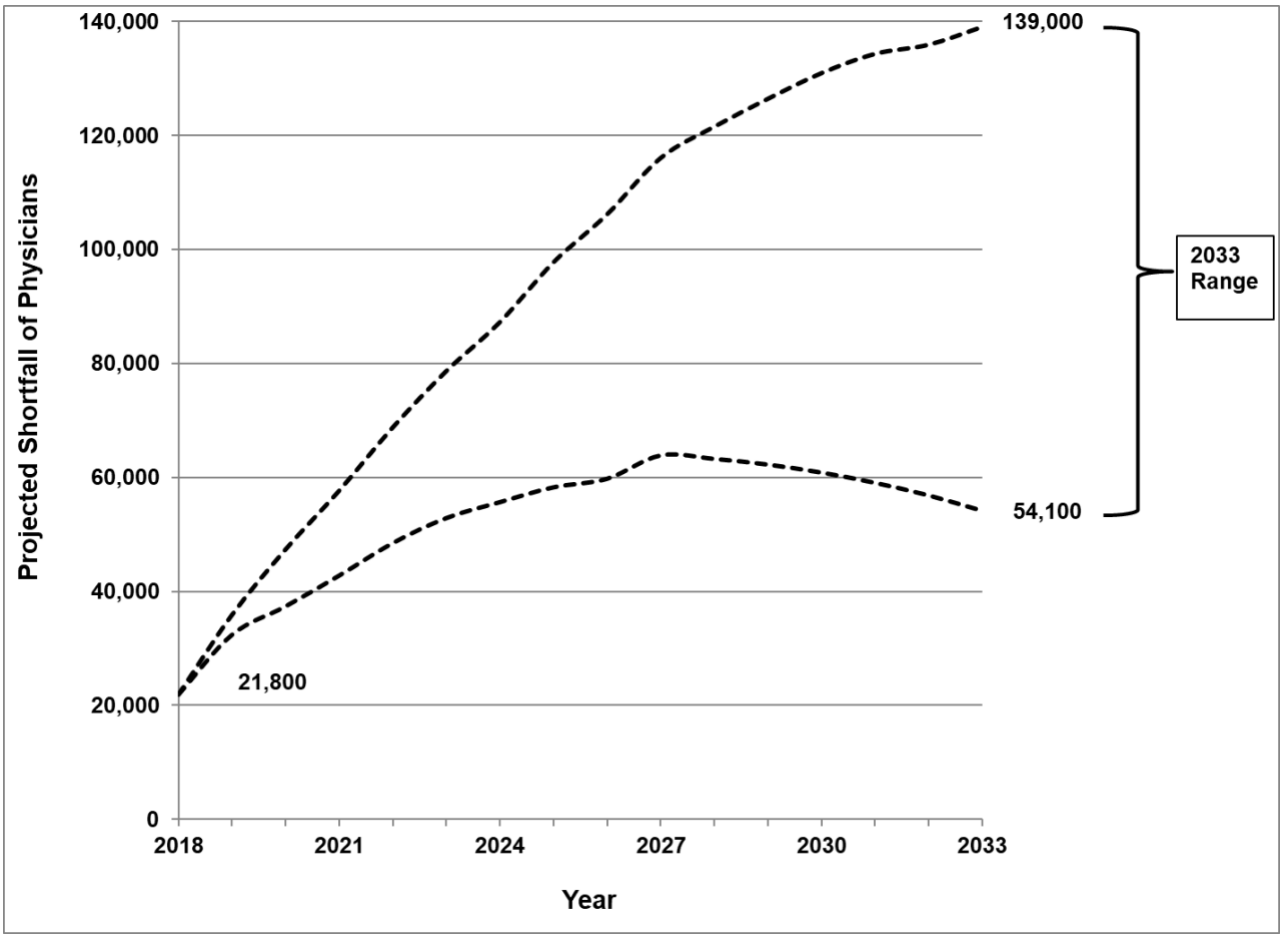


Exhibit 2: Total Projected Physician Shortfall Range, 2018-2033



Primary Care Supply and Demand

Comparison of projected supply and demand for Primary Care physicians (Exhibit 3) predicts a shortage by 2033 of between 21,400 and 55,200 physicians (Exhibit 4). This shortage range for 2033 is almost identical to the 2019 shortage projection, between 21,100 and 55,200 Primary Care physicians by 2032.[16]

The updated projections use higher estimates of the annual number of new Primary Care physicians entering the workforce than were used last year: 8,366 compared with 7,420. Much of this increase is attributed to lower estimates of the number of physicians trained in primary care who become hospitalists each year, based on an AAMC analysis of Medicare billing records, and lower estimates of the number of physicians trained in primary care who subspecialize, based on our analysis of AMA Physician Masterfile data. Offsetting this increase in the number of newly trained Primary Care physicians is the increase in the number of physicians planning to retire earlier than previously modeled, according to analyses based on 2019 NSSP data. This finding is consistent with reports of higher levels of burnout among the primary care workforce and a robust economy that bolstered retirement funds.[18-20] The estimated shortage of about 14,900 Primary Care physicians in 2018 is based on the calculation from the Health Resources and Services Administration (HRSA) that about this number of primary care providers are needed to remove the primary-care-shortage designation in currently designated shortage areas.

Each modeled supply and demand scenario is based on assumptions about the continuation of current trends or changes in care delivery that might happen at a future date, so each scenario has a degree of uncertainty. The projected shortage range widens over time, reflecting (1) that some trends have a compounding effect (such as annually training more APRNs and PAs) and (2) greater uncertainty in supply and demand determinants as we move further into the future. As illustrated in Exhibit 3, projected demand exceeds supply under all scenarios modeled except the one that assumed the highest number of APRNs and PAs in primary care. This APRN/PA High demand scenario assumes (1) that the number of new APRNs and PAs trained each year will continue growing at high rates and the proportion of new entrants choosing primary care will remain at recent levels and (2) that APRNs and PAs will offset demand for physicians at the rates discussed later in this report. Despite large increases over the past decade in the number of APRNs and PAs entering primary care, as well as a large number of primary care physicians trained annually, the demand for primary care providers remains strong. The rate of growth in training APRNs and PAs cannot be sustained indefinitely, but at what level the nation will reach market saturation is unknown.[21-24]

Exhibit 3: Projected Supply and Demand for Primary Care Physicians, 2018-2033

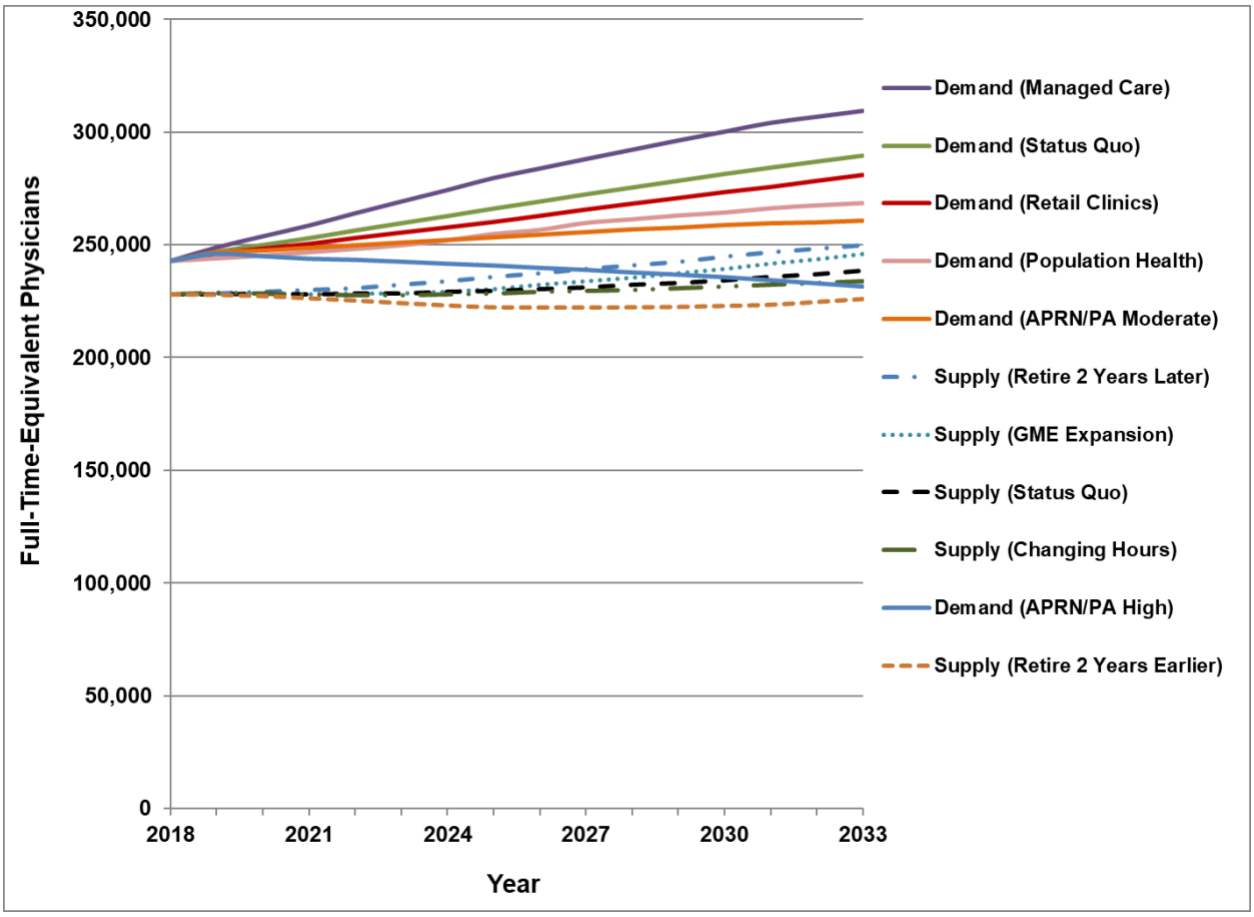
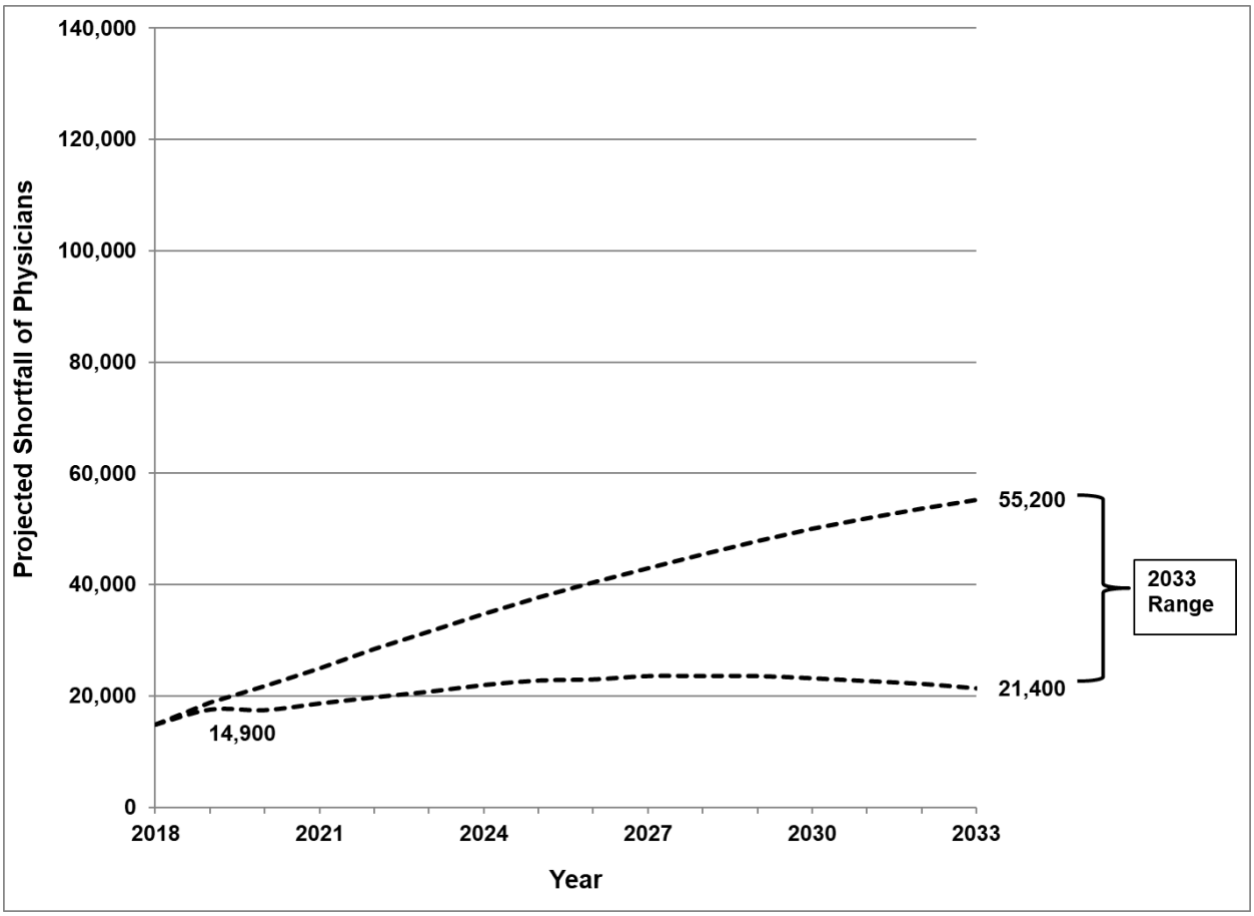


Exhibit 4: Projected Primary Care Physician Shortfall Range, 2018-2033



Non-Primary Care Supply and Demand

Exhibits 5 through 10 depict the overall range of supply and demand growth and projected shortage ranges for non-primary care physicians by specialty category. Under the scenarios modeled, we project a shortage of between 33,700 and 85,200 non-primary care physicians by 2033. Non-primary care specialties are grouped into four categories: Medical Specialties, Surgical Specialties, Primary-Care-Trained Hospitalists, and Other Specialties.

Medical Specialties

The demand for physicians in internal medicine subspecialties is growing rapidly due to population growth and aging, with slower growth in demand for pediatric subspecialties. However, supply is also growing rapidly in these specialties (Exhibit 5). Under the scenarios modeled, this update projects a shortage range of between 9,300 and 17,800 FTEs by 2033 (Exhibit 6), higher than the range of between 5,400 and 13,400 for 2032 projected in the previous report. The main contributor to the higher shortage projections is the updated estimate of physicians planning to retire earlier than previously modeled.

Exhibit 5: Projected Supply and Demand for Medical Specialist Physicians, 2018-2033

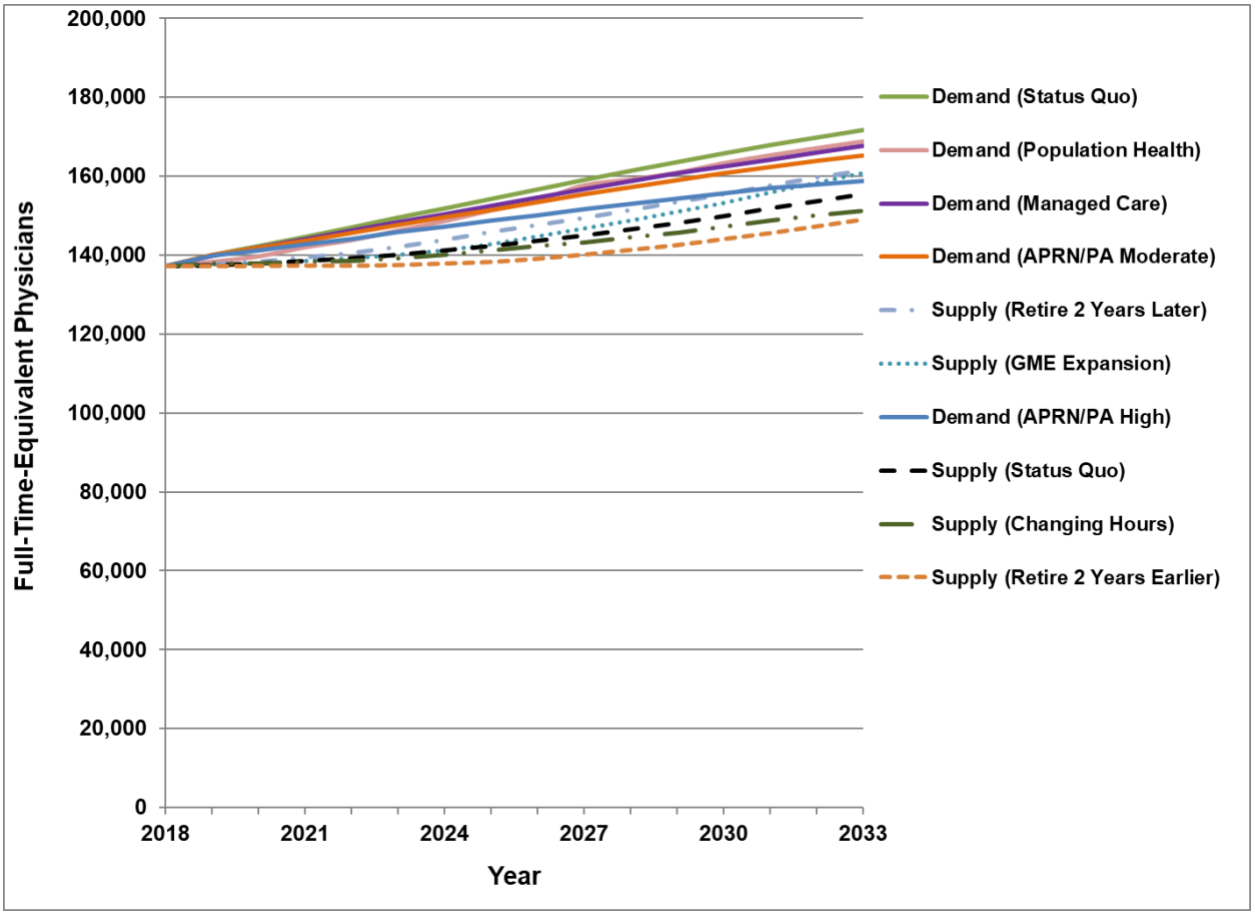
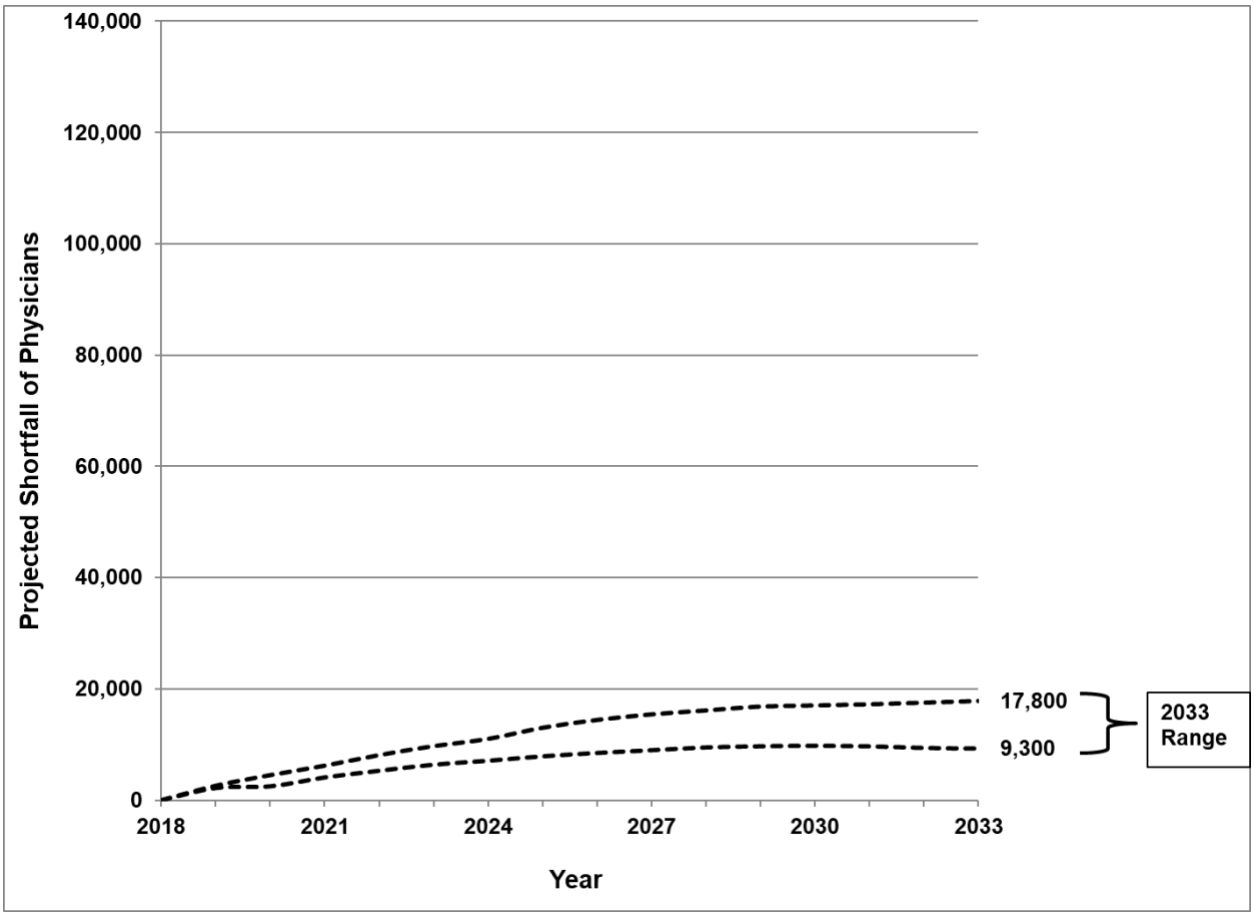


Exhibit 6: Projected Medical Specialist Physician Shortfall Range, 2018-2033



Surgical Specialties

Based on current trends, the supply of surgeons is not projected to change substantially over the next 15 years as future attrition offsets the number of newly trained surgeons. Demand continues to grow, with projected demand exceeding projected supply under all scenarios modeled (Exhibit 7). The projected shortage for 2033 is between 17,100 and 28,700 surgeons (Exhibit 8); it was between 14,300 and 23,400 by 2032. The 2018 higher shortage estimates result mainly from the updated retirement rates, which suggest lower future supply than previously reported.

Exhibit 7: Projected Supply and Demand for Surgeons, 2018-2033

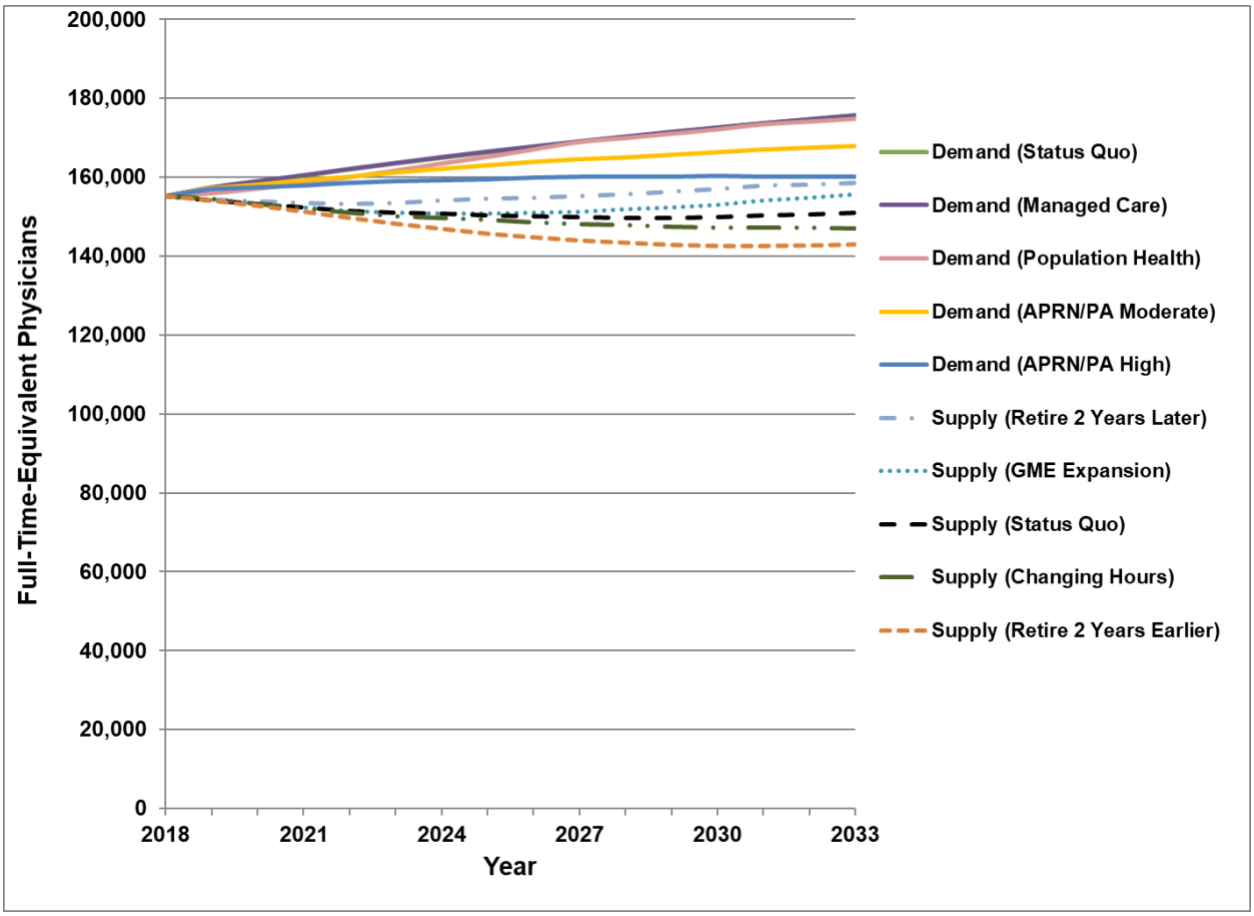
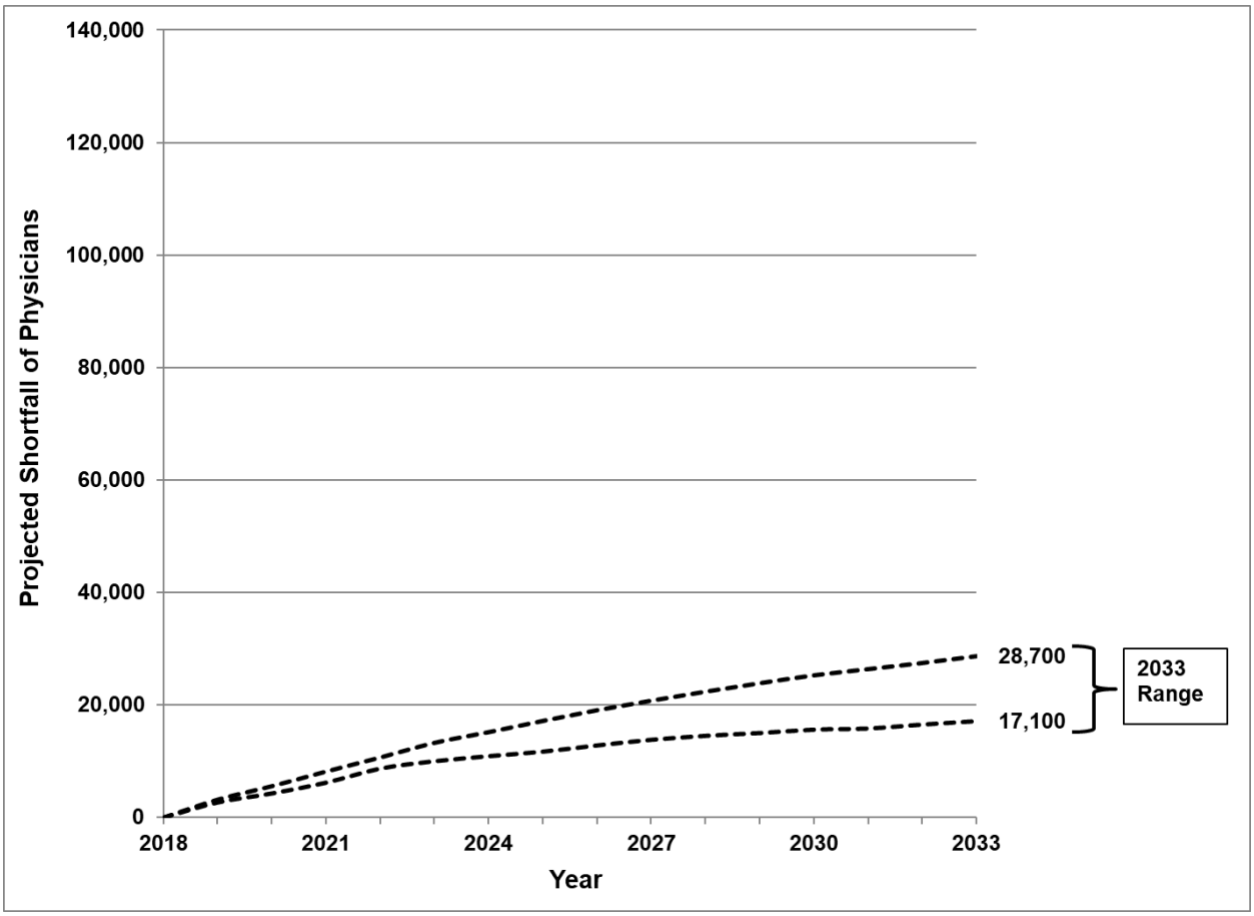


Exhibit 8: Projected Surgeon Shortfall Range, 2018-2033



Primary-Care-Trained Hospitalists

Primary-Care-Trained Hospitalists are analyzed separately from the Primary Care category. The number of physicians working as hospitalists over the past decade has grown rapidly,[25] reflecting a shift in how care is provided rather than in a growing demand for hospital inpatient services (which has declined over this same period[26]). Analysis of billing records by the AAMC identified physicians with at least 90% of their revenue billed through hospitals as physicians likely practicing as hospitalists. Analysis of billing records over multiple years suggests that the number of physicians becoming new hospitalists decreased for the first time: from 1,831 in our 2019 report to 1,221 in this year's analysis. The estimated number of new physicians becoming hospitalists has varied from year to year, so whether this drop of 610 new hospitalists entering the workforce is the beginning of a trend or simply a return to historical levels is unknown. Supply projections suggest that at current rates of physicians becoming hospitalists, there would be more than required to meet projected demand for services (Exhibit 9), with supply by 2033 between 4,600 and 8,000 higher than the level required to meet the growing demand for Hospitalist services (Exhibit 10).

Having more hospitalists reduces the amount of time required for primary care physicians to do hospital rounds, freeing them up to see more patients in ambulatory settings. The increase in the productivity of primary care physicians might not offset the loss of primary care providers to the hospitalist workforce, however.[27,28] Hospitals will not hire more hospitalists than are needed, so, as with many relatively young professions, a shift has been taking place that is not being captured by the assumptions in our model.

The rapid growth in hospitalist supply over the past two decades has been facilitated by (1) financial considerations that increased the willingness of primary care physicians to turn inpatient care over to hospitalists, (2) new duty-hour limits for residents, which reduced their availability to oversee patients in hospitals, (3) the widespread implementation of electronic health records and hospitals' focus on quality and patient safety, and (4) the availability of newly trained generalists trained in hospital settings.[25] It is unclear whether this surge in the growth of hospitalist employment will continue or the nation will reach saturation — at which point, hospitalist demand will change at roughly the same rate as demand for inpatient services. Likewise, if saturation is reached, it is unclear whether physicians who might otherwise choose to become hospitalists will choose other specialties or other settings.

Exhibit 9: Projected Supply and Demand for Primary-Care-Trained Hospitalists, 2018-2033

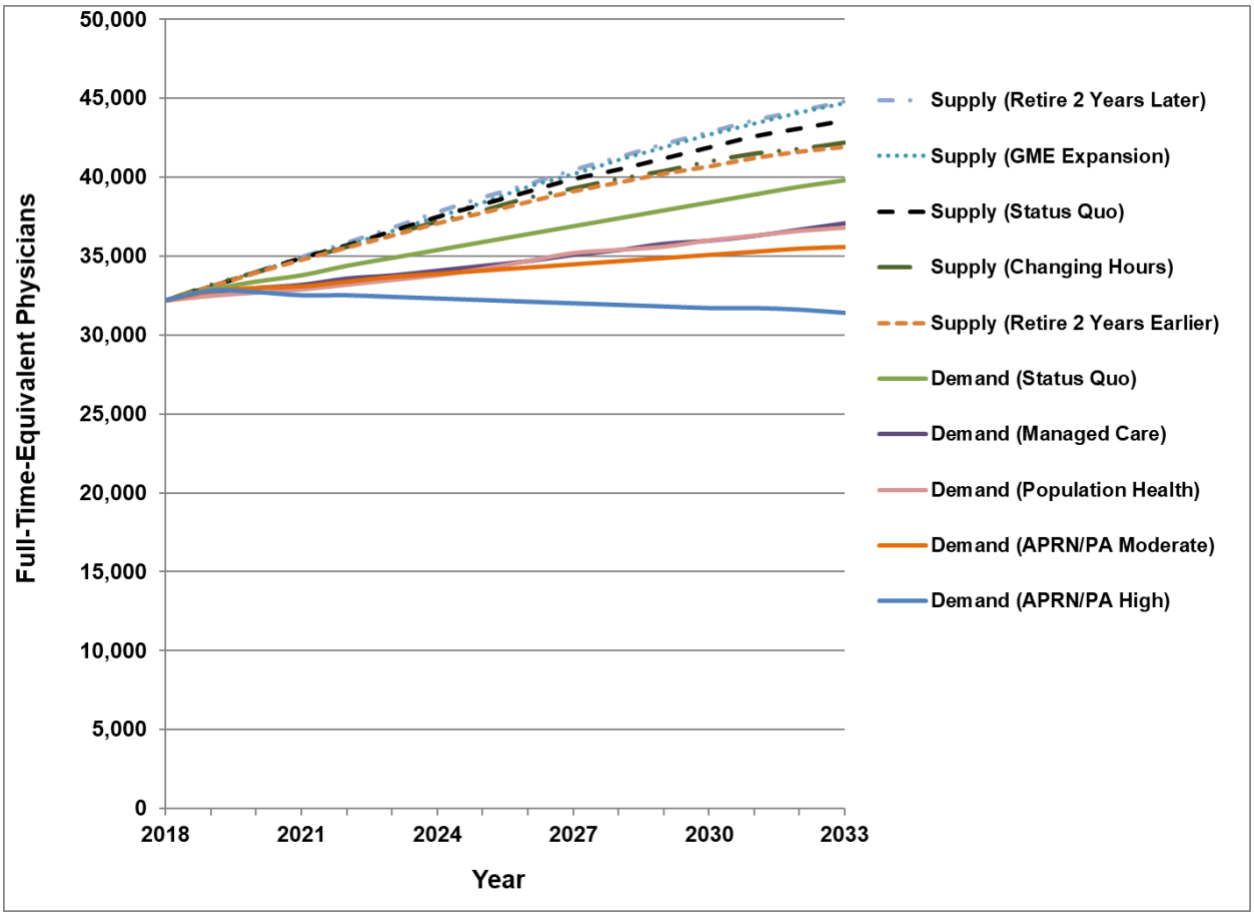
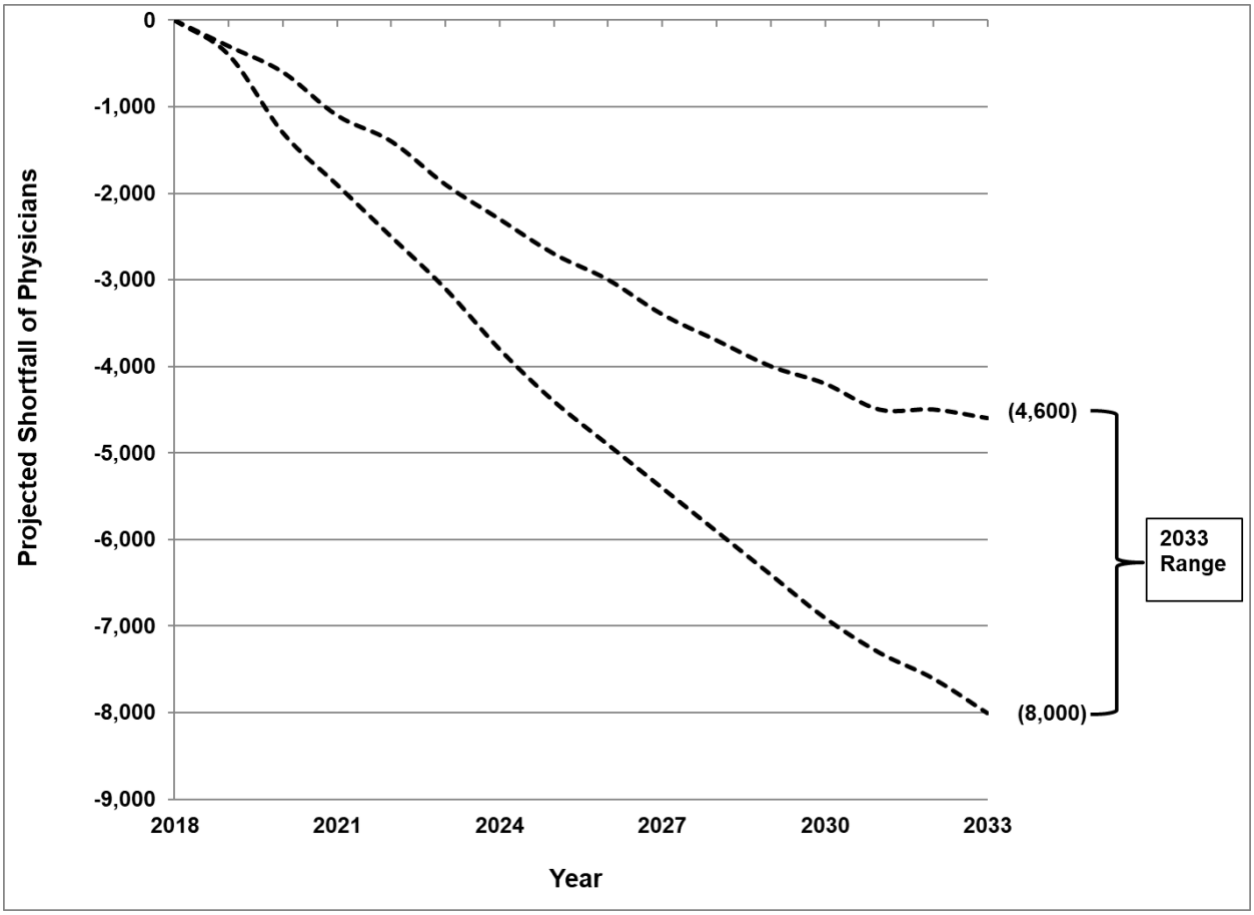


Exhibit 10: Projected Primary-Care-Trained Hospitalists Shortfall Range, 2018-2033



Other Specialties

For the Other Specialties category,[b] projected demand exceeds supply for all but one scenario (Exhibit 11). The projected shortage range for 2033 is between 17,100 and 41,900 physicians (Exhibit 12), similar to last year's shortage range by 2032 of between 20,600 and 39,100 physicians. The lower bound of the shortage range starts to decline around 2027. This decline is attributed mainly to the large number of nurse anesthetists and psychiatric nurse practitioners being trained, which has implications for the demand for anesthesiologists and psychiatrists.

Exhibit 11: Projected Supply and Demand for Other Specialties, 2018-2033

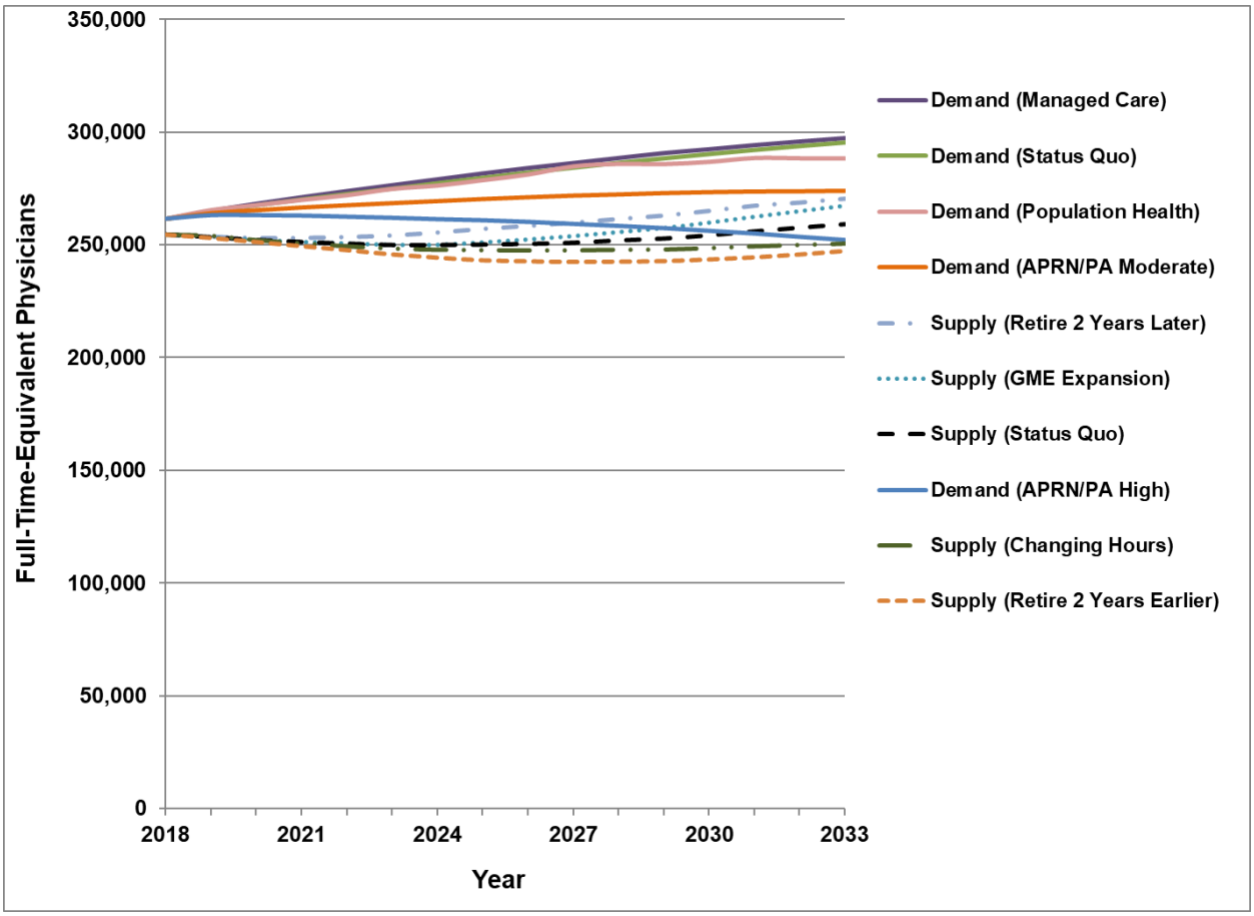
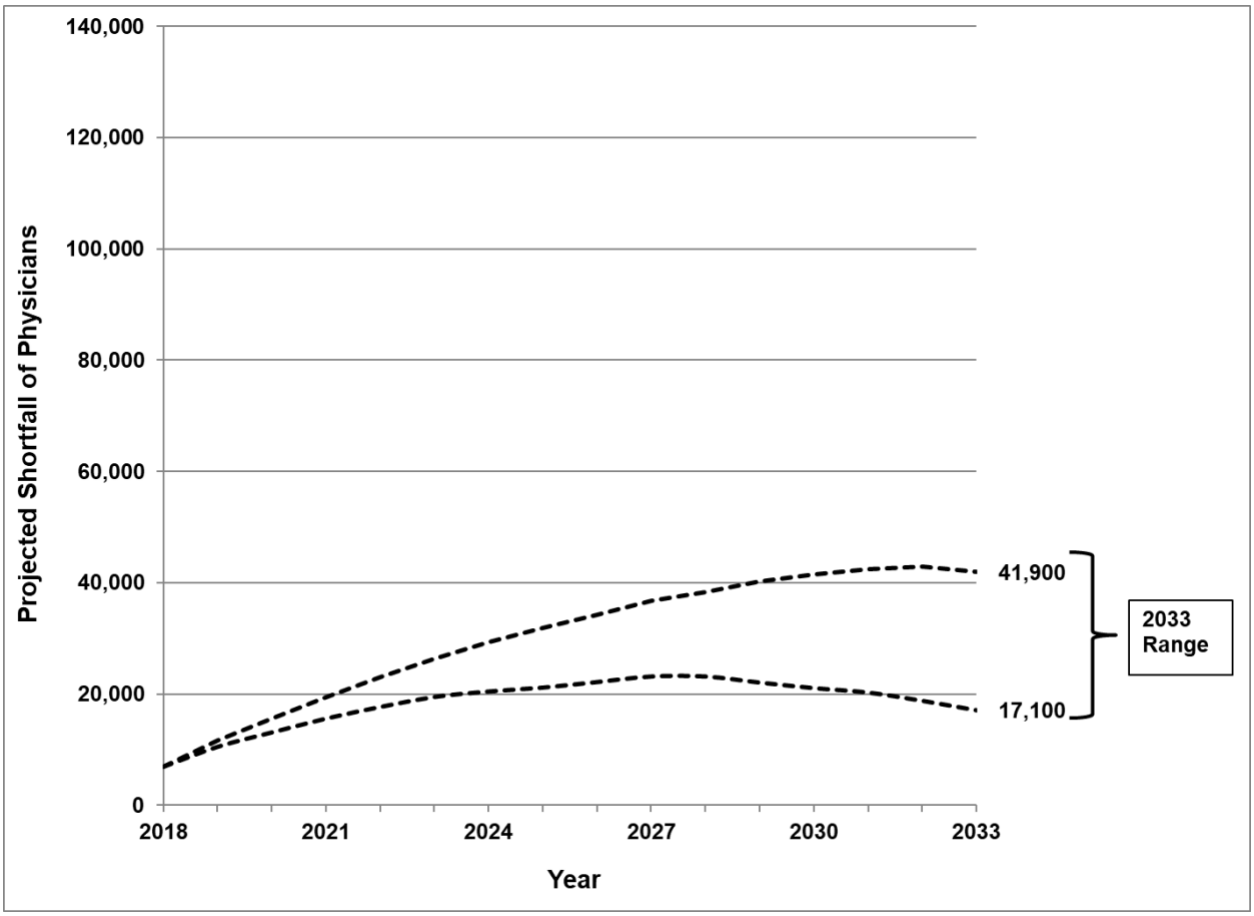


Exhibit 12: Projected Other Specialist Physician Shortfall Range, 2018-2033



SUPPLY MODELING

The microsimulation supply model projects future supply based on the number and characteristics of the current physician workforce and new physicians trained each year, hours-worked patterns, and retirement patterns. This section describes the modeled scenarios and projections, with a brief description of the supply model and model inputs and assumptions. Additional information about the supply model and its inputs can be found in Appendix 1; further details are documented elsewhere.[29]

Supply Modeling Inputs, Assumptions, and Scenarios

All supply projections start with the approximately 807,400 physicians active in 2018, as estimated from the AMA Physician Masterfile. Supply is defined as active physicians who have completed their graduate medical education (GME) and includes physicians involved in both patient-care and non-patient-care activities (i.e., teaching, research, and administration). The beginning supply estimate includes only physicians under age 75 because past research suggests many physicians age 75 and older in the Masterfile are no longer practicing medicine. The starting-year supply consists of about 228,100 Primary Care physicians, 137,300 physicians in internal medicine and pediatric subspecialties, 155,200 physicians in Surgical Specialties, 32,200 Primary Care-Trained Hospitalists, and 254,600 physicians working in Other Specialties.

Consistent with previous reports, we modeled Primary-Care-Trained Hospitalists separately from Primary Care physicians. The Hospitalist projections build on our work to identify hospitalists using Medicare fee-for-service billing records linked to the AMA Physician Masterfile. We defined hospitalists as physicians who generate 90% or more of their billing for hospital-based services.

Our estimate of annual new physicians entering the workforce, 28,980, described in Appendix 1, is similar to last year's estimate, 28,854: an estimated 8,366 new physicians entering Primary Care, 5,655 new physicians entering internal medicine and pediatric subspecialties, 5,012 new physicians entering Surgical Specialties, 1,221 Primary Care-Trained Hospitalists, and 8,726 new physicians entering Other Specialties. The scenarios model the continuation of 28,980 physicians trained each year — with the distribution across specialties consistent with the specialty mix of graduates from school year 2018-2019 — which is the number the system can continue to train without new investment in GME.

Physician weekly-hours-worked patterns and retirement patterns differ by physician age, sex, and specialty category. The updated projections use new data on hours worked and retirement estimated from the 2019 National Sample Survey of Physicians (NSSP). The survey analysis is described in Appendix 1. The updates to hours-worked patterns have little effect on the supply projections compared with previous years' reports. However, the updated retirement patterns suggest that physicians are retiring earlier than previous estimates of retirement patterns indicated, so the future-year supply projections are lower than in previous years' reports.

As in the previous reports, this year, the Status Quo, Retirement, and Hours Worked Scenarios (described below) were included in the analysis comparing physician supply and demand to project a range for future adequacy of physician supply. Also as in past years, modest GME Expansion was modeled separately as a policy-oriented supply scenario but was not included in the shortage projections.

Status Quo Scenario

This scenario models continuation of the status quo in terms of number and characteristics of physicians newly entering the workforce, hours-worked patterns, and retirement patterns. This scenario forms the basis for the other modeled supply scenarios.

Early- and Delayed-Retirement Scenarios

Reflecting the uncertainty about future physician-retirement patterns, these scenarios model physicians retiring two years earlier or two years later, on average, than they do now. The scenarios assume physicians might delay or speed up retirement for financial, health, and other reasons. The 2018 *Medscape National Physician Burnout and Depression Report* indicates that 42% of physician respondents reported burnout due to long work-hours and excess bureaucratic tasks.[30] Burnout is one factor contributing to premature retirement.[4-9] Recognizing the high economic and patient-care costs of premature physician retirement, health organizations look for ways to delay retirement, such as accommodating more flexible working hours.[7,31,32]

Changing Hours Worked Scenario

Our previous report estimated the change in average weekly hours worked by physicians during the past decade using the American Community Survey (ACS). That survey produces data on physician hours worked using the same format every year, so it is preferable to the NSSP for scenarios like this one, which require an understanding of trends in physician hours worked. (Unlike NSSP data, ACS data include no information on physician specialty, which means they cannot be used to forecast actual supply by specialty category, and they cannot differentiate residents and fellows from physicians who have completed their training.) For this scenario, we updated the average annual change using ACS data. To increase sample size across age groups, we combined 2016-2018 ACS files to get an estimate of physician work-hours in 2017, and we combined 2011-2013, 2006-2008, and 2001-2003 files to estimate work-hours for, respectively, 2012, 2007, and 2002. The trend in recent years suggests that average hours worked has been relatively steady for physicians age 35 and older, with a slight decrease for males and a slight increase for females. Among physicians under age 35, there has been an uptick in average hours worked in recent years. This modeled scenario simulates the supply implications if the average annual trend observed in the past five years were to continue. We modeled the change in hours worked by age and sex as a cohort effect.

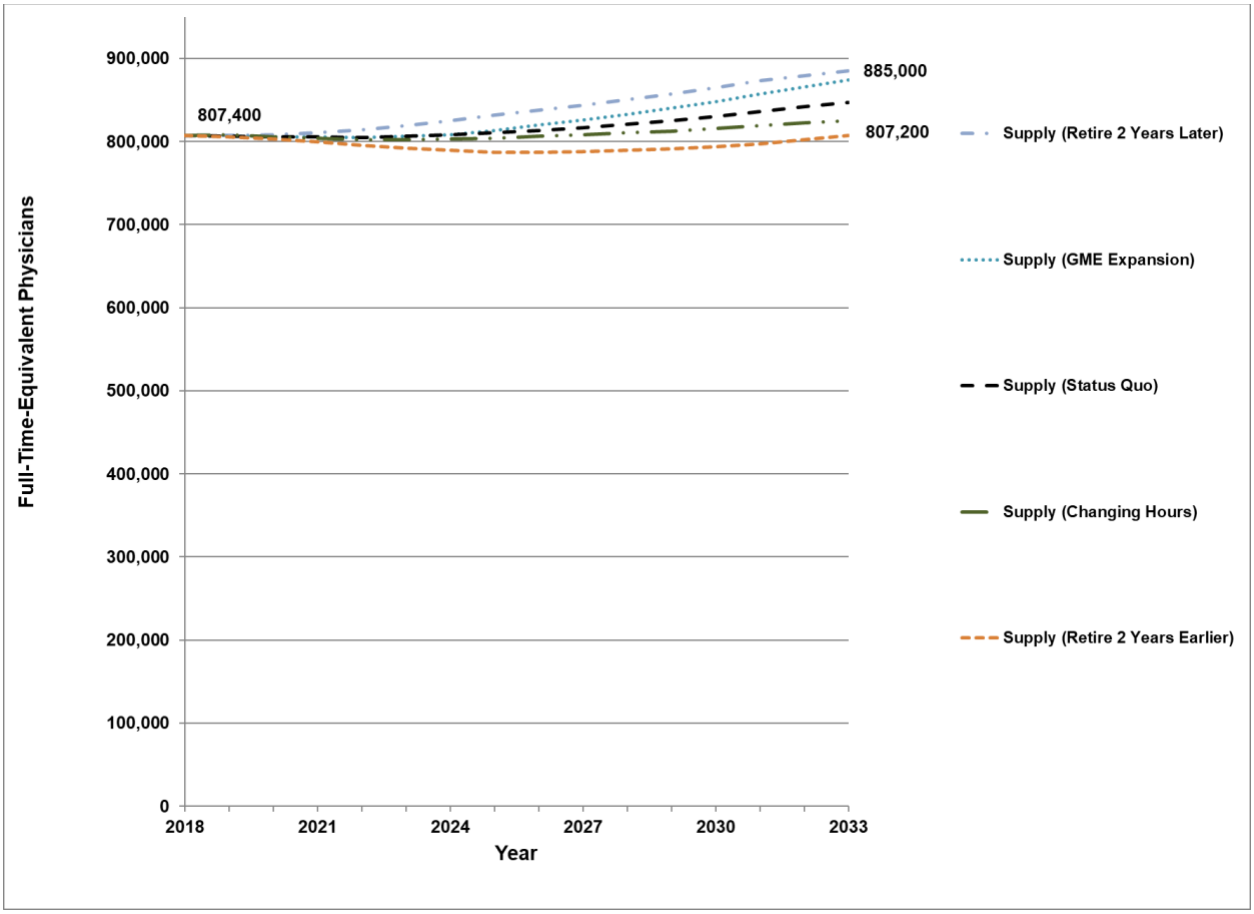
GME Expansion Scenario

This scenario assumes an increase in federally funded GME support to train an additional 15,000 physicians per year, with 3,000 new residency slots added per year over a five-year period. Given an average residency length of four years, this increase is modeled as an additional 3,750 new physicians starting to enter the workforce each year beginning in 2025. This scenario is based on the proposed Resident Physician Shortage Reduction Act. The distribution of new residency slots across specialties is currently unknown, so for modeling purposes, we assume all specialties' residency slots will increase in proportion to their current distribution. This policy-related scenario was not included in calculations of physician-shortage ranges.

Supply Projections

Updated annual projections for physician supply across all scenarios modeled are summarized in Exhibit 13. Under the Status Quo Scenario, total physician supply increases from 807,400 in 2018 to 847,500 by 2033 — a 5% increase. This is below the approximately 10.1% projected growth in the U.S. population over this period, contributing to a 4% decline in the physician-to-population ratio (declining from 246 to 235 physicians per 100,000 population by 2033).

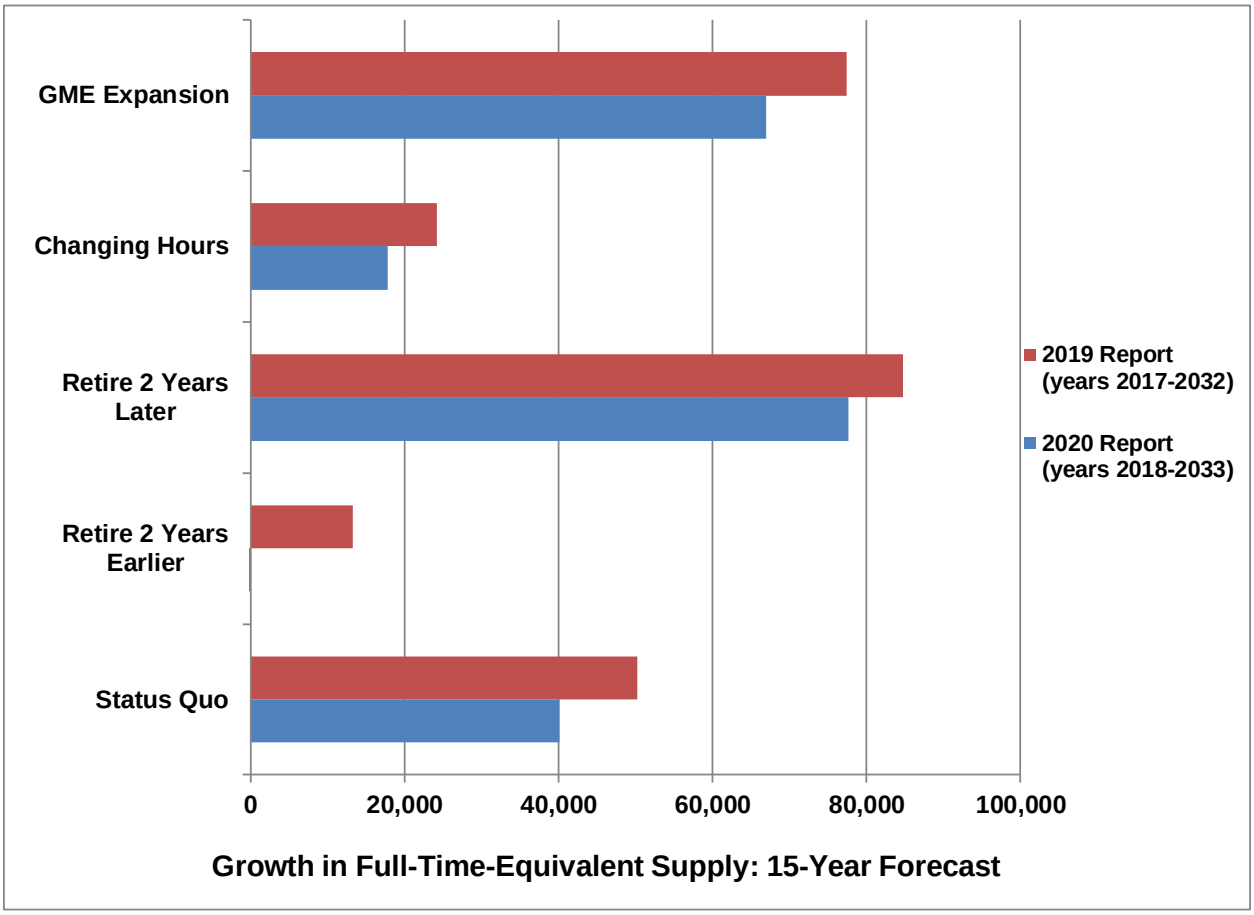
Exhibit 13: Projected Supply of Physicians, 2018-2033



As illustrated in Exhibit 14, this year's updated supply projections covering the period 2018 to 2033 show slower growth in supply compared with 2018 to 2032. The 2019 report projected a 50,200 increase in supply, and the updated report projects a 40,100 increase in supply. The main contributor to the lower projection is the updated retirement patterns, based on the 2019 NSSP, which suggest that physicians are retiring younger than previously estimated (by 0.2 years for male physicians and 2.0 years for female physicians). Under the Retire 2 Years Earlier Scenario, the projected total supply by 2033 would be 200 FTEs lower than the 2018 supply.

The GME Expansion Scenario is designed to approximate proposed legislation that would increase the number of physician residency slots. Because the legislation has yet to be passed, we modeled its effects delayed by one year in this study.

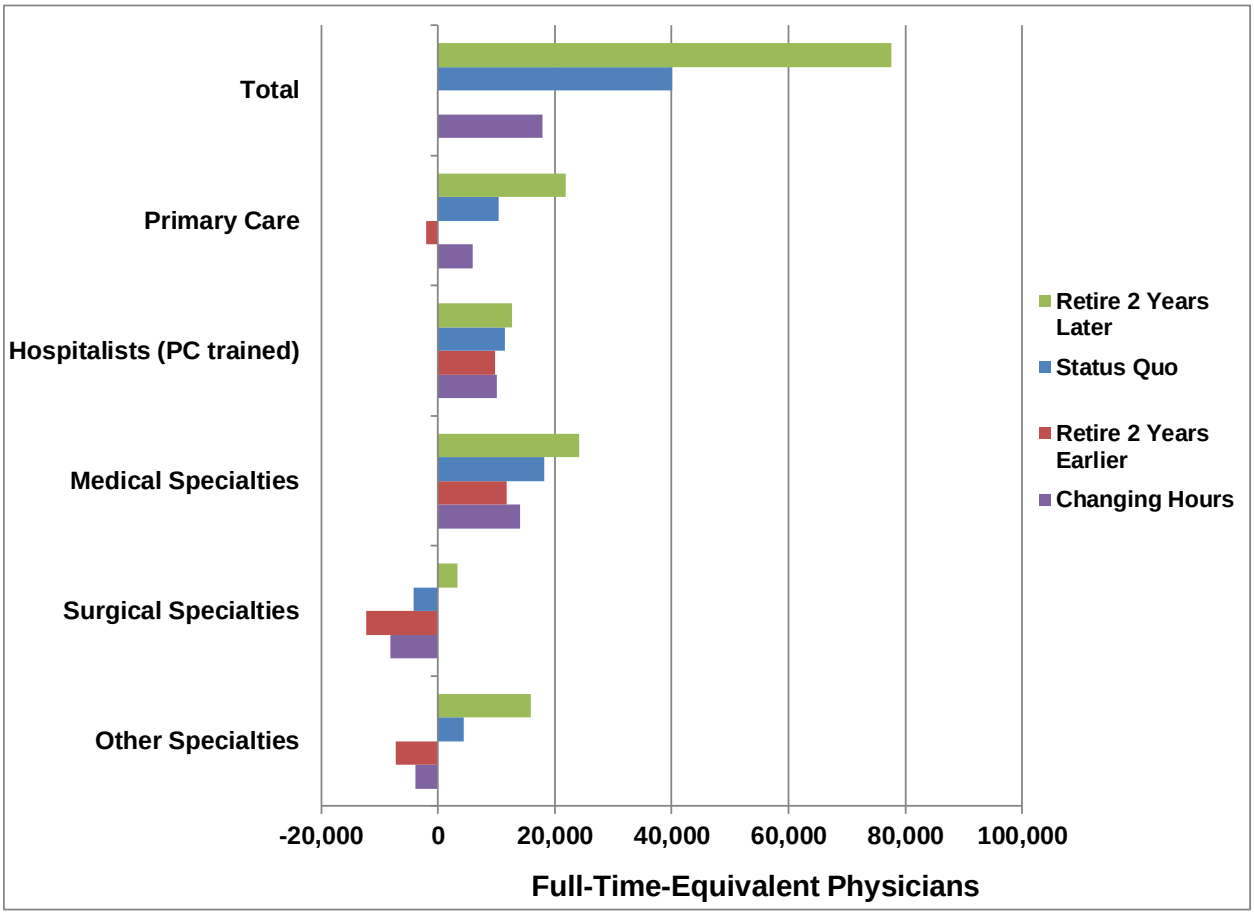
Exhibit 14: Projected Change in Physician Supply: 2020 vs. 2019 Report Projections



Note: The 2020 report value for the Retire 2 Years Earlier Scenario is -200 FTEs.

Whereas there is projected growth in supply for the Medical Specialties and Primary-Care-Trained Hospitalist categories under all scenarios modeled, the results are mixed for the other specialty categories — for example, the supply of physicians in Surgery Specialties is projected to decline under all but the Delayed-Retirement Scenario (Exhibit 15).

Exhibit 15: Projected Change in Physician Supply by Specialty Category, 2018-2033



DEMAND MODELING

Future demand for health care services and the physicians to provide those services is the result of the complex interactions of patients' needs and decisions to seek care, medical and technical considerations of what care is feasible to provide, economic considerations, social norms and policies, and the intricacies of a complex health care system and decisions made by providers and administrators within this health system. While there is significant agreement about improvements needed in the health care system, there is less agreement about how the system should be reformed. There are, however, underlying trends and factors that will affect future demand for health care services and providers regardless of how policy and health system changes might affect how care is used and delivered.

Previous versions of this report highlighted that population growth and aging are the dominant factors affecting future demand for health care services. Other key factors with implications for physician demand include increasing use of advanced practice registered nurses (APRNs), physician assistants (PAs), and other health care workers in care delivery; efforts to improve population health through preventive care; efforts to enhance the value of care delivery through managed-care principles and a variety of mechanisms such as accountable care organizations (ACOs), patient-centered care, value-based insurance design (VBID), and interventions to divert costly hospital-based care to appropriate ambulatory settings; policy initiatives to advance national goals of increasing equity in health outcomes and improving access to high-quality, affordable care; and less quantifiable trends such as advances in technology and medicine.

While some factors, such as an aging population and national goals to expand access to care, will increase demand for physicians, others could decrease demand, or increases and decreases in demand could offset each other. For example, advances in artificial intelligence could improve the productivity of radiologists, pathologists, and others in detecting and diagnosing cancers and other medical conditions, possibly leading to a lower demand for these physicians to care for the existing population.[33,34] However, increasing longevity by reducing cancer deaths and other preventable deaths means more physicians will be needed in the future to care for the larger population still living — many of whom have chronic conditions to be managed. Thus, many of the above factors affecting care use and delivery might not decrease overall demand for physicians but simply shift demand from one care-delivery setting to another (e.g., care by hospitalists shifted to care by community-based providers), shift demand across specialties (e.g., shift from oncology care by reducing cancer incidence to geriatric medicine because people are living longer), or shift demand to the future as increased longevity increases population size.

This section briefly describes the demand model inputs, assumptions, and scenarios and presents the projections. Additional information about the demand model and inputs is included in Appendix 1 and documented elsewhere.[29]

Demand Modeling Inputs, Assumptions, and Scenarios

Population Characteristics and Projections

Between 2018 and 2033, the U.S. population is projected to grow 10.1%, from about 328 million to 361 million people. The population under age 18 is projected to grow by 3.5%; the population age 65 and older, by 45.1%; and the population age 75 and older, by 47.7%.[17] As a result, the national prevalence and incidence of diseases that disproportionately affect older Americans is projected to grow rapidly. Demand for physicians who treat patients with these diseases is expected to grow, as well. For example, the microsimulation demand model finds that between 2018 and 2033, the prevalence of diagnosed diabetes is projected to increase 25% (from 25.4 million to 31.8 million people), and the population with heart disease is projected to increase 30% (from 10.0 million to 13.1 million).

The total U.S. population that is non-Hispanic white is projected to decline slightly, from 197.5 million to 197.0 million, between 2018 and 2033, while the population that is non-Hispanic black is projected to grow by 13.3% (from 40.9 to 46.3 million). The non-Hispanic population of all other races[c] is projected to grow by 35.6% (from 28.8 to 39.1 million), while the Hispanic population is projected to grow by 31.4% (from 59.9 to 78.7 million). Hence, a growing proportion of health care services will be for racial minority and Hispanic patients, underscoring the importance of increasing racial and ethnic diversity among the physician workforce.

The modeling approach involved creating a representative sample of the population in each U.S. county, with county files aggregating to states and states aggregating to a representative sample of the national population. Data sources used to construct the de-identified, representative samples of the population in each geographic location included the 2018 U.S. Census Bureau, for data on county demographics; the 2018 American Community Survey (ACS); the 2017 and 2018 Behavioral Risk Factor Surveillance System (BRFSS); and the 2016 Centers for Medicare and Medicaid Services (CMS), for data on people living in nursing homes and residential care facilities. Sources of the state- and county-level population projections were individual states and IHS Markit, and the source of national population projections was the U.S. Census Bureau. Information for each person in the constructed population files consists of demographics (age, sex, race, and ethnicity); medical insurance type; household income; whether the person lives in the community, a residential care facility, or a nursing home; health-related lifestyle indicators of body weight status (normal, overweight, obese) and current smoker status; presence of chronic conditions (arthritis, asthma, cardiovascular disease, diabetes, or hypertension); patient history of cancer, heart attack, or stroke; and county of residence urban-rural classification using the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties.

Demand for Health Care Services

Current patterns of health care use, estimated using the combined 2013-2017 files of the Medical Expenditure Panel Survey (MEPS) and the 2016 National Inpatient Sample (NIS), both from the Agency for Healthcare Research and Quality (AHRQ), indicate that annual use of health care services varies substantially by patient characteristics. The regression approach we used to model health care use patterns is described in Appendix 1. While regression results varied by specialty and care-delivery setting, the findings were largely consistent with expectations. Patient characteristics associated with greater use of health care services include older age, having medical insurance, presence of the chronic conditions modeled, living in a metropolitan area, and being non-Hispanic white. Some characteristics were associated with mixed results — for example, patients in a managed-care plan were associated with greater use of primary care services and lower use of some specialist services.

Patterns of Care Delivery

Current patterns of care delivery were calculated by first estimating the proportion of time physicians in each specialty spend in each care-delivery setting (e.g., ambulatory care, emergency care, hospital care) to estimate FTE care in that setting. Then, total national care use (e.g., office, outpatient, and emergency visits and hospital inpatient days by diagnosis category) was divided by the FTE count to create services-to-providers ratios. Many physicians provide services across multiple care-delivery settings, including ambulatory visits in physician offices and outpatient clinics, hospital rounds, and emergency department consults. To estimate FTEs by setting, estimates of the proportion of time physicians spend in different care-delivery settings were calculated from a variety of sources, including surveys conducted by professional associations and Medical Group Management Association (MGMA) data. For example, among the 2,280 Primary Care physicians in the 2019 National Sample Survey of Physicians (NSSP), physicians spent 80% of their direct patient-care time providing ambulatory care, 9% providing inpatient care, 6% providing urgent care, and the remaining 5% providing care in nursing homes and assisted living facilities, emergency departments, and other settings.

For modeling purposes, at the national level, we quantified current demand for health care services (and physicians) as equivalent to the level of health care services used (and current physician supply). Demand projections thus extrapolated into the future a "2018 level of care," with any imbalances between supply and demand, whether shortages or excesses. Our starting point in 2018 relies on federal government estimates that the nation requires about 14,900 primary care physicians and 6,894 psychiatrists to de-designate the federally designated primary care and Mental Health Professional Shortage Areas (HPSAs). For modeling purposes, we assumed these 21,794 physicians reflect national shortages. To the extent that shortages currently exist across specialties other than primary care and psychiatry (there are no current federal shortage designations for other specialties), our starting-point assumption may be conservative.[35-39]

Advanced Practice Registered Nurses and Physician Assistants

In 2018, an estimated 248,000 APRNs were licensed in the United States, with the American Association of Nurse Practitioners reporting that 77.8% of them were involved in delivering primary care.[40] In 2018, there were 11,826 certified nurse midwives (CNMs), 101 certified midwives (CMs), and about 58,000 certified registered nurse anesthetists (CRNAs).[41,42,e] At the end of 2018, there were an estimated 131,200 certified PAs; about 94% (123,700) of them were practicing clinically in the United States, 5% (5,900) were practicing in nonclinical positions, and the remainder were outside the United States.[43] Of those in clinical positions, about 27% (33,300) reported working in the offices of primary care providers or practicing primary care, 25% (30,900) reported working in a surgical specialty, 15% (18,400) reported working in an internal medicine or pediatric subspecialty, 13% (16,500) reported working in emergency medicine, 3% (4,300) reported working as hospitalists, and the remainder reported worked in various other specialties.

Although the supply of APRNs and PAs has risen rapidly over the past two decades, and these providers continue to be in high demand, there is also continued high demand for physicians.

The supply of APRNs and PAs has grown rapidly over the past two decades, and if current growth trends continue in the number of new providers trained, we project the supply of these providers will more than double over the next 15 years (with growth rates varying by APRN and PA specialty category). At current rates of production, by 2033, APRN supply will grow by 276,000 FTEs and PA supply, by nearly 138,000 FTEs. There remains a paucity of information on the impact this rapid supply will have on the demand for physicians. The rate of growth in supply vastly exceeds the rate of growth in demand for health care services, which raises the question of the degree to which this growth in supply might reduce the demand for physicians as the ratio of physicians to APRNs and PAs falls from current levels of about 2.2:1 to a projected 1.1:1 by 2033.

In this and previous reports, we modeled two scenarios that made different assumptions about the degree to which APRN and PA supply growth, beyond the growth required to maintain current staffing patterns, might offset demand for physicians. Both scenarios assume no demand effect from any change in the scope of practice for either profession. We modeled a High Use Scenario that assumes each additional APRN or PA beyond the supply needed to maintain current staffing patterns will ease demand for physicians in their specialty as follows: anesthesiology (by 60% of an FTE), Primary Care (50%), women's health (40%), Medical Specialties (30%), Other Specialties (30%), and Surgical Specialties (20%). The Moderate Use Scenario assumes the adjustment in physician demand is half the above percentages.

Constructive feedback we received on previous reports indicates the meaning of these percentages can be misunderstood, so we need to better articulate what they represent. The percentages imply nothing about the value of services APRNs and PAs provide relative to physicians, but rather, they simply estimate the extent to which these providers fill a currently unmet need or reduce demand for physicians.

Health care services are usually complex, requiring delivery by teams of people. Without the nurses, lab technicians, administrators, social workers, and many other types of workers who team with physicians to deliver care, the panel of patients each physician could manage would be relatively small. For example, if the patient panel a physician could handle alone is 500, while the patient panel a physician could handle working with a team is 1,000, then working with a team eases demand for physicians by 50%; working in teams, what would otherwise take 100 physicians would take only half as many. Quantifying the amount of this improved efficiency is challenging with currently available data. Complicating the issue is whether the additional team member provides the same services the physician would have (i.e., they substitute for the physician) or additional services the physician would not have (i.e., they complement the physician), as discussed in following example.

A 2012 study by physicians with the University of California estimated that patients receiving care from primary care physicians received only 55% of recommended chronic and preventive services.[44] The authors attributed this gap between services recommended and services provided to physicians being overworked, with panel sizes that were too large. The authors also provided estimates of the work done by primary care physicians that could be delegated to others — specifically, to APRNs and PAs. They estimated that 50%-77% of physician time to provide preventive care and 25%-47% to provide chronic care could be delegated to APRNs and PAs. The authors assumed that physicians would continue to provide all acute care services. One conclusion derived from the study is that primary care physicians working alone had insufficient time to provide all recommended services and address the acute care needs of a panel of 2,500 patients. However, by delegating work to an APRN or PA, one FTE primary care physician and one FTE APRN or PA could jointly take care of all the acute care needs and recommended preventive and chronic care services for this panel of 2,500.

This example raises important questions about what is unknown when modeling the implications of a rapidly growing supply of APRNs and PAs: (1) will patients continue to receive only 55% of recommended services with APRNs and PAs effectively substituting for physicians, (2) will patients start to receive closer to 100% of recommended services with the physician and the APRN or PA complementing one another, or (3) will the addition of the APRN or PA increase the total level of services that patients receive, with some substituting and some complementing? In the first case, the amount an APRN or PA can ease demand for physicians might approach 100% for services that could be delegated, but care stays at a level of 55% of recommended services. In the second case, if an APRN or PA provides only the services not currently being provided, the amount of physician demand being eased would be 0%, but the level of care would approach optimal. Most likely, as in the third case, APRNs and PAs will provide some substitute functions (freeing physicians to work at the top of their licenses) and some complementary functions (improving the level of care received by patients but lowering the percentage by which APRNs and PAs offset physicians).

Furthermore, some APRNs certified in family medicine or other primary-care-related area will choose to work in retail clinics or other settings that typically do not employ physicians in direct patient care. Ashwood et al. estimated that about 39% of retail clinic visits replace physician visits, and 58% of retail clinic visits are additional care that would not otherwise have occurred.[45] Many patients seen in retail clinics appear to be from populations with lower access to physician services for economic or other reasons.[46] An APRN working in a retail clinic seeing patients with noncomplex conditions who might otherwise be seen in a physician's office might offset a portion of an FTE physician. Another example where growth in the supply of APRNs and PAs might lead to growth in care they provide that does not overlap with care provided by physicians is APRN- and PA-led interventions to reduce hospital readmissions by conducting postdischarge follow-up care (often involving visits to the patient's home).[47-50]

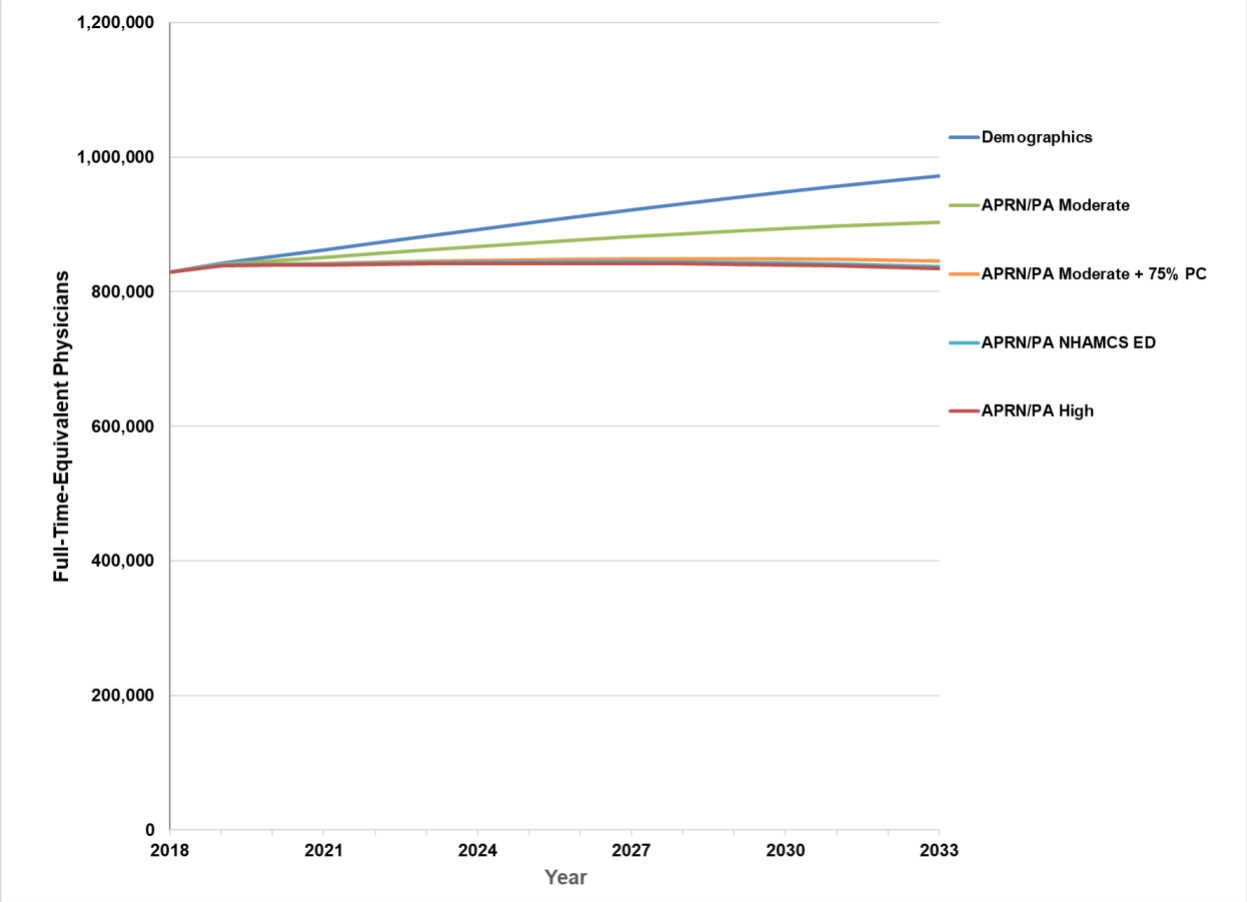
To better understand the modeled assumptions and the sensitivity of physician-demand projections to greater use of APRNs and PAs, we looked at the following:

- The National Hospital Ambulatory Care Survey (NHAMCS) collects data on emergency department (ED) visits and indicates whether the patient was seen by a physician, PA only, APRN only, or a combination of physician and APRN or PA. Our analysis of NHAMCS data from 2011 to 2016 indicates that over time, the proportion of ED visits where a patient is seen exclusively by a physician has been declining and is highest for older patients. Overall, about 72% of ED patients were seen by a physician but not an APRN or PA, and 28% were seen by an APRN or PA (with many of these patients also seen by a physician). As a proxy for the degree to which APRNs and PAs and physicians overlap in the ED setting, we calculated the ratio of visits where an APRN or PA (and possibly a physician) saw the patient to visits where only a physician did: 2:5, or 39%. Keeping in mind that this ratio is calculated for the ED setting only, if we use it as a proxy for the degree to which APRNs and PAs offset demand for physicians across all specialty areas (rather than using the numbers modeled in the APRN/PA High and APRN/PA Moderate Scenarios), the overall physician-demand projections are almost identical to physician demand under the APRN/PA High Scenario, at 834,000 physicians by 2033. Demand projections differ by specialty category under these two scenarios, however (Exhibit 16, APRN/PA Moderate +75% Primary Care (PC) and APRN/PA NHAMCS ED Scenarios).

- We modeled a scenario where APRNs and PAs in primary care mainly substitute for physicians rather than providing complementary care or increasing access to care (APRN/PA Moderate + 75% PC). For this scenario, we assumed that each additional APRN or PA, beyond that needed to meet the demands of a growing and aging population, directly reduced demand for physicians by 0.75 FTE. Under this scenario, the demand for Primary Care physicians in 2033, 202,700, would drop below the projected 2033 supply, 238,400; the projected demand would thus drop even lower than the current supply of 228,100. Overall, under this scenario, total demand for physicians by 2033 is projected at 845,300, which is 126,800 fewer physicians than modeled under the Status Quo Scenario (Exhibit 16, APRN/PA NAMCS ED Scenario). We think this scenario is unlikely to occur.

Among the unknowns is whether there is a market saturation point at which APRNs and PAs might have difficulty finding employment. A growing body of literature, both in the United States and internationally, indicates APRNs and PAs provide high-quality care, increase physician productivity, and, in some specialties, perform many of the same functions as physicians; however, there is little information to indicate the extent to which APRNs and PAs displace demand for physicians.[51-54] The supply of these providers has risen rapidly over the past two decades and they continue to be in high demand, yet there is also continued high demand for physicians.

Exhibit 16: Physician Demand Under Alternative Scenarios of the Degree to Which Advanced Practice Registered Nurses and Physician Assistants Reduce Demand for Physicians, 2018-2033



Scenarios Modeled

We projected physician demand under scenarios that reflect various assumptions about the use of health care services and care delivery. All the scenarios reflect changing demographics from 2018 to 2033 and assume no further increase in medical insurance expansion under the Affordable Care Act (ACA). Although some states are exploring legislative efforts to increase insurance coverage within their states through expansion of Medicaid or through single payer plans, no such legislation is imminent. Our analyses suggest that states' proposed plans to expand Medicaid coverage will have minimal effect on national coverage and physician demand.

As in previous reports, we modeled the implications of greater use of managed-care, retail clinics staffed primarily by APRNs, rapid growth in supply of PAs and APRNs, and achieving certain population health goals to illustrate the potential impact of improved preventive care. Modeled scenarios used to estimate future adequacy of physician supply are the following:

- **Changing demographics (Status Quo Scenario):** This scenario extrapolates current health care use and delivery patterns to future populations using projected demographic shifts (age, gender, and race/ethnicity) from 2018 to 2033. Within each demographic group, the prevalence of disease and health risk factors is assumed to remain unchanged over time. Demand estimates by region and by urban-rural location apply national-average patterns of care to the population in each county — controlling for demographics, lifestyle choices, disease prevalence, insurance coverage, household income, and level of rurality. The demand scenarios summarized below all build on this scenario.

- **Managed care as a proxy for accountable care organizations (ACOs) and value-based payment models (Managed Care Scenario):** Over the past several decades, the U.S. health care system has explored different types of value-based and outcome-based payment and integrated care delivery models for both publicly and privately insured populations. This scenario models implications for physician demand of 100% of the insured U.S. population being enrolled in risk-based entities like an HMO or ACO. The key modeled impacts, based on an analysis of MEPS data, are a 7.5% increase in national demand for Primary Care physicians, a 1.3% decrease in demand for internal medicine and pediatric subspecialty physicians, a 5.9% decrease in demand for Primary Care-Trained Hospitalists, and a mixed impact on demand for physicians in Surgery and Other Specialties. Other specialties with a substantial increase in demand under this scenario were psychiatry, neurology, and otolaryngology; specialties with a substantial decrease in demand were nephrology, allergy and immunology, and urology.

- **Expanded use of retail clinics (Retail Clinics Scenario):** Retail clinics provide a convenient, cost-effective option for patients with minor acute conditions, and the care is covered by many insurance plans.[55] The estimated number of retail health clinics in the United States was more than 2,800 by the end of 2017. If recent growth rates continue, the number of retail clinics could double to 5,600 by 2022.[56] Retail clinics may be an alternative to traditional primary care providers for some services, and there is evidence that retail clinics are serving a population underserved by primary care providers.[46] Ashwood et al. estimated that about 39% of clinic visits replace physician visits, 3% replace emergency department visits, and 58% are new visits that would not otherwise have occurred.[45] This scenario explores the demand implications of shifting care from Primary Care physician offices to retail clinics for 10 conditions typically treated at retail clinics.[46,57] It assumes the following:

    - Patients with chronic conditions will be seen by their regular primary care provider even for noncomplex health issues that could be treated in a retail clinic.

    - Care in retail clinics will primarily be provided by APRNs (only an estimated 250 PAs practiced in retail clinics in 2018).[58]

    - For care provided in Primary Care physician offices, 83% of visits to a pediatrician's office are handled primarily by a physician (reflecting that between APRNs and physicians, 83% of the pediatric workforce are physicians) and 71% of adult primary care office visits are handled primarily by a physician.

    - We used the Medical Group Management Association's 2015 estimates for mean annual ambulatory patient encounters for general pediatricians and family physicians to translate the reduction in office visits to the reduction in demand for physicians.[59]

  These assumptions suggest that about 4,700 visits by children to a retail clinic rather than a pediatrician's office reduce demand for pediatricians by one physician, and about 5,500 retail clinic visits by an adult reduce demand for an adult Primary Care physician by one physician. Given the findings from Ashwood et al., these estimates might overstate the degree to which retail clinics reduce demand for Primary Care physicians.[45] Still, this scenario suggests that noncomplex health

care services provided by 8,000-9,000 FTE Primary Care physicians could be diverted to retail clinics.

- **Increased use of APRNs and PAs under "moderate use" and "high use" assumptions (APRN/PA Moderate and High Scenarios):** These scenarios reflect the rapid growth in supply of APRNs and PAs and the assumptions described in the previous section, "Advanced Practice Registered Nurses and Physician Assistants." For modeling purposes, the APRN/PA High Scenario assumes each additional APRN or PA beyond the supply needed to maintain current staffing patterns will ease demand for physicians in their specialty as follows: anesthesiology, 60% of an FTE; Primary Care, 50%; women's health, 40%; Medical Specialties, 30%; Other Specialties, 30%; and Surgical Specialties, 20%. The APRN/PA Moderate Scenario assumes the adjustment in physician demand is half the above percentages. The percentages imply nothing about the value of services APRNs and PAs provide relative to physicians, but rather, they simply estimate the extent to which these providers fill a currently unmet need or reduce demand for physicians.

- **Achieving select population health goals (Population Health Scenario):** Key risk factors and lifestyle behaviors that population health policies and programs target for disease prevention are obesity, hypertension, dyslipidemia, hyperglycemia, and smoking.[60-62] The goal of reducing the prevalence of those conditions is consistent with Healthy People goals and objectives of the Centers for Disease Control and Prevention.[63] To assess the physician shortage under a Population Health Scenario, we used the Disease Prevention Microsimulation Model (DPMM).[64-67] We simulated the implications for health care demand of (1) a modest 5% sustained reduction in excess body weight among adults who are overweight or obese; (2) reductions in blood pressure, cholesterol, and blood glucose levels among adults who have elevated levels, with the magnitude of reductions determined by published reports of clinical trials about what can be achieved through appropriate medication and counseling[68-70]; and (3) 25% of smokers quit smoking — though with high recidivism. The mechanisms by which this hypothetical scenario could be achieved included increased use of medical homes, value-based insurance design, and increased emphasis on preventive care to provide patients with testing and counseling and to improve patient adherence to treatment regimens.[71-77] The model assumes greater use of APRNs, PAs, and other health professions to provide the additional counseling and monitoring required to achieve the goals. This scenario illustrates the potential impact on demand for physicians associated with improved population health and reduced disease prevalence and mortality. Modeling assumptions, methods, and the source of data for key parameters are described in more detail in the 2017 report[78] and include:

    - **Sustained 5% body weight loss for overweight and obese adults:** Numerous lifestyle interventions have achieved 5% or more body weight loss, on average. Although sustaining weight loss is challenging for many patients, a patient-centered medical home model with long-term counseling and pharmacotherapy will presumably help patients maintain weight loss. Reducing excess body weight lowers risk for cardiovascular disease, diabetes, various cancers, and other conditions.

    - **Improved blood pressure, cholesterol, and blood glucose levels for adults with elevated levels:** These goals can be achieved by appropriate screening and pharmacotherapy, as well as by weight loss. Clinical trials indicate that patients with hypercholesterolemia can reduce total blood cholesterol by 34.42 mg/dL (CI, 22.04-46.40) by using statins[68]; patients with uncontrolled hypertension can reduce systolic blood pressure by 14.5 mm Hg (CI, 14.2-14.8) and diastolic blood pressure by 10.7 mm Hg (CI, 10.5-10.8) by using antihypertensives[69]; and patients with elevated hemoglobin A1c levels can reduce A1c by 1 percentage point (CI, 0.5-1.25), with appropriate screening and pharmacotherapy, gradually reducing the level to where diabetes control is reached, at an A1c of 7.5%.[70]

- **Smoking cessation:** Patients who stop smoking can lower their risk for various cancers, diabetes, cardiovascular disease, and other diseases.[79-81] Researchers report that compared with a similar population that continues to smoke, cessation at age 25 to 34 years extends life by about 10 years, on average.[80] Cessation at ages 35 to 44 extends life by 9 years and at ages 45 to 54, by 6 years, on average.

The updates to the DPMM used in modeling changes in disease states and mortality leading to achieving the model population health goals included using (1) the most recent National Health and Nutrition Examination Survey data (2017-2018) and (2) more recent published clinical trials and observational studies for some health conditions (to update health-transition equations).[82]

This Population Health Scenario is a component of the new Evolving Care Delivery System Scenario (described in the "Evolving Care Delivery System Demand Implications" section), which explores the implications for physician demand of several changes in care delivery as the nation strives to achieve national objectives of improving access to high-quality, cost-effective care. This scenario produces three main impacts on physician demand: (1) In the early years after achieving the modeled population health goals, the demand for physicians falls due to the improved health of the population; (2) over time, as mortality rates fall, demand for physicians rises relative to the Status Quo Scenario because a larger population is still living; and (3) demand shifts between specialties — for example, to a lower demand for endocrinologists but higher demand for geriatricians.

Demand Projections

This section presents projected growth in demand for physicians at the national level and by population demographics (age and race/ethnicity). (Growth in demand is presented by census region and urban-rural geographic area in the "Geographic Distribution of Physician Supply and Demand" section.)

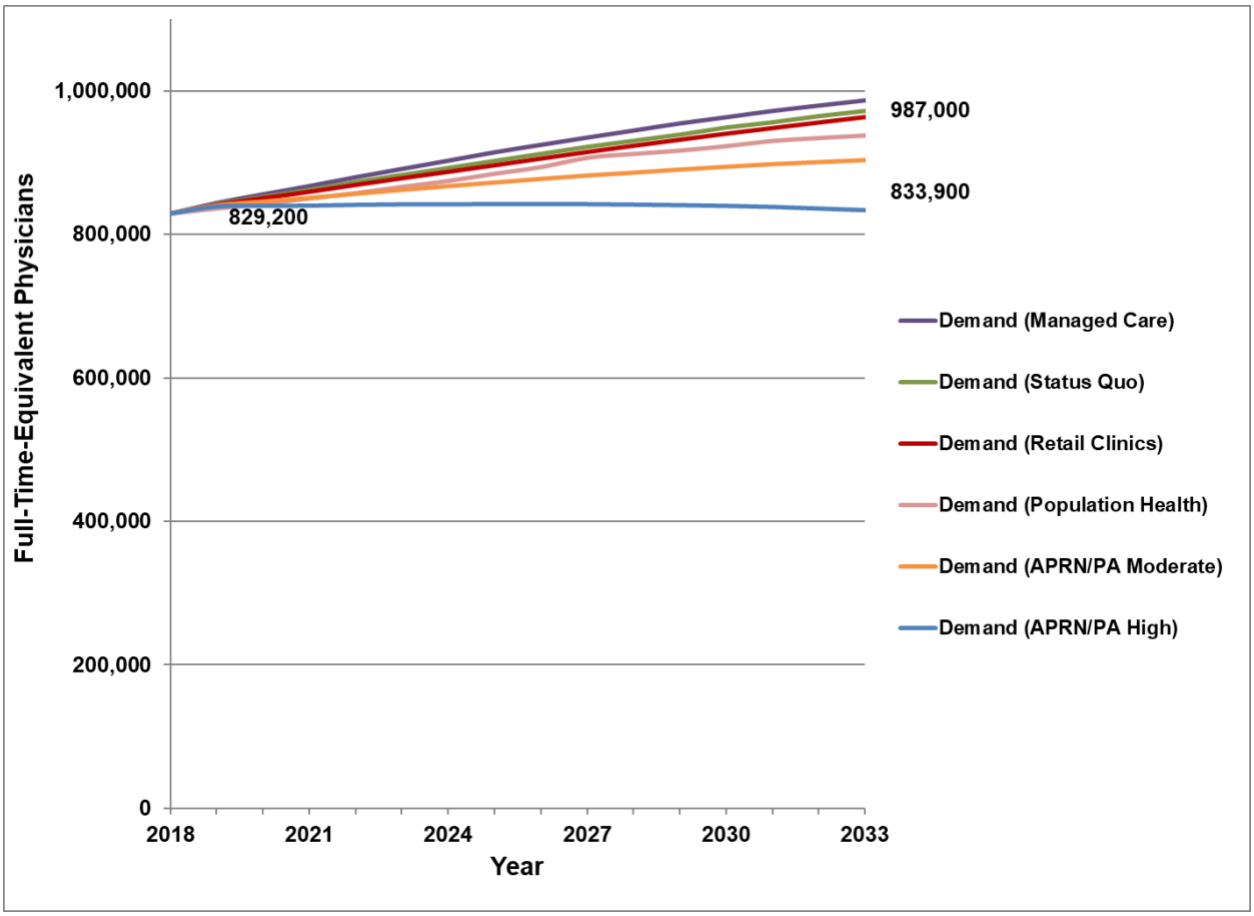
National Demand

Population growth and aging are the largest contributors to changing the demand for physician services. Between 2018 and 2033, changing demographics alone are projected to increase national demand for physicians by about 142,900 FTEs (17%) (Exhibit 17). Demand for Primary Care physicians is projected to grow by 46,600 FTEs (19%). Higher growth rates are expected for Primary-Care-Trained Hospitalists (7,600 FTEs, 24%) and Medical Specialists (34,400 FTEs, 25%); lower growth rates are expected for Surgical Specialties (20,500, 13%) and Other Specialties (33,800 FTEs, 13%) (Appendix 2,

Exhibit 38).

Analysis of MEPS data finds that, controlling for demographics and health risk factors, patients who report being in a health maintenance organization have more touch points with the health care system than patients not in an HMO. The modeled Managed Care Scenario indicates that if all insured patients were moved into managed-care plans that were more like HMOs in terms of how patients use care, there would be a net increase in physician demand, with the increase coming largely from higher demand for primary care providers. By 2033, according to that scenario, national demand would be about 14,900 physicians higher than it would be according to the Status Quo Scenario, with the additional demand for 19,800 Primary Care physicians partially offset by the reduced demand for 4,100 physicians in internal medicine and pediatric subspecialties. According to the Managed Care Scenario, demand for Surgery Specialties is unchanged, though the projected demand for some surgical specialties does vary. Demand for physicians in the Other Specialties category is 1,900 higher due primarily to higher demand for psychiatrists and neurologists. Demand for Primary Care-Trained Hospitalists decreases by 2,700 FTEs.

Exhibit 17: Projected Demand for Physicians, 2018-2033



The simulated increase in the use of retail clinics modeled demand only for primary care, with demand for Primary Care physicians declining by 8,500 physicians by 2033 relative to the Status Quo Scenario. The Retail Clinics Scenario used conservative assumptions about which type of primary care visits would be provided in a retail clinic because it assumes people with severe chronic disease continue to receive care from their normal primary care provider even for services often provided in retail clinics. Although this scenario only modeled demand that has historically been provided in primary care offices that might shift to retail clinics, the growth in retail clinics could reduce the number of avoidable emergency department visits. Ashwood et al. estimated that about 3% of clinic visits replace emergency department visits.[45]

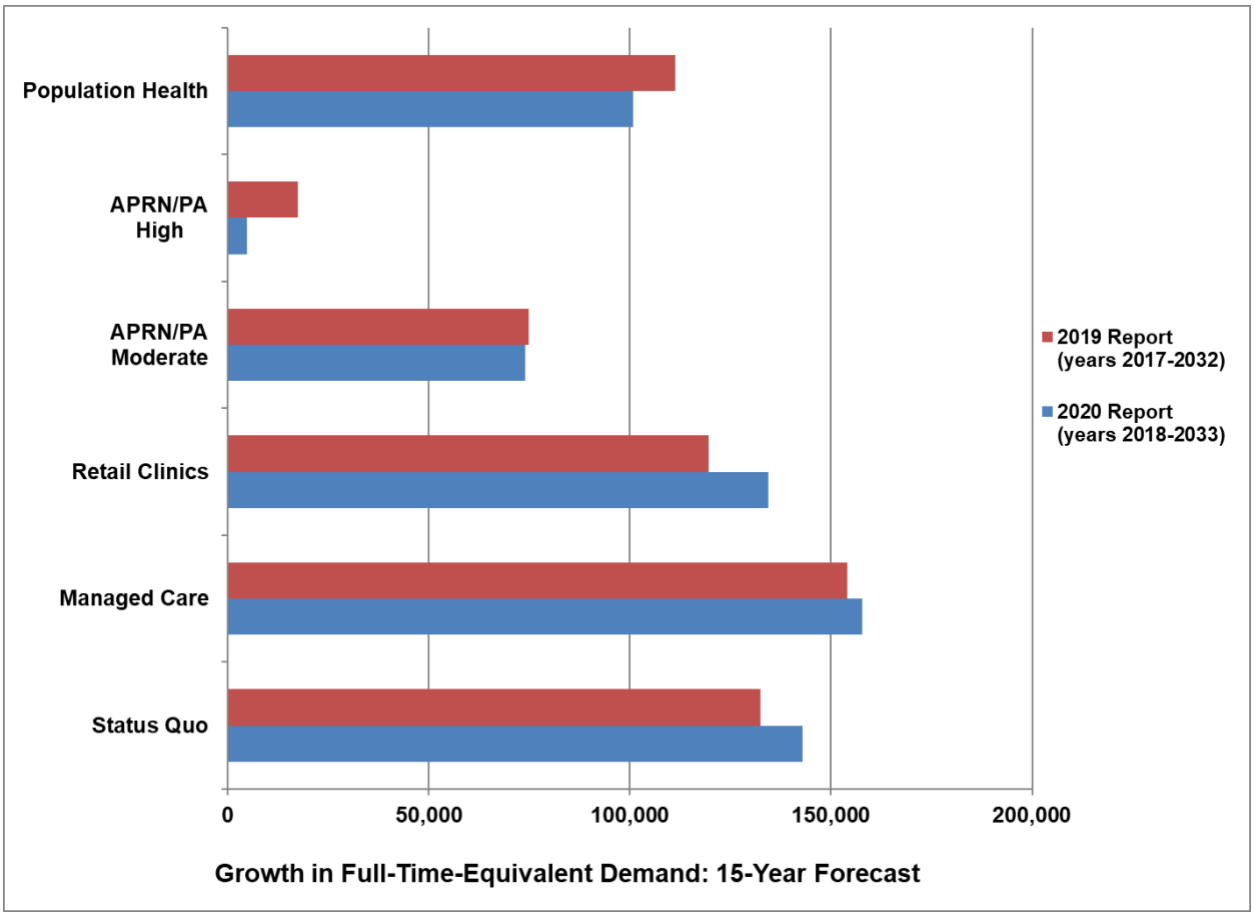
The impacts of increased use of APRNs and PAs are substantial and will vary by physician specialty and assumptions about the future level and scope of care delivery these professions provide. Relative to the Status Quo Scenario projections for 2033, under the APRN/PA Moderate Scenario, projected physician demand declines by 68,900 physicians by 2033 with increased use of APRNs and PAs, and under the APRN/PA High Scenario, by 138,200 physicians. The APRN/PA High and Moderate Scenarios assume an approximate doubling of the APRN and PA workforce between 2018 and 2033.

Under the Population Health Scenario, about 18 million more people would be alive by 2032 than projected by the Status Quo Scenario, and the care required by this still-living population will be more than offset by the reduction in care from people being healthier, on average. The net effect is an increase in demand for health care services relative to the Status Quo Scenario. The Population Health Scenario includes the APRN/PA Moderate Scenario, under the assumption that achieving the modeled

population health goals would happen through greater use of APRNs and PAs for counseling and follow-up care, beyond levels currently provided, to help patients achieve desired health outcomes. Furthermore, the additional 18 million people alive by 2033 under this scenario would require more APRN and PA services, so there would be fewer available APRNs and PAs to offset projected physician shortages. Physician demand under this scenario is 34,600 FTEs fewer than the Status Quo Scenario projections for 2033.

Exhibit 18 compares projected growth in physician demand from the updated projections with last year's report. Both reports used a 15-year projection horizon (2017 to 2032 rather than 2018 to 2033). Under the Status Quo, Managed Care, and Retail Clinics Scenarios, the projected 15-year growth in demand is slightly higher than it was in the 2019 report; for the APRN/PA Moderate Scenario, projected demand growth is almost identical; and for the APRN/PA High and Population Health Scenarios, the projected demand growth is lower than last year's report due to higher projected growth in the number of APRNs and PAs.

Exhibit 18: Projected Change in Physician Demand: 2020 vs. 2019 Report Projections

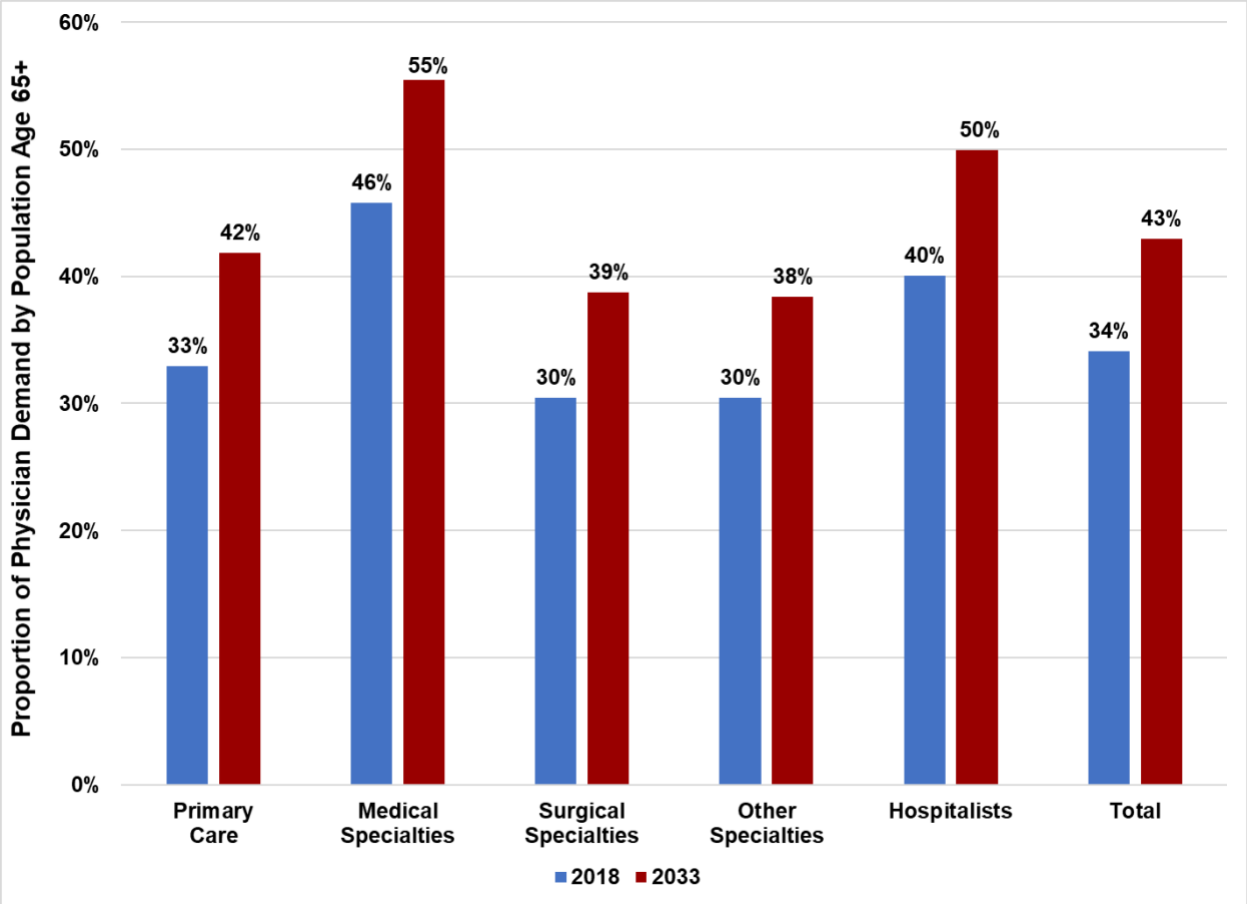


Demand by Population Demographics

Current and projected growth in demand for physician services reflects, in large part, the aging of the population and growth in size of racial and ethnic minority populations.

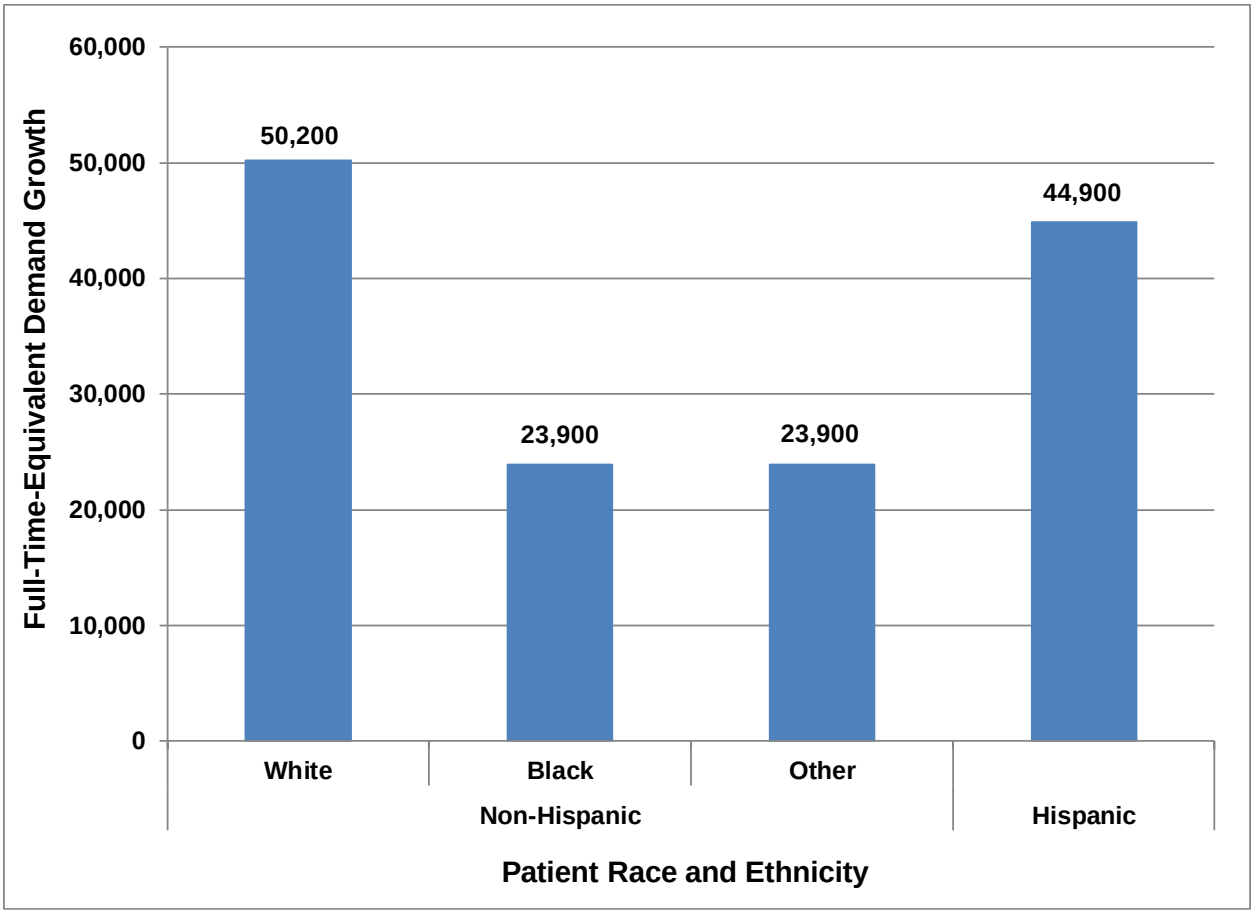
Physician Demand by Patient Age (Exhibit 19): Currently, about a third (34%) of FTE physician demand is from patients age 65 and older, equivalent to 282,700 FTE physicians to care for the population age 65 and older. By 2033, 43% of demand (equivalent to 417,800 FTE physicians) will be for the care of the population age 65 and older. These projections underscore the growing importance of the Medicare program in future years because an increasing proportion of patient care will be provided to Medicare enrollees.

Exhibit 19: Proportion of Physician Demand by Population Aged 65+, 2018 and 2033



Physician Demand by Patient Race and Ethnicity (Exhibit 20): Patterns of health care use and delivery differ systematically by patient race and ethnicity, reflecting underlying differences in age distribution, disease prevalence (e.g., obesity), and health-related behaviors (e.g., smoking); economic factors (e.g., medical insurance coverage, household income); possibly cultural differences in care utilization; and other factors affecting access. For modeling purposes, we categorized patients into one of four mutually exclusive categories: non-Hispanic white, non-Hispanic black, non-Hispanic all other, and Hispanic.[f]

Exhibit 20: Projected Physician Demand Growth by Patient Race and Ethnicity, 2018-2033



In 2018, an estimated 60% of the U.S. population was non-Hispanic white, but this population accounted for about 69% (568,900 FTEs) of total physician demand. The Hispanic population, however, represented 18% of the U.S. population but accounted for about 13% (105,200 FTEs) of physician demand. Between 2018 and 2033, the non-Hispanic all other population is projected to grow the most rapidly in percentage terms (35.6% growth), followed by the Hispanic (31.4%), non-Hispanic black (13.3%), and non-Hispanic white (-0.3%) populations. Based on changing demographics, demand for physician services is projected to grow by 142,900 FTEs from 2018 to 2033 (Exhibit 20). This growth includes an additional 50,200 FTEs (9% growth) associated with an aging non-Hispanic white population, 44,900 FTEs (43% growth) associated with growth and aging of the Hispanic population, 23,900 FTEs (39% growth) associated with growth and aging of the non-Hispanic all other population, and 23,900 FTEs (25% growth) associated with growth and aging of the non-Hispanic black population.

In 2019, an estimated 68.2% of physicians were white, 23.3% were Asian, 2.6% were black or African American, 0.4% were American Indian or Alaska Native, 0.4% were Native Hawaiian or Other Pacific Islander, 3.8% were Hispanic, Latino, or of Spanish origin, 3.3% were other races, and 1.9% were multiple race/ethnicities (based on data from the NSSP, which allowed the selection of multiple categories). During the 2019-2020 academic year, the demographics of medical school enrollment consisted of 49.8% non-Hispanic white, 22.5% Asian, 7.3% black, 6.5% Hispanic, and the remainder, other or multiple race/ethnicities (12.9%) or unknown race/ethnicity (1%).[83] These findings highlight that some minorities (black and African American, Hispanic/Latino, Native American and American Indian, and Native Hawaiian and Pacific Islander) are underrepresented among physicians relative to both U.S. and patient demographics. Furthermore, based on national demographic trends, demand for physician services is projected to grow proportionately faster for minority populations.

EVOLVING CARE DELIVERY SYSTEM DEMAND IMPLICATIONS

The U.S. health care system continually evolves to reflect changes in the nation's goals and priorities, changes in medicine and technology, changes in patient expectations, and the economic realities of care delivery. National priorities and legislation over the past decade — such as the Affordable Care Act of 2010 (ACA), the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA), and the 21st Century Cures Act — aimed to improve patient satisfaction and access to high-quality, affordable care.[84-86]

Utilization-based health workforce demand projections have been criticized for assuming a perpetuation of the current health care system, which is represented by the demand Status Quo Scenario, rather than modeling the workforce needed for a future system. While recognizing the contemporary health care system is based on current health policy, infrastructure, and technology that will not transform overnight, the research presented in this section of the report explores trends in system transformation and their potential implications for the physician workforce. The projections combine elements of modeling scenarios described earlier in this report and information from the literature on other emerging trends. *Because this work is an amalgamation of demand scenarios included in the shortage projections, this scenario is not included in calculating those projections*.

The goal of some recent health care legislation has been to move the health care system away from a fee-for-service model that rewards quantity of services delivered to a system that promotes quality and value.[87] Changes encouraged by legislation and payment reform include strengthening the nation's primary care foundation,[88] promoting and achieving population health goals to improve disease prevention,[89-92] improving coordination of care to manage high-risk patients across the care continuum,[93,94] and making care more affordable by eliminating unnecessary spending and discouraging low-value care.[95] Only a few early ACA policies specifically targeted physician supply, with modest changes to graduate medical education funding and increased funding for health centers and the National Health Service Corps. Most recent changes in legislation and business practices primarily affect physician demand indirectly through changes in care-usage and care-delivery patterns.

Responses to changing financial incentives have led to changes in the organization of the health care industry. Payers and providers are consolidating horizontally and vertically and restructuring internal operations to increase efficiency.[96] A growing proportion of physicians are employees rather than practice owners, and 2016 was the first year more than half (52.9%) of practicing physicians were employees.[97] There is some evidence that employee physicians work fewer hours per week in direct patient care than self-employed physicians, partly because they spend more time on administrative and indirect patient-care activities and they have less financial incentive to extend already long hours worked per week.[98-100]

Key mechanisms for producing value specifically promoted by the ACA or incentivized through payment reform include patient-centered care, team-based care, value-based insurance design (VBID), risk sharing, disease management, rewarding quality, and greater use of technology such as electronic medical records and telemedicine. These mechanisms are not mutually exclusive, and multiple mechanisms often contribute to the same goals. For example, improved medication adherence to control hypertension, hyperlipidemia, and hyperglycemia helps reduce risk for cardiovascular disease, stroke, and diabetes and sequelae.[101-102] There is strong evidence that medication adherence is improved through VBID,[75-76] patient-centered medical homes (PCMH),[72,74] disease management programs and counseling,[103,104] team-based care,[75,105,106] and increased use of technology.[107,108]

The challenges of modeling the implications of evolving care delivery on future demand for physicians include (1) the paucity of evidence about effects of evolving care delivery, and the evidence that has been generated focuses on the earliest and, so far, most successful trials of the innovation; (2) much of

the published literature evaluating interventions to change patient health and utilization outcomes pertains to a specific population or disease, so it cannot be generalized to the U.S. population; (3) multiple factors often influence patient outcomes, so the impact of specific interventions or trends cannot be isolated (e.g., using technology in conjunction with PCMH); and (4) the mechanisms for achieving health system goals (e.g., technology) continue to evolve over time. Because of these challenges, rather than model a set of interventions such as VBID and PCMH, we modeled five major components of an improved health system:

1. **Improving population health:** This component of the Evolving Care Delivery System Scenario is the Population Health Scenario described previously and used to develop the physician-shortage ranges. This scenario modeled the national goals of making progress toward reducing excess body weight; reducing the prevalence of hypertension, hypercholesterolemia, and hyperglycemia; and smoking cessation; these are only a subset of targeted patient health outcomes. Achieving these goals, however, would (1) prevent or delay disease onset and disease severity, leading to lower demand for physician services, and (2) reduce mortality, with more people living to an older age, leading to increased demand for physician services. Model outcomes suggest that by 2033, there would be a net increase in physician demand of 28,900 FTEs to service a larger population due to reduced mortality. This scenario assumes APRNs and PAs would be a key workforce component, providing the additional counseling and follow-up required to meet the modeled population goals and helping care for the larger living population.

2. **Managing care and risk-bearing organizations:** As discussed in the "Demand Modeling" section, one demand scenario modeled differences in health care use patterns of patients in a managed-care plan compared with patients not in a managed-care plan as a proxy for differences in care use and care-delivery patterns associated with applying managed-care principles. While accountable care organizations (ACOs) differ in many ways from traditional managed-care plans, they share many of the same goals around disease prevention, shifting care to appropriate lower-cost settings and providers, care coordination, and improving care quality and efficiency. This component of the Evolving Care Delivery System Scenario incorporates the Managed Care Scenario modeled to forecast the range of physician shortages. The main outcome of this scenario is a net 14,900-FTE increase in physician demand, due almost entirely to an increase in demand for primary care physicians and psychiatrists, and a decrease in demand for physicians in many other specialties.

3. **Addressing unmet behavioral health needs:** The shortage of behavioral health providers and the unmet behavioral health needs in the United States have been well documented. This provider shortage extends beyond the 6,894 psychiatrists required to de-designate Mental Health Professional Shortage Areas. Nearly one in five adults with mental illness report they were unable to obtain treatment because of barriers to getting the help they need, and the prevalence of undiagnosed needs is high.[109-113] Approaches to addressing unmet behavioral health needs include improving access to behavioral health services and training primary care providers and others to screen patients for behavioral health needs. While psychiatry is the only specialty focused on addressing patient mental health needs, primary care is essential for addressing and screening for patient behavioral health needs because it is the main point of entry into the health care system.[114] This is especially true in rural areas and underserved communities.[115] There is not enough information yet to quantify how addressing unmet behavioral health needs will affect demand for Primary Care physicians, so, for this scenario, we model only the potential impact on demand for psychiatrists.

   Analysis of MEPS data finds that people without medical insurance, people living in underserved areas, and racial and ethnic minority populations have fewer annual visits to psychiatrists compared with their counterparts who are insured, living in suburban areas, and non-Hispanic white. We model a scenario where these disparities in access to psychiatrist

services are cut in half, which raises demand for psychiatrists by close to 7,500 higher than the baseline demand (Status Quo) scenario by 2033.

4. **Organizing care across care-delivery settings and coordinating multidisciplinary care:** Efforts to improve quality of care and better coordinate multidisciplinary care across delivery settings, as well as incentives through the Hospital Readmissions Reduction Program, have contributed to declines in the proportion of patients readmitted to the hospital following discharge.[116-119] Efforts continue to prevent avoidable hospitalizations and emergency visits through increased access to primary care and preventive services and to divert emergency visits to appropriate lower-cost settings such as physician offices, retail clinics, urgent care centers, and crisis centers for behavioral health conditions.[120-123] A study of 98,000 patients found that PCMH implementation reduced annual emergency visits by 9.3%.[124] This 9.3% reduction is only a portion of what the health care system is striving to achieve. In some instances, efforts to reduce demand for hospital services will reduce overall demand for physicians. In other instances, these efforts will shift demand from hospital-based physicians to physicians practicing in ambulatory settings. For this analysis, we modeled the following assumptions:

    a. Consistent with recent health workforce modeling for the Health Resources and Services Administration (HRSA), we modeled a gradual 5% reduction in hospital inpatient utilization, relative to the Status Quo demand projections, with a corresponding reduction in demand for Primary-Care-Trained Hospitalists. We assumed that reduced hospital demand for other physicians (e.g., in Medical and Surgery Specialties) would be offset by increased demand for these physician services in ambulatory or outpatient settings. This 5%-reduction assumption is likely conservative. Studies report that participation in a PCMH team-based intervention reduced hospitalizations for PCMH-targeted conditions by 13.9% and for all other conditions, by 3.8%,[125] and it reduced rehospitalization rates from 18.8% to 7.7%.[126]

    b. We modeled an 18% decline in emergency visits relative to the Status Quo demand projections, with a corresponding decrease in demand for emergency physicians. The modeled 18% decline starts with estimates by Truven Analytics that 71% of emergency visits by people with employer-sponsored health insurance are potentially avoidable (either by diverting the visit to an appropriate ambulatory setting or by having treated the medical condition that precipitated the visit).[127] We assume this 71% estimate approximates potentially avoidable emergency visits for the Medicaid, Medicare, and uninsured populations. Not all potentially avoidable emergency visits can be prevented or diverted, and we modeled a 25% reduction in these visits. Thus, the 18% decline assumption reflects a 25% reduction of the 71% of potentially avoidable emergency visits. We assume each averted emergency visit would be replaced by an ambulatory visit to a physician office or outpatient or clinic setting, with ambulatory visits prorated across Primary Care and Medical Specialists (with about two-thirds of redirected visits being patients seen by a Primary Care provider and one-third, seen by a Medical Specialist).

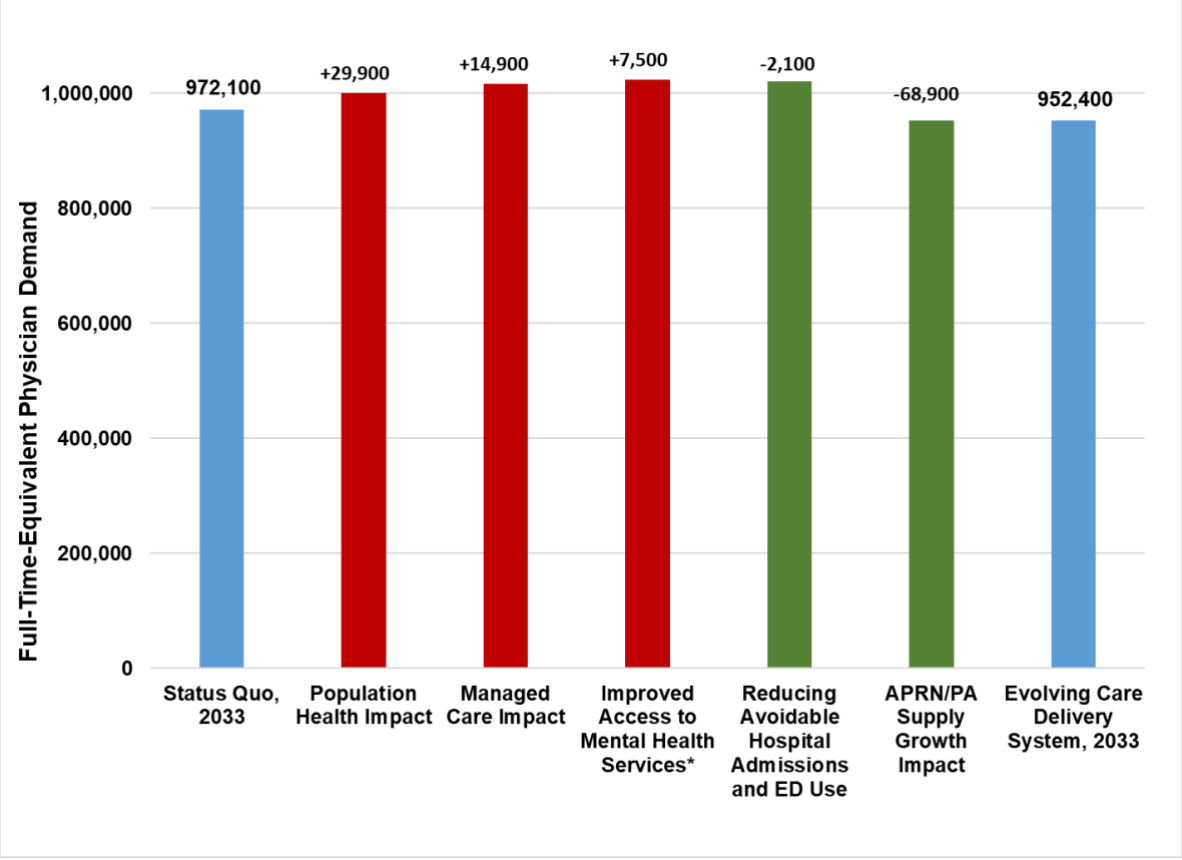
        The impact by 2033 of this scenario component is a 9,700-FTE decrease in demand for emergency physicians and a 2,000-FTE decrease in demand for Primary-Care-Trained Hospitalists, offset by an increase in demand for 6,100 FTE Primary Care physicians and 3,600 FTE physicians in internal medicine and pediatric subspecialties.

5. **Increased supply and expanding role of APRNs and PAs:** For this Evolving Care Delivery System Scenario, we include the APRN/PA Moderate Scenario under the assumption that to achieve national goals around improvements in population health and improved access to care, APRNs and PAs will help address many unmet patient needs and efforts to improve patient health outcomes.

Other trends beyond the five modeled components of this Evolving Care Delivery System Scenario could change future demand for physician services, though we do not have enough information to quantify the magnitude of increases or decreases in demand these other factors could cause or which specialties each factor might apply to. Factors not modeled include potential advances in medicine and technology and increased use of existing technologies such as telemedicine.

The Status Quo Demand Scenario modeled that between 2018 and 2033, total demand for physicians would increase by 142,900 FTEs if care delivery is relatively unchanged, with this increase coming from a growing and aging population (Appendix 2, Exhibit 38). Many changes in care delivery could increase demand for physicians by expanding access to care, addressing unmet needs, or reducing mortality. Other changes might shift care across care-delivery settings or across provider types. The largest modeled impact on physician demand is the 68,900-FTE decrease in physician demand associated with more than doubling the size of the APRN and PA supply over the next 15 years if the APRN and PA training pipeline continues to expand (Exhibit 21). By 2033, demand would be about 952,700 FTE physicians — 19,700 FTEs (2%) lower than the 972,100-FTE estimate from the Status Quo Scenario.

Exhibit 21: Physician Demand Implications of Evolving Care Delivery System Components by 2033

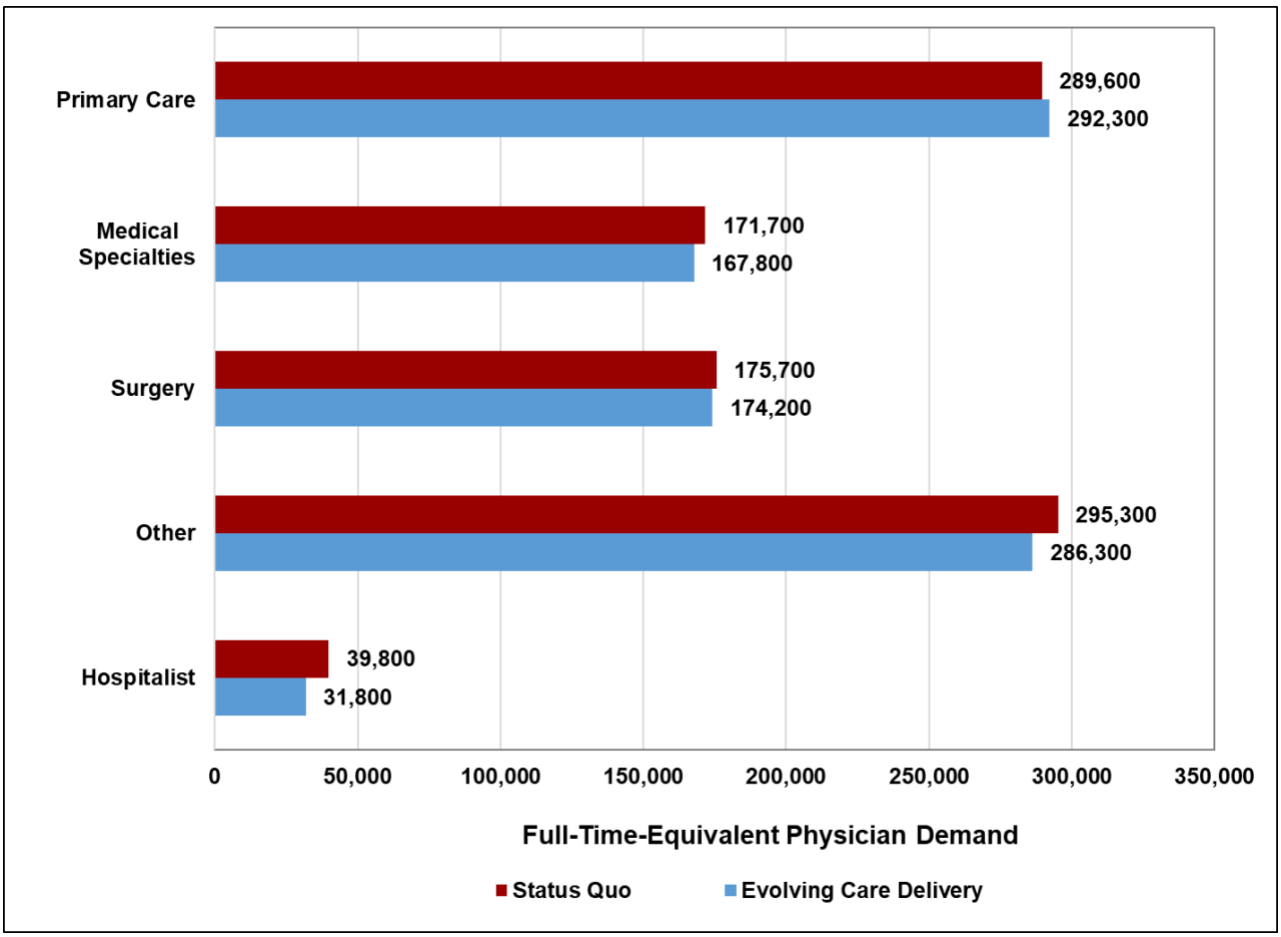


*The estimate for improving access to mental health services likely understates the total impact on physician demand because it reflects only the impact on demand for psychiatrists. The impact on demand for primary care physicians and specialist physicians who provide mental health services to their patients is unknown.

Note: The blue lines represent total demand by 2033 under the Status Quo and Evolving Care Delivery System Scenarios; the red and green lines show the estimated magnitude of trends or factors that will potentially increase or decrease demand, respectively, relative to the Status Quo Scenario.

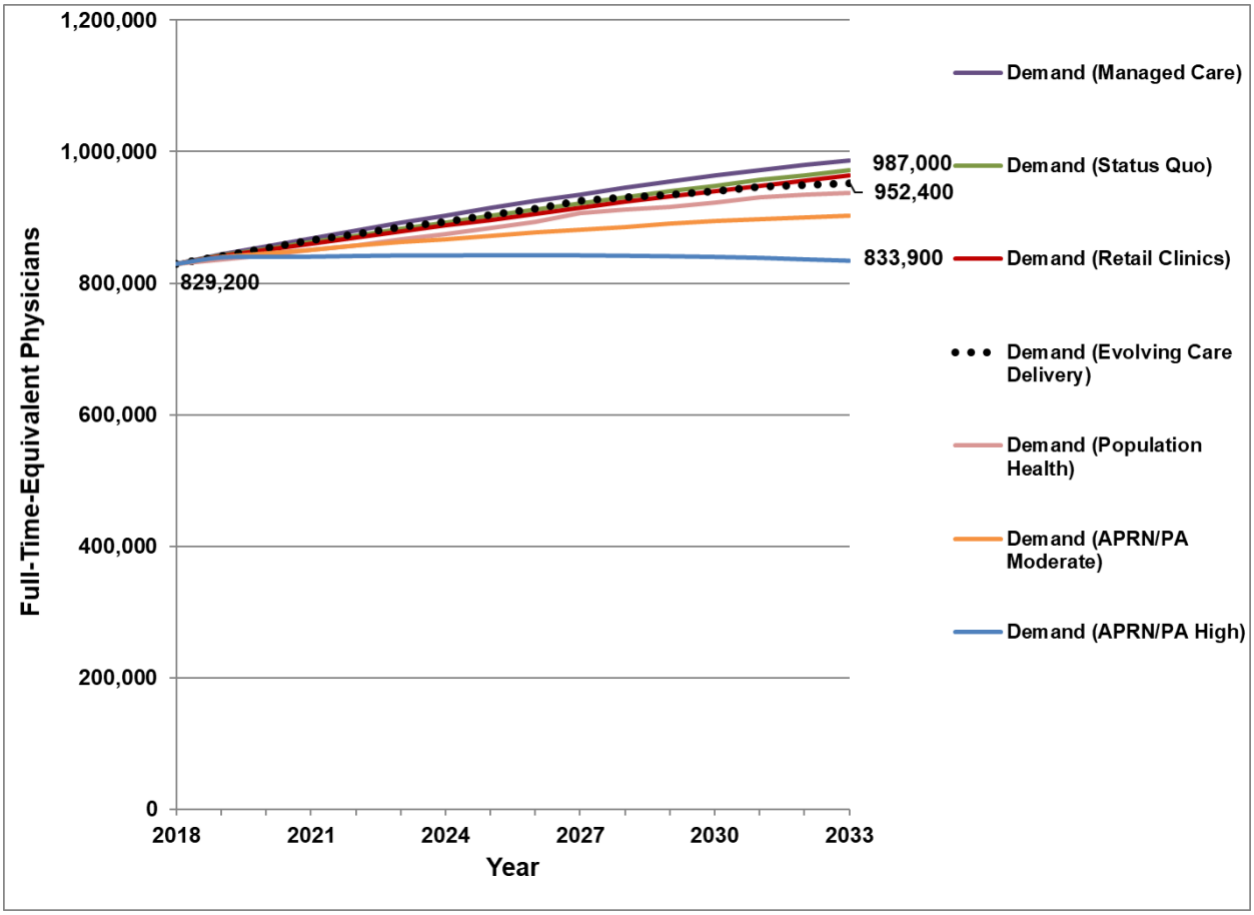
Modeling results suggest that by 2033, demand for Primary Care physicians under the Evolving Care Delivery System Scenario would be 2,700 FTEs higher than projected under the Status Quo Demand Scenario (Exhibit 22). Demand would be lower by 3,900 FTEs for Medical Specialties and by 1,500 FTEs for Surgery Specialties. The largest decline in demand (9,000 FTEs) is for Other Specialties, with much of this drop due to a decline in demand for emergency physicians and the impact on physician demand associated with the projected large growth in supply of certified registered nurse anesthetists (CRNAs) and psychiatric nurse practitioners (NPs). The 8,000-FTE drop in demand for Primary-Care-Trained Hospitalists might overstate the decline to the extent that the impact on hospitalizations from higher enrollment in HMO-type plans and the efforts to reduce hospital readmissions overlap and thus lead to double counting some of the demand-decrease estimates.

Exhibit 22: Projected Growth in Physician Demand Under Status Quo and Evolving Care Delivery System Scenarios, 2018-2033



Demand projections under the Evolving Care Delivery System Scenario fall within the range of the demand scenarios used to develop the physician-shortage ranges, with three demand scenarios projecting higher physician demand and three demand scenarios projecting lower physician demand (Exhibit 23). This is not surprising because this scenario combines elements of the Managed Care, Population Health, and APRN/PA Moderate Scenarios.

Exhibit 23: Evolving Care Delivery System Scenario Demand Projections, 2018-2033



While additional research will improve understanding of how care delivery — and its workforce implications — might evolve over time, the findings presented here suggest that changes in care delivery that decrease demand for physicians will be partially offset by changes in care delivery that increase demand for services. This is not surprising because the national priorities of expanding access to care, providing more comprehensive care, and reducing mortality will increase demand for health care services and providers. System changes to reduce the growth of health care expenditures will likely decrease physician demand in some specialties and care-delivery settings by shifting care from specialists to generalists, from physicians to nonphysicians, and from hospital-based physicians to community-based physicians.

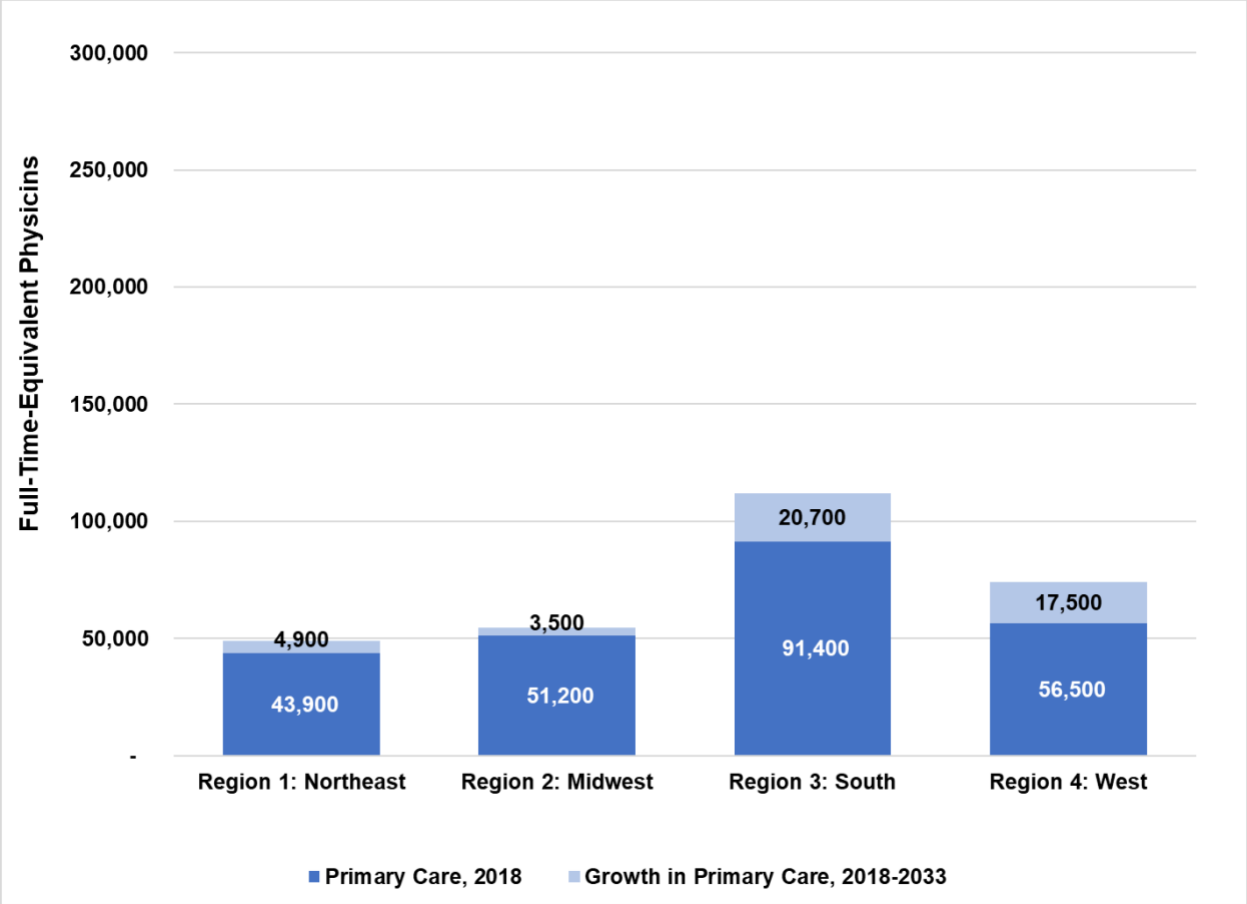
GEOGRAPHIC DISTRIBUTION OF PHYSICIAN SUPPLY AND DEMAND

Current supply and demand for physicians and projected growth in demand vary geographically by region and by urban-rural location.

Physician Demand by Census Region

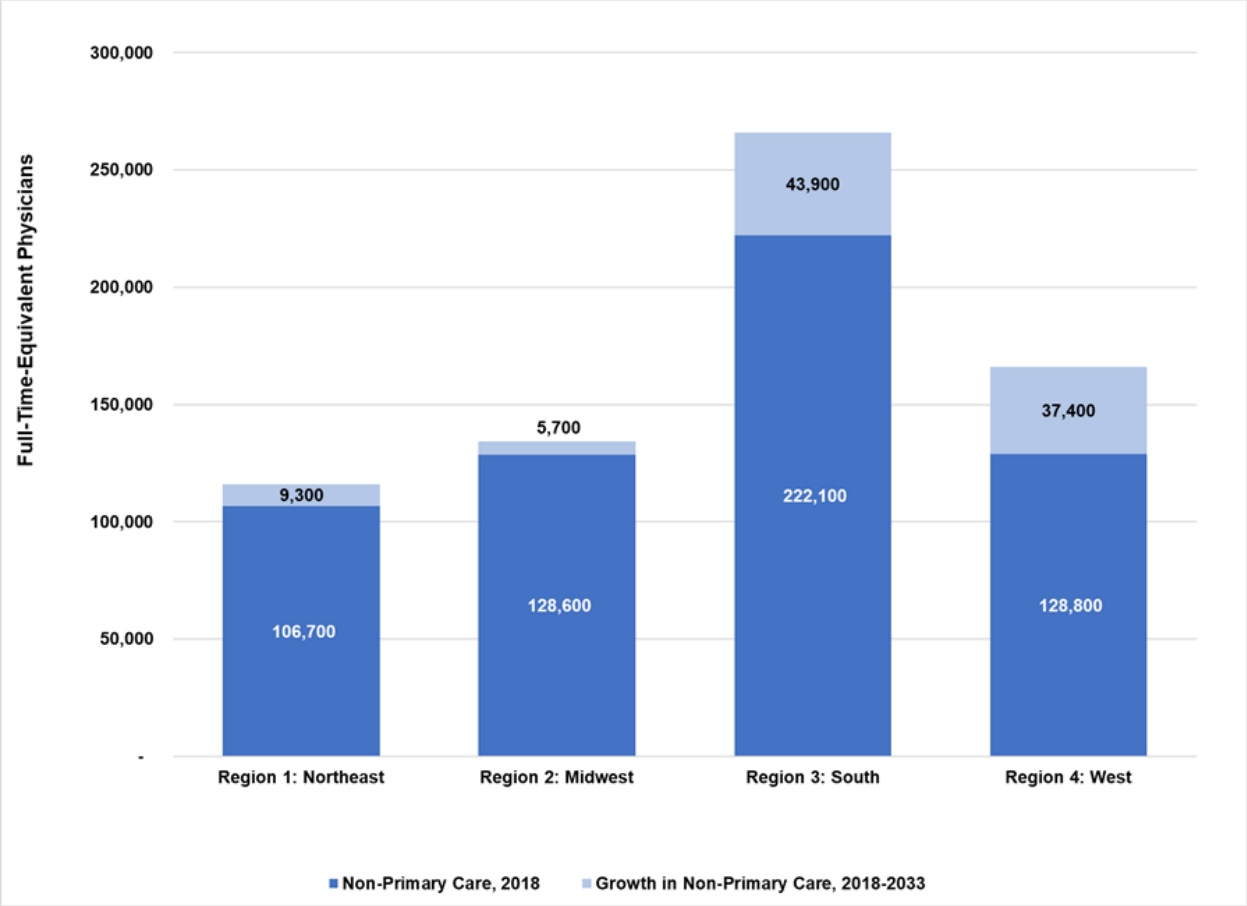
Utilization of physician services and projected growth in demand vary by census region due to differences in demographics and projected population growth, insurance coverage, health risk factors (e.g., obesity, smoking prevalence), disease prevalence, economic conditions, and care-access barriers. If care were evenly distributed across the United States after adjusting for demographics, socioeconomic factors, and prevalence of disease and health risk factors, physician demand in 2018 would be distributed as follows across census regions: 313,500 FTEs (37.8%) in the South Region, 185,300 FTEs (22.3%) in the West Region, 179,800 FTEs (21.7%) in the Midwest Region, and 150,600 FTEs (18.2%) in the Northeast Region. Demand growth from 2018 to 2033 is projected to be largest in the South (64,700 FTEs) and West (54,900 FTEs) and smallest in the Midwest (9,200 FTEs) and Northeast (14,200 FTEs) (see Appendix 2, Exhibit 33). Both demand in 2018 and projected growth in demand between 2018 and 2033 are expected to be similarly distributed across regions in Primary Care and non-primary care (Exhibits 24 and 25).

Exhibit 24: Physician Primary Care Demand and Demand Growth by Census Region, 2018-2033



Note: Demand is defined as the number of FTE physicians required to provide a national-average level of care given the demographics, prevalence of disease and health risk factors, insurance coverage, household income levels, and health care use patterns of the population residing in each region.

Exhibit 25: Physician Non-Primary Care Demand and Demand Growth by Census Region, 2018-2033

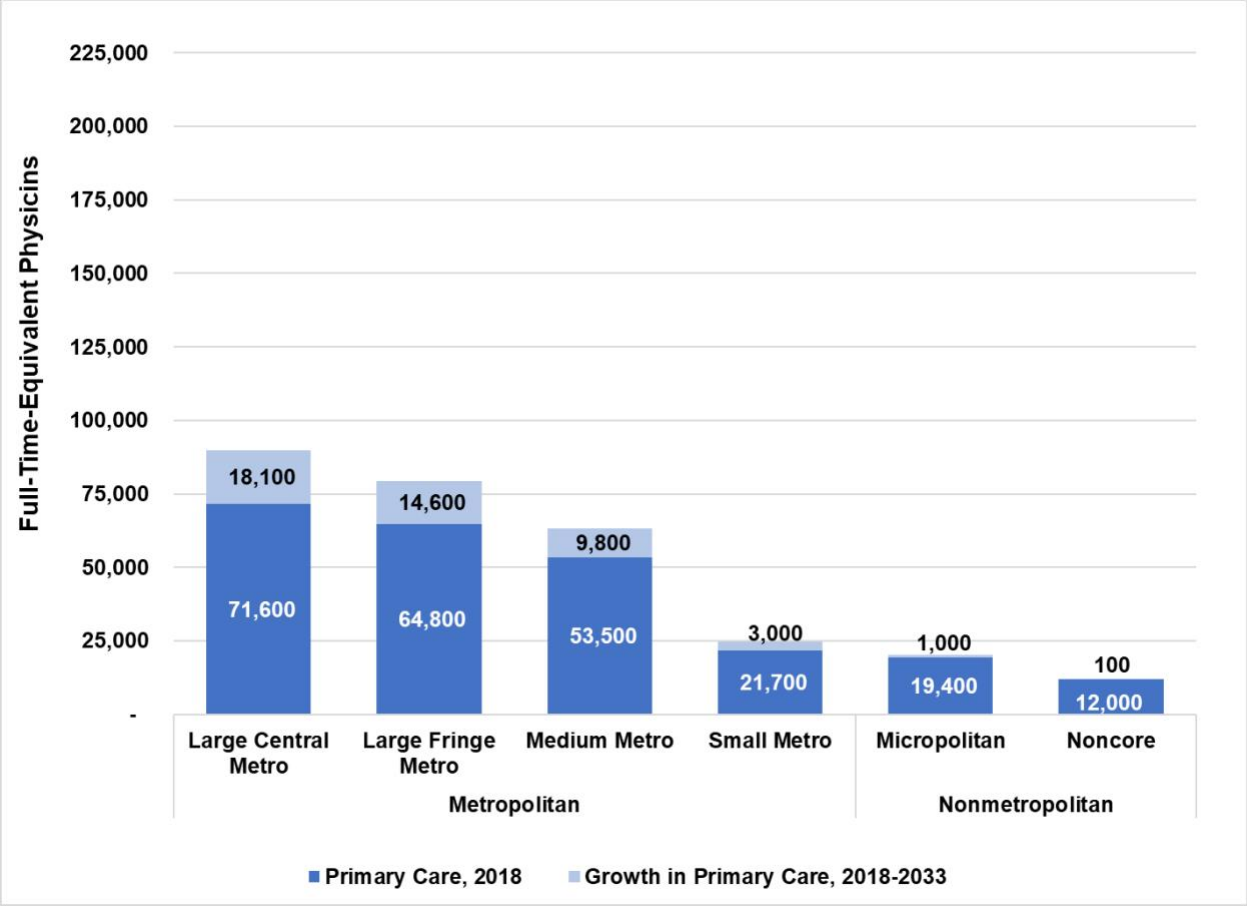


Note: Demand is defined as the number of FTE physicians required to provide a national-average level of care given the demographics, prevalence of disease and health risk factors, insurance coverage, household income levels, and health care use patterns of the population residing in each region.

Physician Demand by Urban-Rural Location

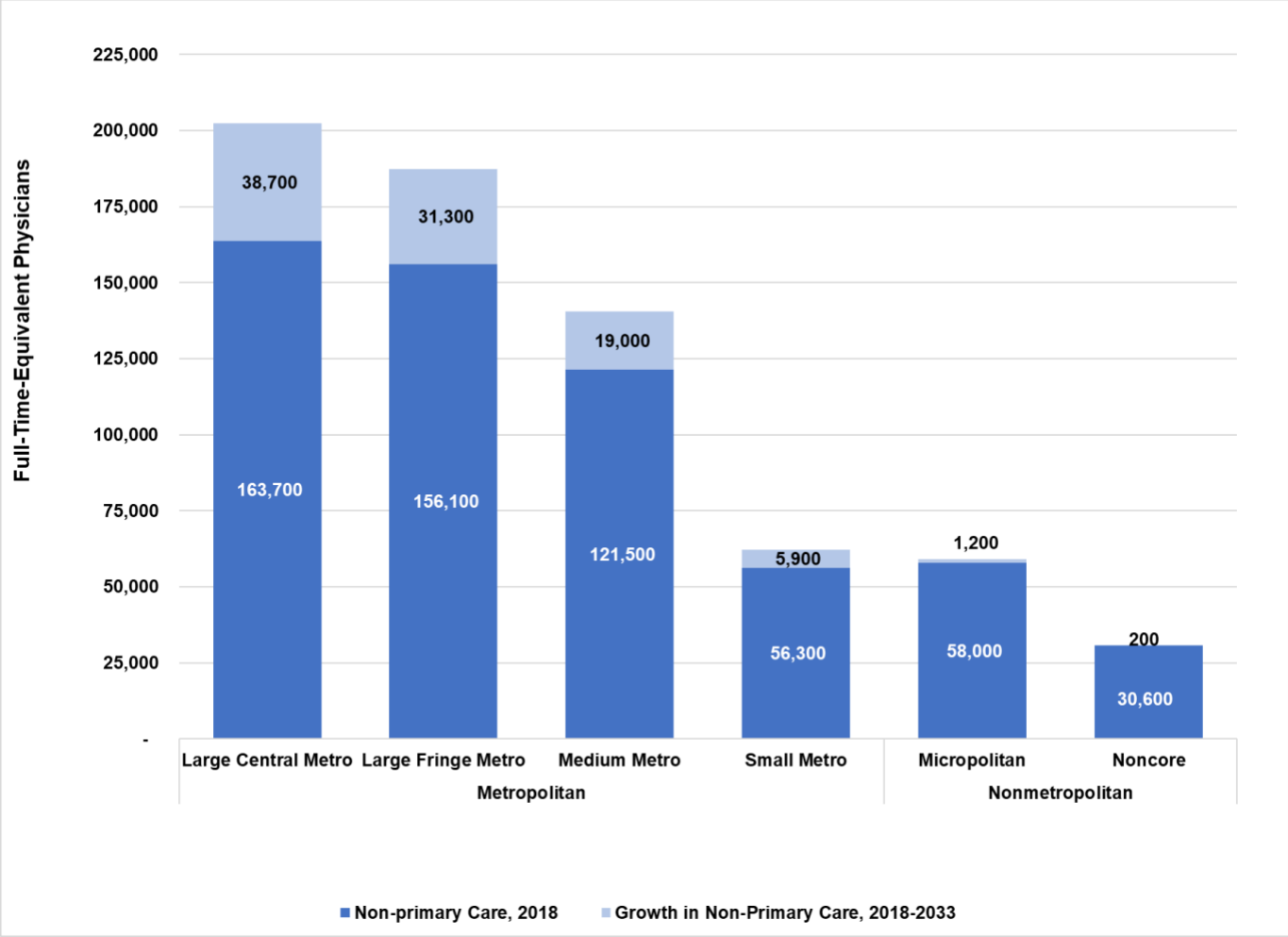
We estimated physician demand and demand growth across type of location, from urban to rural, as defined by the 2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties (Exhibits 26 and 27; Appendix 2, Exhibit 34).[g] Demand is defined by population residency location type controlling for geographic variation in population characteristics (demographics, disease prevalence, medical insurance coverage, lifestyle choices, and household income). Between 2018 and 2033, almost all (98%) projected growth in physician demand will be in metropolitan areas.

Exhibit 26: Physician Primary Care Demand and Demand Growth by Metropolitan Designation, 2018-2033



Note: Demand is defined as the number of FTE physicians required to provide a national-average level of care given the demographics, prevalence of disease and health risk factors, insurance coverage, household income levels, and health care use patterns of the population residing in counties with each urban-rural designation using the 2013 NCHS Urban-Rural Classification Scheme for Counties.

Exhibit 27: Physician Non-Primary Care Demand and Demand Growth by Metropolitan Designation, 2018-2033



Note: Demand is defined as the number of FTE physicians required to provide a national-average level of care given the demographics, prevalence of disease and health risk factors, insurance coverage, household income levels, and health care use patterns of the population residing in counties with each urban-rural designation using the 2013 NCHS Urban-Rural Classification Scheme for Counties.

PROVIDERS REQUIRED IF U.S. ACHIEVED EQUITY IN HEALTH CARE UTILIZATION

Achieving health equity is a national goal often cited by government and other organizations, with research suggesting substantial room for progress.[128-132] One component of achieving this goal is to improve access to care for populations that have historically faced barriers to receiving care. The Health Care Utilization Equity (HCUE) Scenarios modeled for this report quantify the implications for physician demand if currently underserved populations had similar care-use patterns as populations facing fewer barriers to care — controlling for demographics, lifestyle choices, and disease prevalence. *This analysis is not included in the ranges of scenarios that summarize projected gaps between supply and demand across physician specialty categories*. Rather, it is intended as an additional point of consideration when gauging workforce adequacy and to stimulate discussion of how best to address health care utilization inequity. The analysis shows that due to sociodemographic differences, historically underserved populations have received less care beyond utilization differences that can be explained by differences in age distribution, disease prevalence, and other health risk factors.

As shown in Exhibit 28, under current patterns of health care service use, the non-Hispanic white population uses about 288.0 FTE physicians per 100,000 population. In comparison, the Hispanic population uses about 175.7 FTE physicians per 100,000 population, with other racial minority groups' use between these two numbers.

We modeled two hypothetical scenarios to estimate the anticipated increase in the use of health care services if underserved populations had use patterns similar to a population not perceived as underserved. The first scenario (HCUE Scenario 1) assumes people without medical insurance and their peers with insurance had similar care-use patterns and people living outside and their peers living inside suburban[h] metropolitan areas had similar care-use patterns. For example, an uninsured male age 50 with diabetes living in a rural area was modeled as having the utilization patterns of an insured male age 50 with diabetes living in a suburban metropolitan area. Under these assumptions, an additional 74,100 FTE (9%) physicians would be required to meet the additional demand for services (

Exhibit 29 and Appendix 2,

Exhibit 39). More APRNs and PAs would also be required to meet the additional demand for services.

The second HCUE scenario (HCUE Scenario 2) models the additional physicians required under a hypothetical scenario in which everyone utilized care as if they had equivalent utilization patterns to non-Hispanic white, insured populations residing in suburban metropolitan areas. For example, an uninsured black male age 50 with diabetes living in a rural area was modeled as having the utilization rate of an insured non-Hispanic white male age 50 with diabetes living in a suburban metropolitan area. Under these assumptions, we estimated an 18% increase in physician demand, or about 145,500 FTE physicians (Exhibit 30).

These estimates are approximately double the estimates in previous reports, reflecting a change in approach. In previous reports, the HCUE scenarios modeled the increase in demand for health care services if people in nonmetropolitan areas had the care-use patterns of people living in metropolitan areas. In these new estimates, we modeled all people having care-use patterns of people living in suburban metropolitan areas — who typically have the greatest access to care. These modeled scenarios are not intended to describe what future demand for physicians is likely to be, but rather to highlight the large disparities in use of services between people with and without insurance, among people residing in counties across different levels of rurality, and by race and ethnicity.

Exhibit 28: Current Use of FTE Physician Services per 100,000 Population by Patient Race and Ethnicity, 2018

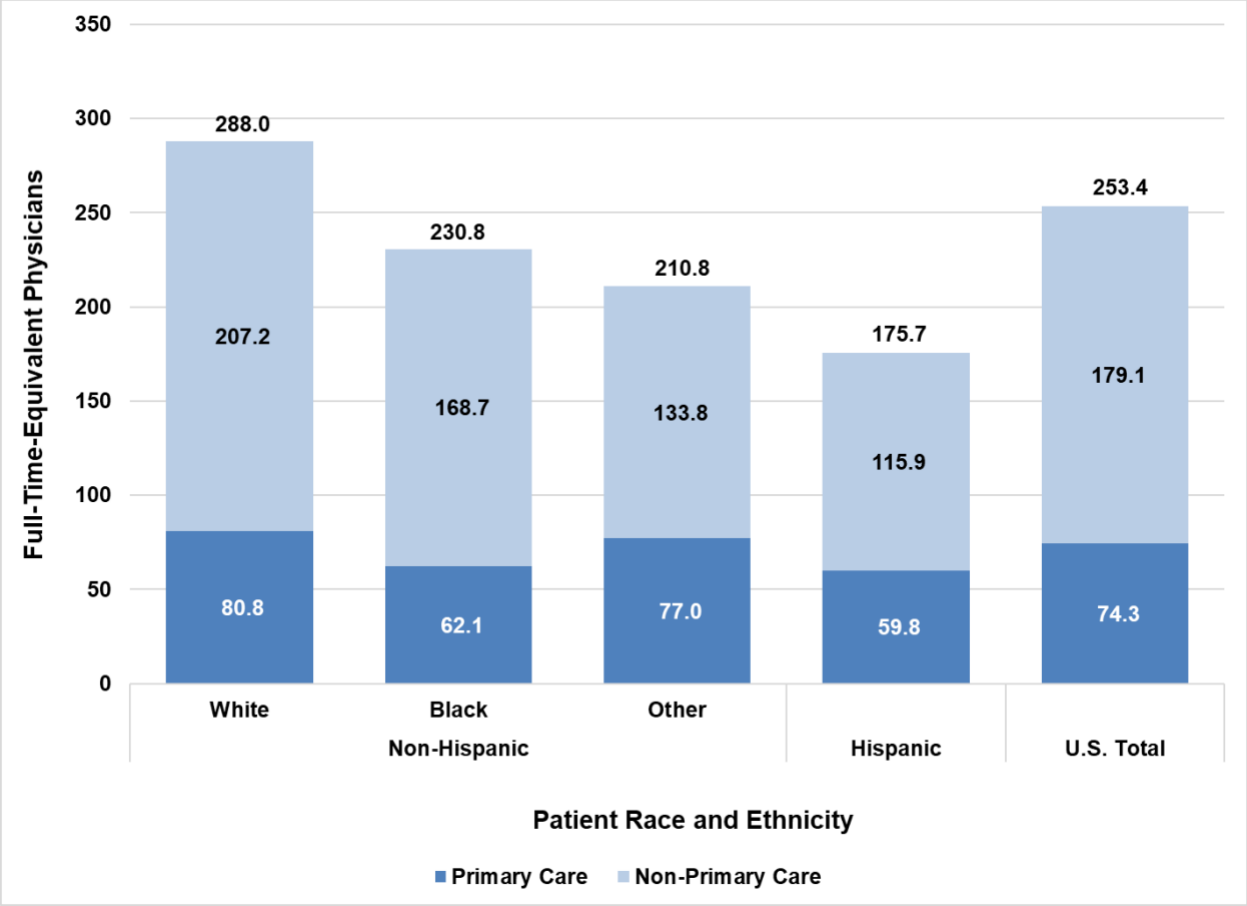


Exhibit 29: Health Care Utilization Equity Scenario 1, 2018

Specialty Group	Physicians				Additional Providers Required	
	Current Supply	Requirements Under Equity Scenario	Current Gap	% Gap	Advanced Practice Nurses	Physician Assistants
Total	807,400	881,500	74,100	9%	18,200	8,300
Primary Care	228,100	249,900	21,800	10%	7,700	1,300
Non-Primary Care	579,300	631,600	52,300	9%	10,500	7,000
Medical Specialties	137,300	154,000	16,700	12%	3,300	1,600
Surgical Specialties	155,200	168,000	12,800	8%	1,400	2,500
Other Specialties	254,600	275,500	20,900	8%	5,000	2,600
Hospitalists*	32,200	34,100	1,900	6%	800	300

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Exhibit 30: Health Care Utilization Equity Scenario 2, 2018

Specialty Group	Physicians				Additional Providers Required	
	Current Supply	Requirements Under Equity Scenario	Current Gap	% Gap	Advanced Practice Nurses	Physician Assistants
Total	807,400	952,900	145,500	18%	41,200	17,300
Primary Care	228,100	262,600	34,500	15%	12,200	3,000
Non-Primary Care	579,300	690,300	111,000	19%	29,000	14,300
Medical Specialties	137,300	155,500	18,200	13%	3,600	2,000
Surgical Specialties	155,200	184,600	29,400	19%	3,200	6,300
Other Specialties	254,600	313,900	59,300	23%	20,600	5,500
Hospitalist*	32,200	36,300	4,100	13%	1,600	500

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

The implications of these hypothetical scenarios vary substantially by patient race and ethnicity, census region, and urban-rural location (Appendix 2,

Exhibit 40-44). For most specialties, demand for physician services by underserved populations would rise under the HCUE1 and HCUE2 scenarios. However, for some underserved populations, demand would fall, reflecting a higher prevalence of select chronic conditions among these underserved populations and potential declines in demand for chronic disease services if these patients had improved access to preventive care. Examples of demands for services among minority populations that would decline under the HCUE2 scenario include for hematology and oncology, nephrology, rheumatology, colorectal surgery, radiation oncology, and allergy and immunology. These possible declines in demand could be due to access to preventive care diminishing higher prevalence rates among minority populations for obesity, hypertension, diabetes, nonalcoholic fatty liver disease, various types of cancer, and other chronic diseases.[133-138] The decline in use of hematology and rheumatology services might be overstated to the extent that diseases such as sickle cell disease and lupus are much more prevalent among minority populations than in the non-Hispanic white population.[139-141]

CONCLUSIONS

Rapidly changing business practices and conditions, as well as public policies at the state and federal levels, continue to reshape the U.S. health care system. Such changes underscore the need for reliable information about the capacity of the nation's future health care workforce in general — and the physician workforce in particular — so that both public and private stakeholders can make well-informed investments to supply the U.S. population with the health care it needs. The pace of change in the health care system, coupled with the long lead time needed to train new physicians, necessitates frequent updating of both health care workforce models and their resulting projections. Thus, the AAMC has committed to commission an annual update of national physician workforce projections with a threefold aim: (1) updating and improving workforce projections, (2) presenting new analyses on the workforce needed for a growing and aging population and an evolving health care system, and (3) identifying future directions for research to inform and improve these projections.

In 2019, the AAMC fielded a National Sample Survey of Physicians (*n* = 6,000 responses). The survey collected data on physician practice patterns, including hours worked and retirement intentions. Compared with data collected from a handful of states from earlier years and used previously for supply modeling, the new data indicate that average hours worked per week for physicians across specialties, age groups, and gender have declined slightly from previous years. Furthermore, survey results indicate physicians plan to retire earlier than assumed in previous models of future supply. These new data and the resulting projections of lower future supply highlight the need to constantly update and improve workforce projections. The findings also illustrate the value of providing ranges for workforce projections to indicate the uncertainty in trends and factors that affect physician supply and demand. The observed decline in hours worked appears to be the continuation of a trend seen over the past two decades in the American Community Survey, though in recent years, the decline has slowed. Possible explanations for the finding that physicians intend to retire earlier than previously observed include a temporary phenomenon tied to strong economic conditions through the end of 2019 and a more permanent trend linked to physician burnout.

Despite the dizzying pace of debate around the organization, regulation, finance, and technology of health care delivery, the essential drivers of physician supply and demand are changing much less dramatically. We continue to project physician demand will grow faster than supply, leading to a projected total physician shortage of between 54,100 and139,000 physicians by 2033, including a Primary Care physician shortage of between 21,400 and 55,200 physicians and a shortage of physicians in non-primary care specialties of between 33,700 and 86,700 physicians (which includes 17,100 to 28,700 physicians in Surgery Specialties).

If the population health goals of modest reduction in excess body weight; improved control of blood pressure, cholesterol, and blood glucose levels; and reduced smoking prevalence were achieved, the demand for physicians would be 28,900 FTEs higher by 2033 than it would be in the absence of achieving these goals. This appears to be somewhat of a paradox — that improving population health leads to greater demand for physicians. Our modeling suggests that improved health will reduce mortality and physician demand slightly in the initial years because the population is healthier. However, the reduction in mortality will lead to a larger and older population to support, which will increase demand for physicians.

To bring rates of care for currently underserved populations up to the rates for populations facing fewer sociodemographic, economic, and geographic barriers to care, 74,100 to 145,500 more physicians would be needed. This estimate is substantially higher than our estimate in previous reports and reflects a change in approach. Previously, we assumed people in nonmetropolitan areas had care-use patterns similar to their peers in metropolitan areas. The updated estimates assumed everyone had care-use patterns similar to their peers in large suburban areas. These numbers underscore the challenges of expanding access to care when not enough physicians are being trained to offset the large number of physicians approaching retirement, coupled with the growing health care needs of an aging population.

Study findings also highlight disparities between the racial and ethnic diversity of physician supply and the people they care for. Over the next 15 years, demand for physicians is projected to increase by 142,900 FTEs under the Status Quo Scenario. Two-thirds of this growth is associated with projected growth in demand for physician services by racial/ethnic minority populations — including 44,900-FTE growth to provide care to the growing and aging Hispanic population and 23,900 each for the growing and aging non-Hispanic black population and the non-Hispanic all other populations, which includes American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, and two or more races.

This report updates exploratory work — using the Evolving Care Delivery System Scenario — analyzing how the health care delivery system is evolving and the potential implications for physician demand. While this work was not used to construct the projected shortage ranges, it incorporates several of the demand scenarios used to construct the shortage ranges: (1) greater use of managed-care principles, which shifts a portion of care from specialist physicians to Primary Care physicians and increases the overall demand for primary care services; (2) achieving select population health goals; and (3) the continued rapid growth in APRN and PA supply. We also modeled the potential physician workforce implications of addressing unmet behavioral health needs and reducing demand for hospital-based care through a combination of prevention and diversion to appropriate community-based settings. Some trends will increase demand for physicians to provide increased access and more comprehensive care, while other trends will decrease demand. The net effect is a 19,700-FTE (2%) decline in demand for physicians by 2033 relative to the Status Quo Scenario, which extrapolates future demand based on current care-delivery patterns accounting for changing demographics. This drop is primarily due to the approximate doubling of the APRN and PA workforces over the next 15 years. Additional research is needed to refine this work, but early findings suggest that the evolving care-delivery system will not substantially change the total number of physicians required but will shift care across care-delivery settings and physician specialties.

The studies summarized in each of the previous four reports used the most recent data available to the modeling team, which continued to refine model inputs, assumptions, and the scenarios. Key findings across those annual reports and this one include:

- For modeling demand, population growth and aging continue to have the greatest impact on demand growth. While the U.S. Census Bureau periodically updates population projections, this source of demand growth is relatively stable and can be projected with a high level of confidence, barring unforeseen catastrophic events.
- Efforts to improve population health might cause small short-term reductions in demand for health services, but in the long run, could increase demand for physicians as people live longer.
- There are substantial inequities in access to care beyond what can be explained by lack of medical insurance and geographic variation in supply adequacy. Efforts to improve access to care for racial and ethnic minority populations will require a large increase in physician supply in addition to the policy and economic changes required to improve equity.
- The rapid growth in the supply of APRNs and PAs will partially offset the projected growing shortage of physicians, but there is still a paucity of information on the degree to which increased APRN and PA supply offers the resources to deliver more comprehensive care to patients by complementing physician care versus by substituting for some types of care.
- A large number of physicians are nearing retirement, and retirement decisions have large short-term implications for physician supply. However, the number of physicians trained each year has large long-term implications for physician supply.

FUTURE DIRECTIONS IN HEALTH WORKFORCE RESEARCH

Our 2019 report highlighted the need for new, nationally representative data on physician work patterns to better understand the trend in physicians working fewer hours and the potential impact of high levels of burnout on retirement intentions. The AAMC 2019 NSSP helped fill this data gap. Although analysis of survey results is ongoing, it has already provided information about hours-worked patterns and retirement intentions we were able to use to update parameters for supply modeling in this report.

The projected shortage ranges reflect uncertainty about how emerging care-delivery and financing models might change health care use and delivery patterns, as well as about physician labor force participation patterns. All models struggle to quantify the future impact of fundamental changes that have not yet happened or been anticipated. The high level of uncertainty, combined with the need to incorporate new research and updated data about physician supply and demand, underscores the importance of continually monitoring the projected future adequacy of supply. Uncertainties continue to abound about whether, how, and how fast emerging payment and care-delivery models might affect physician supply and demand. Evidence to date has not demonstrated that changes in payment or care-delivery models substantially change physician workforce supply or demand.

In addition to needing more data to diminish the uncertainties about how the health care system may evolve and about the physician workforce implications of new care-delivery and financing models, more data and research in these areas could improve health workforce projections:

- **APRNs, PAs, and hospitalists — rapid growth, market saturation, and services needed:** This report explores the potential implications of continued rapid growth in APRN and PA supply, and more information is needed. To what extent can the health care system continue to absorb this new supply of health care professionals? What are the implications for demand for physicians? To what extent have APRNs and PAs reduced demand for physicians in some specialties, and to what extent are APRNs and PAs providing previously unfilled services and expanding access to care? Published research suggests that patients in primary care settings receive from their physicians only 55% of recommended chronic and preventive services, with perhaps much of the gap between services provided and services recommended due to the time constraints that physicians face when meeting with patients. To what extent will the increased supply of APRNs and PAs partially substitute for physicians in providing the 55% of recommended chronic and preventive services already being provided, and to what extent will this additional supply help deliver the 45% of recommended services not currently being provided? The hospitalist supply also continues to grow rapidly. Might market saturation be reached for hospitalists and, if so, at what point will employment growth slow to a level to keep pace with growth trends in hospital inpatient care?

  We have brought new data to bear on these issues in this report, but fully addressing the above questions to inform workforce modeling requires input from physicians, APRNs, and PAs, as well as the health systems that employ these providers. To help inform the modeling of the interprofessional effects of future workforce supply and the demand for other professions, a panel of physicians, APRNs, and PAs should be convened to compile an inventory of the data and research still needed to estimate the necessary model parameters and test the modeling assumptions currently in use. Specifically, such a panel should produce guidance on the research and data collection needed to assess (1) what proportion of APRN and PA time is for performing activities that physicians also provide and how that varies (e.g., by specialty or setting); (2) what proportion of APRN and PA time is spent in activities that complement physician efforts and expand the comprehensiveness of services provided to patients (e.g., conducting follow-up visits or providing care to patients that otherwise would not have been provided); and (3) what proportion of APRN and PA time is spent providing care to people who otherwise would not have received services (e.g., services provided in retail clinics or health clinics for patients who otherwise would not have sought physician services).

We also need data and research on the labor market for Primary-Care-Trained Hospitalists to better understand and model their evolving role in hospital-based care delivery.

- **Current shortages and inefficiencies:** The demand projections start with the assumption that physician supply and demand are in equilibrium in 2018 — except for primary care and psychiatry, where federal government estimates for Health Professional Shortage Areas are used as a conservative proxy for the current shortage of physicians. How might we better measure current shortages in other specialties? To the extent that current national shortages (or surpluses) exist for other specialties, the projections underestimate (or overestimate) demand from 2018 to 2033 by roughly the size of the current national imbalance between supply and demand. This raises questions about how best to quantify current imbalances between supply and demand across specialties.

- **Priority issues in the physician workforce:** Along with the work needed to inform physician workforce projections, research is needed on topics of critical importance to physicians, their employers, and physician workforce planners, including these: the covariates of physician burnout; improving workforce diversity; the impact of medical education debt; the determinants of physician practice location; the role and impact of telehealth on physician practice; and physicians' experiences of harassment and discrimination.

- **COVID-19 impact:** The COVID-19 pandemic is likely to have short- and long-term consequences on the nation's physician workforce, including educational pipeline issues (e.g., interruption of education, cancellation of clinical rotations, changes in curriculum); regulatory issues (e.g., changes in licensure and reimbursement); how medicine is practiced (e.g., uptake of telehealth, small private practices being hit hard economically); workforce exits (e.g., due to death from COVID-19, early burnout-induced retirement or postponed retirement due to the economy); specialty mix (e.g., interest in some specialties, like infectious disease, may increase while interest in others, like emergency medicine, may decrease); and demand shifts (e.g., scope-of-practice changes for other professions, changes in demand due to delayed care, sudden need for critical care for COVID-19 cases, longer-term demand decreases due to COVID-19 deaths).

APPENDIX 1: DATA AND METHODS

This appendix provides a brief overview of the workforce microsimulation models used, the data and assumptions, and information on select model inputs. Detailed technical documentation of the supply and demand models is available elsewhere.[29,82]

Synopsis of Study Methods

Consistent with the previous physician workforce reports, this 2020 update used a microsimulation approach to project the future supply of and demand for health care services and physicians. The workforce models have been used to model supply and demand for physicians and other health occupations for federal and state governments, trade and professional associations, and health systems.[142]

The supply model simulates career decisions of physicians given the number, specialty mix, and demographics of the current workforce and new physicians trained each year, as well as weekly-hours-worked patterns and projected retirement rates that differ by specialty category and physician age and sex. As described in the report, modeled scenarios to develop the projections range include (1) the Status Quo Scenario, which assumes no changes in the training pipeline absent additional investment in graduate medical education and continuation of current hours worked and retirement patterns as indicated by physicians participating in the AAMC 2019 National Sample Survey of Physicians (NSSP); (2) the Retire 2 Years Earlier or Retire 2 Years Later Scenarios, for changing physician-retirement patterns relative to current patterns of retirement intention; and (3) a Changing Hours Worked Scenario, in which the downward trend in hours worked observed over the past decade continues over time, where today's physicians work slightly fewer hours per week compared with older cohorts — though the decline in hours worked appears to have slowed in recent years. A modest expansion of GME programs is modeled as a policy scenario but not included in the projections ranges.

The demand projections start with the Status Quo Scenario, by extrapolating current levels of care into the future as the population grows and ages and modeling projected changes in disease prevalence and other health risk factors among the population if health care use and delivery patterns remained unchanged. Additional scenarios modeled were the (1) Managed Care Scenario, for the implications for physicians if the entire insured population were shifted into managed-care plans that more closely resemble health maintenance organizations; (2) Retail Clinics Scenario, for the implications of shifting noncomplex care for people without chronic conditions from Primary Care physician offices to retail clinics where care is predominantly provided by advanced practice registered nurses (APRNs); (3) APRN/PA High Use and APRN/PA Moderate Use Scenarios, for continued rapid growth in supply of APRNs and physician assistants (PAs), with varying assumptions of the degree to which additional providers offset demand for physicians; and (4) Population Heath Scenario, for the implications of improving population health with modest improvements in body weight, smoking cessation, and control of blood pressure, cholesterol, and blood glucose levels.

To convey uncertainty associated with factors and trends that have implications for physician supply and demand, we modeled four supply scenarios and six demand scenarios used to develop the physician adequacy ranges. Comparing each supply scenario with each demand scenario produces 24 paired projections of future supply adequacy for each of the five physician specialty groupings. The extreme high and low pairings of supply and demand scenarios are least likely to occur because multiple factors tend to mitigate highs and lows. Given the propensity of such systems-level "checks and balances" to avoid extremes, we used the 25th to 75th percentile of the paired projections to reflect a likely range. Ranking the 24 supply-demand combinations from largest surplus to largest shortage, the midpoint of the sixth and seventh supply-demand combinations forms the lower bound (25th percentile) of any projected shortage, while the midpoint of the 18th and 19th supply-demand combinations forms the upper bound (75th percentile) of the projected shortage.

Supply Model Overview and Updates

Current Physician Workforce: Supply modeling started with using the 2018 AMA Physician Masterfile to identify the size and characteristics of the current workforce. In 2018, there were about 807,400 physicians under age 75 in active practice who had completed their GME.[i] The approximately 228,100 active Primary Care physicians were 28% of the workforce, and another 32,200 (4% of the workforce) were Primary-Care-Trained Physicians Practicing as Hospitalists. About 137,300 (17%) physicians are in Medical Specialties, 155,200 (19%) in Surgical Specialties, and 254,600 (32%) in the Other Specialties. Women constituted about a third of the workforce. Physicians within the traditional retirement age of between 65 and 75 were 16% of the active workforce, and those between age 55 and 64 made up 27% of the active workforce. Therefore, it is possible that more than a third of currently active physicians might retire within the next decade.

New Entrants: Estimates of the number of physicians completing GME came from published information on programs accredited by the Accreditation Council for Graduate Medical Education (ACGME) and the American Osteopathic Association (AOA), accounting for a small number of programs that are still dually accredited.[143,144] The age and sex distribution of new physicians was derived from analysis of the 2018 AMA Physician Masterfile. We estimate about 28,980 physicians completed GME between 2018 and 2019 (similar to the 28,854 estimate in last year's report). In total, about 8,366 physicians (29% of new graduates) entered the workforce as Primary Care providers; 1,221 (4%) entered as new Primary Care-Trained Hospitalists; 5,655 (20%) entered in internal medicine and pediatric subspecialties; 5,012 (17%) entered in Surgical Specialties; and 8,726 (30%) entered in Other Specialties. Compared with the 2019 report, our estimates of annual new entrants to the workforce are higher for Primary Care by 946 physicians, higher for Medical Specialties by 205 physicians, lower for Surgery by 177 physicians, lower for Other Specialties by 238 physicians, and lower for Primary-Care-Trained Hospitalists by 610 physicians. Changes from last year reflect, in part, fewer Primary Care-Trained Hospitalists and additional analysis of first and second specialty for physicians in the AMA Masterfile that shows the changes in physician specialization after completing initial residency (e.g., numbers of physicians in Primary Care and Medical Specialties moving into other areas such as sleep medicine and specialization outside their initial training).

Hours-Worked Patterns: Supply projections consider differences in average hours per week spent in patient care by physician age, sex, and specialty group. This component of the model is based on ordinary least squares regression analysis of the 2019 NSSP (n = 6,000). The dependent variable was weekly patient-care hours worked, and explanatory variables were physician age group (<35, 35-44, 45-54, 55-59, 60-69, 70-74, and 75+ years), sex, age-by-sex-interaction term, and region of the country. Separate regressions were estimated by specialty category (Primary Care, Medical Specialties, Surgical Specialties, and Other Specialties). These newer, national data found that physicians worked fewer hours, on average, than were found using the older, state-level data used in previous reports. However, differences in weekly hours worked by physician age and sex showed similar patterns to the older data. Younger male and female physicians start off working about the same number of hours each week, but by age 35 and beyond, female physicians work about 4-6 fewer hours per week than their male peers in the same specialty category. Surgeons tend to work slightly more hours per week, followed by the Medical Specialties, Primary Care, and Other Specialties. Physicians in the oldest age group modeled (age 75+) work about 11-18 fewer hours per week than their peers under age 35 in the same specialty category, with the drop in hours largest for Surgeons and smallest for Primary Care physicians.

Retirement Patterns: Retirement patterns by physician age, sex, and specialty group were estimated from the 2019 NSSP. For the previous reports, retirement patterns for each specialty came from analysis of Florida's mandated biannual physician licensure survey (2012-2013 data), which asks about intention to retire in the upcoming five years. The updated retirement patterns show physicians are retiring earlier than suggested by the Florida data — possibly reflecting increasing levels of physician burnout[4-6,30,145-147] and of financial security after the years of economic recovery that followed the 2007-2009 recession.

Demand Model Overview and Updates

Demand for physicians is calculated based on projected demand for health care services and staffing patterns for care delivery. Demand for health care services is defined as the level of care likely to be sought by consumers given their needs, care-use patterns, and economic considerations such as level of health insurance coverage and cost of care. Demand differs from "need," which is based on clinical and epidemiological considerations.

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 utilized (and current physician supply). Demand projections are thus extrapolating a "2018 level of care" with any imbalances between supply and demand, whether shortages or excesses, extrapolated into the future. An exception pertains to federal government estimate that the nation requires about 14,900 primary care physicians and 6,894 psychiatrists to de-designate the federally designated primary care and Mental Health Professional Shortage Areas (HPSAs).[j] For modeling purposes, we assume these nearly 21,800 physicians reflect a national shortage in 2018, the starting year for the projections. To the extent that other shortages already exist in specialties other than primary care and psychiatry, our starting-point assumption may be conservative.

The microsimulation approach simulates demand for health care services for a nationally representative sample of the 2018 U.S. population projected to 2033. Whereas previously the modeling was done at the state level, the updated demand model now forecasts physician demand at the county level. Modeling at the county level allows for comparison of supply and demand at the sub-state level and by urban-rural designation of the counties where people reside. This report presents supply and demand estimates for each of the six National Center for Health Statistics (NCHS) urban-rural county classification codes rather than simply by metropolitan versus nonmetropolitan location. This change affected how the Health Care Utilization Equity Scenarios were modeled, with populations taking on care-use patterns of large suburban populations rather than the metropolitan average.

The population files for each county were constructed to create a representative sample of the population in each county by statistically combining de-identified data for individuals participating in the American Community Survey, Behavioral Risk Factor Surveillance System, and Medicare Beneficiary Survey. Additional information came from population distributions and disease prevalence rates calculated from the CMS Minimum Dataset for Nursing Home Residents. The resulting constructed database for each county contains a health profile for a representative sample of the population that includes demographics (age, sex, race/ethnicity), health risk factors (obesity, smoking), insurance type, household income, and presence of history of various chronic diseases. County-level population projections, by demographic, were then used to reweight the population file to reflect population growth, aging, and greater racial and ethnic diversity in future years.

Prediction equations in the demand model come from regression analysis of the Medical Expenditure Panel Survey and the National Inpatient Sample (NIS). They were used to quantify the relationship between patient characteristics available in these data sets and in the constructed population database and patient annual use of health care services. Negative binomial regression was used to quantify the relationship between patient characteristics and annual office and outpatient visits to a physician by specialty type. The use of negative binomial regression reflects that many patients had no annual visits to a particular physician specialty, and other patients had one or more visits during the year, which produces a skewed distribution for annual visits. Logistic regression was used to model the relationship between patient characteristics and hospital admission and emergency department visits for about two dozen diagnosis categories. Poisson regression with NIS data was used to model hospital length of stay, by admission diagnosis category, as a function of patient characteristics available in NIS (demographics, insurance type, presence of diabetes). Separate regressions were estimated for adults and children. The estimated coefficients from these regressions were applied to the constructed

population files to forecast future demand for health care services by physician specialty, care-delivery setting, and geographic location.

Current staffing patterns, measured as FTE physicians per unit of health care used (e.g., office or outpatient visits, emergency visits, home health visits, inpatient days, residents) based on national averages, were then applied to the projected demand for health care services by care-delivery setting and physician specialty.

Exhibit 31 summarizes, by demand model component, the data sources incorporated into this 2020 workforce projections update.

Exhibit 31: Summary of Demand Modeling Data Sources

Model Component	Data Sources
National and state population files	2018 American Community Survey https://www.census.gov/programs-surveys/acs 2017 and 2018 Behavioral Risk Factor Surveillance System https://www.cdc.gov/brfss/ 2016 CMS Minimum Dataset for Nursing Home Residents https://www.cdc.gov/nchs/nnhs/ 2016 Medicare Beneficiary Survey, Residential Care
Weights for population projections	2017 U.S. Census Bureau national population projections; state-county population projections to estimate demand by region and urban-rural location https://www.census.gov/ https://www.census.gov/programs-surveys/acs
Health care use equations	2013-2017 Medical Expenditure Panel Survey (Pooled) https://www.meps.ahrq.gov/mepsweb/
Hospital inpatient day equations	2016 National Inpatient Sample https://hcup-us.ahrq.gov/db/nation/nis/NIS_Introduction_2016.jsp
Health care use calibration and validation	2016 National Inpatient Sample https://hcup-us.ahrq.gov/db/nation/nis/NIS_Introduction_2016.jsp 2014 and 2015 National Hospital Ambulatory Medical Care Survey https://www.cdc.gov/nchs/ahcd/about_ahcd.htm#NHAMCS 2016 National Ambulatory Medical Care Survey https://www.cdc.gov/nchs/ahcd/about_ahcd.htm#NAMCS
Physician staffing ratios	2018 AMA Masterfile https://www.ama-assn.org/practice-management/masterfile/ama-physician-masterfile
Urban-rural classification	2013 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme for Counties https://www.cdc.gov/nchs/nnhs/index.htm
Population health (population-level prevalence)	2017-2018 National Health and Nutrition Examination Survey https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?BeginYear=2017

APPENDIX 2: ADDITIONAL TABLES AND CHARTS

Exhibit 32: Projected Physician Demand by Patient Race and Ethnicity, 2018-2033

Specialty Group and Year	Non-Hispanic			Hispanic	Total
	White	Black	Other		
2018					
Total	568,900	94,300	60,800	105,200	829,200
Primary Care	159,600	25,400	22,200	35,800	243,000
Non-Primary Care	409,300	68,900	38,600	69,400	586,200
Medical Specialties	92,100	18,500	9,000	17,700	137,300
Surgical Specialties	110,100	15,400	10,700	19,000	155,200
Other	185,800	30,400	16,700	28,600	261,500
Hospitalist*	21,300	4,600	2,200	4,100	32,200
2033					
Total	619,100	118,200	84,700	150,100	972,100
Primary Care	176,400	32,400	31,200	49,600	289,600
Non-Primary Care	442,700	85,800	53,500	100,500	682,500
Medical Specialties	106,900	24,400	13,200	27,200	171,700
Surgical Specialties	115,900	18,400	14,400	27,000	175,700
Other	195,500	37,000	22,700	40,100	295,300
Hospitalist*	24,400	6,000	3,200	6,200	39,800
Growth 2018 to 2033					
Total	50,200	23,900	23,900	44,900	142,900
Primary Care	16,800	7,000	9,000	13,800	46,600
Non-Primary Care	33,400	16,900	14,900	31,100	96,300
Medical Specialties	14,800	5,900	4,200	9,500	34,400
Surgical Specialties	5,800	3,000	3,700	8,000	20,500
Other	9,700	6,600	6,000	11,500	33,800
Hospitalist*	3,100	1,400	1,000	2,100	7,600

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Exhibit 33: Projected Physician Demand by Census Region, 2018-2033

Specialty Group and Year	Region 1: Northeast	Region 2: Midwest	Region 3: South	Region 4: West	Total
2018					
Total	150,600	179,800	313,500	185,300	829,200
Primary Care	43,900	51,200	91,400	56,500	243,000
Non-Primary Care	106,700	128,600	222,100	128,800	586,200
Medical Specialties	25,000	28,600	54,000	29,700	137,300
Surgical Specialties	28,100	35,500	57,600	34,000	155,200
Other	47,900	57,500	97,700	58,400	261,500
Hospitalist*	5,700	7,000	12,800	6,700	32,200
2033					
Total	164,800	189,000	378,100	240,200	972,100
Primary Care	48,800	54,700	112,100	74,000	289,600
Non-Primary Care	116,000	134,300	266,000	166,200	682,500
Medical Specialties	29,000	32,000	69,100	41,600	171,700
Surgical Specialties	29,700	36,000	67,200	42,800	175,700
Other	50,700	58,600	113,600	72,400	295,300
Hospitalist*	6,600	7,700	16,100	9,400	39,800
Growth 2018 to 2033					
Total	14,200	9,200	64,700	54,900	142,900
Primary Care	4,900	3,500	20,700	17,500	46,600
Non-Primary Care	9,300	5,700	43,900	37,400	96,300
Medical Specialties	4,000	3,400	15,100	11,900	34,400
Surgical Specialties	1,600	500	9,600	8,800	20,500
Other	2,800	1,100	15,900	14,000	33,800
Hospitalist*	900	700	3,300	2,700	7,600

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Note: Category totals might not sum to totals because of rounding.

Exhibit 34: Projected Physician Demand by Urban-Rural Location, 2018-2033

Specialty Group and Year	Metropolitan				Nonmetropolitan		
	Large Central	Large Fringe	Medium	Small	Micropolitan	Noncore	Total
2018							
Total	235,300	220,900	175,000	78,000	77,400	42,600	829,200
Primary Care	71,600	64,800	53,500	21,700	19,400	12,000	243,000
Non-Primary Care	163,700	156,100	121,500	56,300	58,000	30,600	586,200
Medical Specialties	38,800	37,700	29,300	13,100	10,300	8,100	137,300
Surgical Specialties	39,800	40,500	31,300	14,200	20,400	9,000	155,200
Other Specialties	76,400	69,700	53,700	25,900	24,400	11,400	261,500
Hospitalist*	8,700	8,200	7,200	3,100	2,900	2,100	32,200
2033							
Total	292,200	266,800	203,800	86,900	79,500	42,900	972,100
Primary Care	89,700	79,400	63,300	24,700	20,400	12,100	289,600
Non-Primary Care	202,500	187,400	140,500	62,200	59,100	30,800	682,500
Medical Specialties	51,500	48,400	36,100	15,500	11,300	8,900	171,700
Surgical Specialties	48,100	47,700	35,600	15,400	20,200	8,700	175,700
Other Specialties	91,500	80,700	59,900	27,700	24,500	11,000	295,300
Hospitalist*	11,400	10,600	8,900	3,600	3,100	2,200	39,800
Growth 2018 to 2033							
Total	56,900	45,900	28,800	8,900	2,100	300	142,900
Primary Care	18,100	14,600	9,800	3,000	1,000	100	46,600
Non-Primary Care	38,800	31,300	19,000	5,900	1,100	200	96,300
Medical Specialties	12,700	10,700	6,800	2,400	1,000	800	34,400
Surgical Specialties	8,300	7,200	4,300	1,200	-200	-300	20,500
Other Specialties	15,100	11,000	6,200	1,800	100	-400	33,800
Hospitalist*	2,700	2,400	1,700	500	200	100	7,600

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Note: Demand location is defined by population residency location using the 2013 NCHS Urban-Rural Classification Scheme for Counties (cdc.gov/nchs/data_access/urban_rural.htm#2013_Urban-Rural_Classification_Scheme_for_Counties). Category totals might not sum to totals because of rounding.

Exhibit 35: Summary of Projected Gap Between Physician Supply and Demand, 2018-2033

Specialty Group	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Total Physicians																
75th Percentile	21,800	35,800	47,300	57,600	68,700	78,600	87,200	97,700	106,100	116,000	121,500	126,400	130,900	134,300	135,900	139,000
25th Percentile	21,800	32,300	37,300	42,700	48,400	52,800	55,600	58,200	59,700	63,800	63,200	62,200	60,800	59,000	56,800	54,100
Primary Care																
75th Percentile	14,900	18,800	21,800	25,000	28,400	31,500	34,700	37,800	40,400	43,000	45,500	47,800	50,100	52,000	53,700	55,200
25th Percentile	14,900	17,600	17,500	18,700	19,800	20,800	22,000	22,800	23,000	23,600	23,600	23,600	23,200	22,700	22,200	21,400
Non-Primary Care																
75th Percentile	6,900	16,600	24,800	32,200	39,600	48,100	53,800	59,400	64,300	69,100	73,100	77,600	80,100	82,300	85,100	86,700
25th Percentile	6,900	14,500	19,700	24,800	29,300	32,900	35,200	37,300	38,900	41,500	40,600	40,100	39,100	37,400	35,600	33,700
Medical Specialties																
75th Percentile	-	2,600	4,500	6,200	8,100	9,700	11,000	13,000	14,400	15,400	16,100	16,800	17,000	17,200	17,500	17,800
25th Percentile	-	2,200	2,500	4,100	5,300	6,400	7,100	7,900	8,500	9,000	9,500	9,700	9,800	9,700	9,400	9,300
Surgical Specialties																
75th Percentile	-	3,200	5,600	8,200	10,700	13,300	15,200	17,200	19,100	20,800	22,400	23,900	25,300	26,400	27,500	28,700
25th Percentile	-	2,700	4,300	6,200	8,700	10,000	10,900	11,700	12,800	13,800	14,500	15,000	15,600	15,800	16,500	17,100
Other Specialties																
75th Percentile	6,900	11,700	15,600	19,400	23,100	26,400	29,300	31,900	34,300	36,700	38,300	40,200	41,500	42,500	42,900	41,900
25th Percentile	6,900	10,500	13,100	15,600	17,700	19,500	20,500	21,200	22,200	23,200	23,200	22,100	21,100	20,300	18,800	17,100
Hospitalist*																
75th Percentile	-	-300	-600	-1,100	-1,400	-1,900	-2,300	-2,700	-3,000	-3,400	-3,700	-4,000	-4,200	-4,500	-4,500	-4,600
25th Percentile	-	-400	-1,300	-1,900	-2,500	-3,100	-3,800	-4,400	-4,900	-5,400	-5,900	-6,400	-6,900	-7,300	-7,600	-8,000

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Note: The shortage range for total physicians can differ from 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 can differ from the sum of the ranges for the specialty categories. The negative numbers are projected excess supply, and the positive numbers are projected shortages.

Exhibit 36: Projected Physician Supply, 2018-2033

	Workforce Participation Scenarios				Policy Scenario
Year	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Changing Hours Worked	GME Expansion
2018	807,400	807,400	807,400	807,400	807,400
2019	806,400	805,530	807,060	808,400	806,400
2020	805,700	802,760	808,140	805,700	805,700
2021	805,300	799,360	810,610	803,800	805,300
2022	805,200	795,680	814,000	802,400	805,200
2023	806,100	792,050	818,800	802,000	806,100
2024	808,300	789,460	825,160	803,000	808,300
2025	810,600	787,290	832,020	804,200	813,500
2026	813,600	787,350	837,900	806,200	819,700
2027	816,900	787,940	844,020	808,100	825,900
2028	820,800	789,350	850,720	810,400	832,900
2029	824,900	790,970	857,480	812,500	840,100
2030	830,200	793,815	865,065	815,600	848,300
2031	836,400	797,300	873,300	819,400	857,400
2032	841,900	802,000	878,900	822,300	865,900
2033	847,500	807,200	885,000	825,200	874,400
% Growth, 2018-2033	5%	0%	10%	2%	8%

Exhibit 37: Physician Supply Projection Summary by Specialty Category, 2018-2033

Specialty Group and Year	Workforce Participation Scenarios				Policy Scenario
	Status Quo	Retire 2 Years Earlier	Retire 2 Years Later	Changing Hours Worked	GME Expansion
2018					
Total	807,400				
Primary Care	228,100				
Non-Primary Care	579,300				
Medical Specialties	137,300				
Surgical Specialties	155,200				
Other Specialties	254,600				
Hospitalists*	32,200				
2033					
Total	847,500	807,200	885,000	825,200	874,400
Primary Care	238,400	226,100	249,900	234,000	245,900
Non-Primary Care	609,100	581,100	635,100	591,200	628,500
Medical Specialties	155,500	149,000	161,400	151,300	160,800
Surgical Specialties	151,000	142,900	158,500	147,000	155,600
Other Specialties	259,000	247,300	270,400	250,700	267,400
Hospitalists*	43,600	41,900	44,800	42,200	44,700
Growth 2018 to 2033					
Total	40,100	-200	77,600	17,800	67,000
Primary Care	10,300	-2,000	21,800	5,900	17,800
Non-Primary Care	29,800	1,800	55,800	11,900	49,200
Medical Specialties	18,200	11,700	24,100	14,000	23,500
Surgical Specialties	-4,200	-12,300	3,300	-8,200	400
Other Specialties	4,400	-7,300	15,800	-3,900	12,800
Hospitalists*	11,400	9,700	12,600	10,000	12,500

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Note: Category totals might not sum to totals because of rounding.

Exhibit 38: Projected Physician Demand by Scenarios Modeled, 2018-2033

Specialty Group and Scenario	2018	2033	Growth 2018 to 2033	% Growth 2018 to 2033
Scenario 1: Status Quo				
Total	**829,200**	972,100	142,900	17%
Primary Care	243,000	289,600	46,600	19%
Non-Primary Care	586,200	682,500	96,300	16%
Medical Specialties	137,300	171,700	34,400	25%
Surgical Specialties	155,200	175,700	20,500	13%
Other Specialties	261,500	295,300	33,800	13%
Hospitalists*	32,200	39,800	7,600	24%
Scenario 2: Status Quo + Managed Care				
Total		**987,000**	**157,800**	**19%**
Primary Care		309,400	66,400	27%
Non-Primary Care		677,600	91,400	16%
Medical Specialties		167,600	30,300	22%
Surgical Specialties		175,700	20,500	13%
Other Specialties		297,200	35,700	14%
Hospitalists*		37,100	4,900	15%
Scenario 3: Status Quo + Increased Use of Retail Clinics				
Total		963,600	134,400	16%
Primary Care		281,100	38,100	16%
Non-Primary Care		682,500	96,300	16%
Medical Specialties		171,700	34,400	25%
Surgical Specialties		175,700	20,500	13%
Other Specialties		295,300	33,800	13%
Hospitalists*		39,800	7,600	24%
Scenario 4: Status Quo + Increased Use of APRNs and PAs ("Moderate Offset" Level)				
Total		903,200	74,000	9%
Primary Care		260,600	17,600	7%
Non-Primary Care		642,600	56,400	10%
Medical Specialties		165,300	28,000	20%
Surgical Specialties		167,900	12,700	8%
Other Specialties		273,800	12,300	5%
Hospitalists*		35,600	3,400	11%
Scenario 5: Status Quo + Increased Use of APRNs and PAs ("High Offset" Level)				
Total		833,900	4,700	1%
Primary Care		231,700	-11,300	-5%
Non-Primary Care		602,200	16,000	3%
Medical Specialties		158,800	21,500	16%
Surgical Specialties		160,000	4,800	3%
Other Specialties		252,000	-9,500	-4%
Hospitalists*		31,400	-800	-2%
Scenario 6: Status Quo + Increased Use of APRNs ("Moderate Offset" Level) + Population Health Goals Achieved				
Total		**937,500**	**108,300**	**13%**
Primary Care		268,700	25,700	11%
Non-Primary Care		668,800	82,600	14%
Medical Specialties		168,800	31,500	23%
Surgical Specialties		174,900	19,700	13%
Other Specialties		288,300	26,800	10%
Hospitalists*		36,800	4,600	14%

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty. APRNs = advanced practice nurses; PAs = physician assistants.

Exhibit 39: Additional Physicians Required to Achieve Health Care Utilization Equity in 2018 by Specialty Category

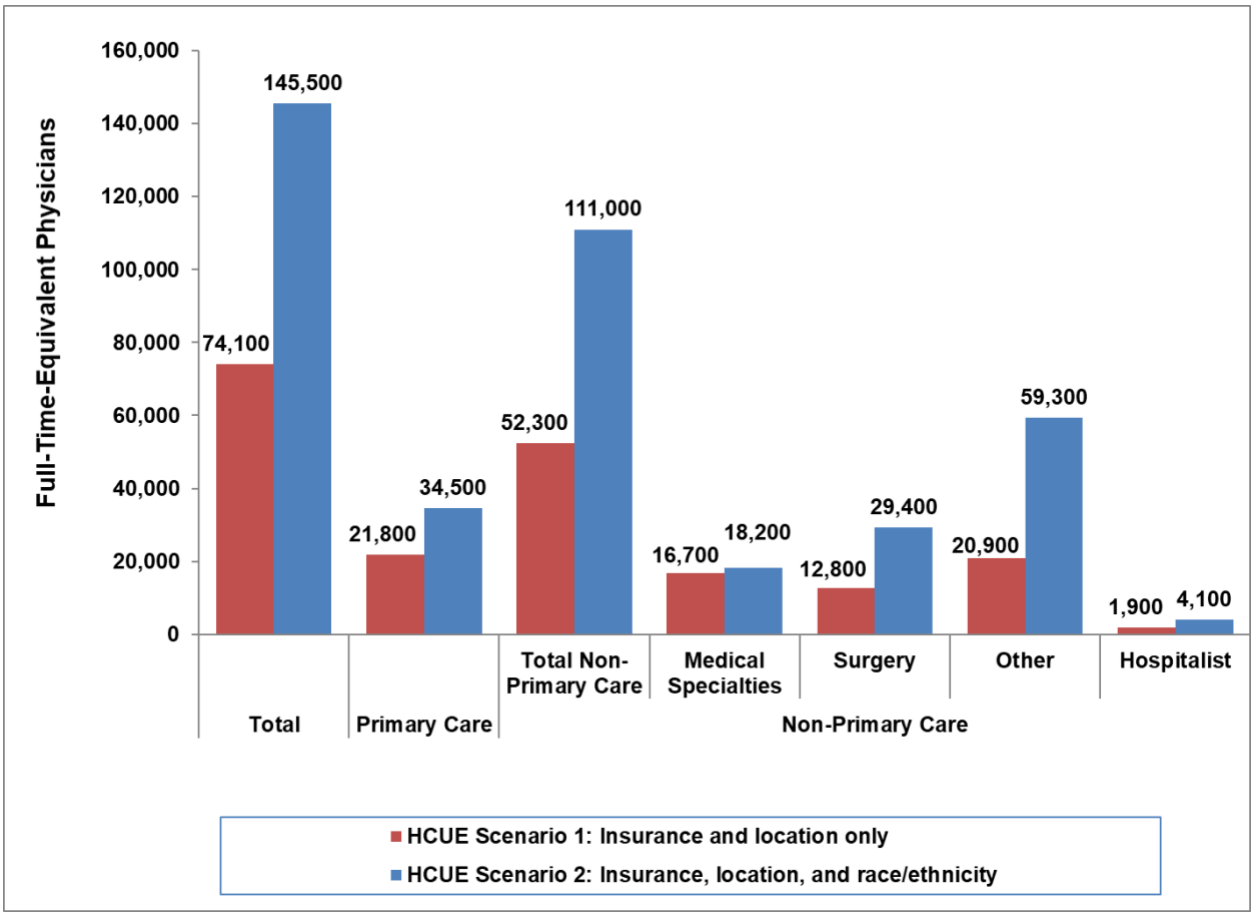


Exhibit 40: Additional Physicians Required to Achieve Health Care Utilization Equity in 2018 by Patient Race/Ethnicity

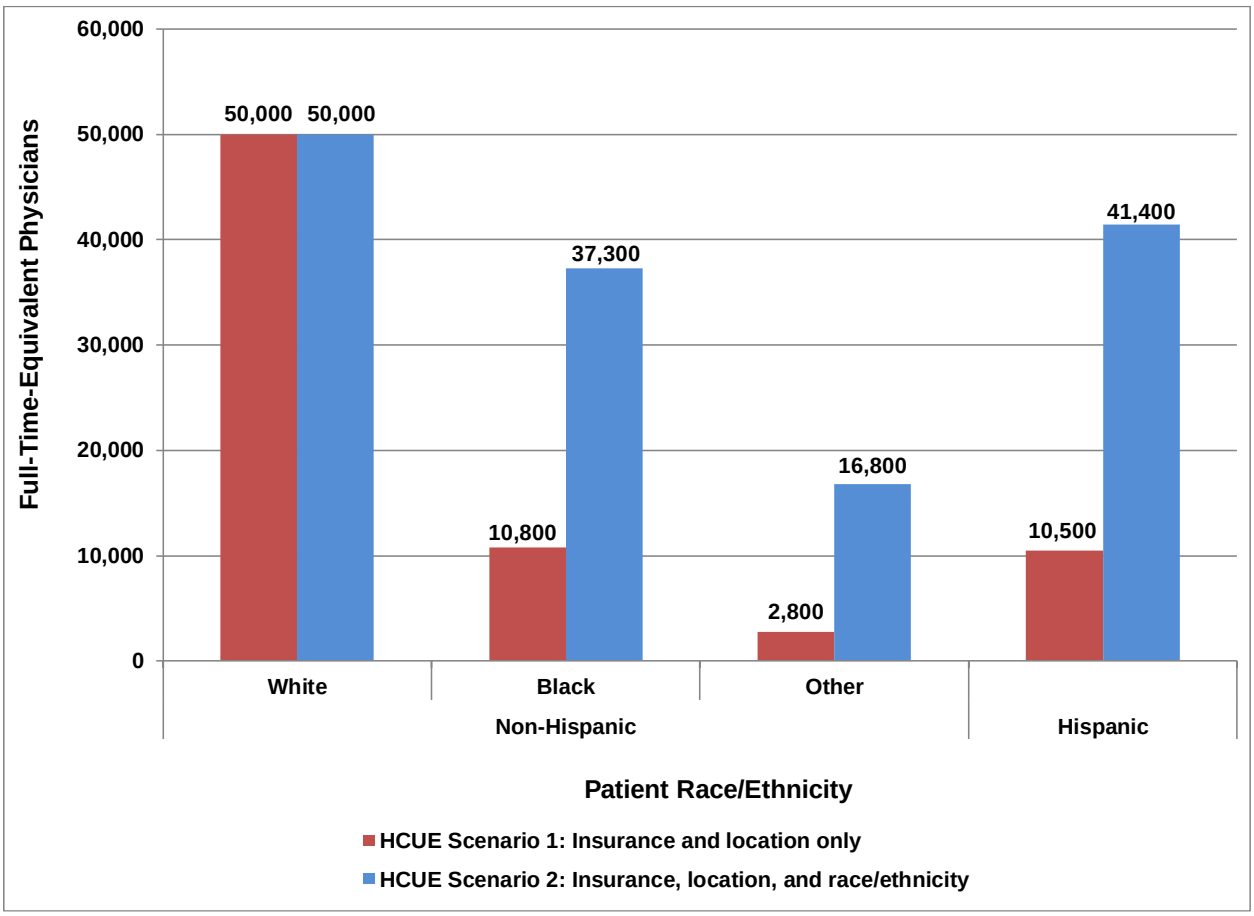


Exhibit 41: Additional Physicians Required to Achieve Health Care Utilization Equity in 2018 by Region

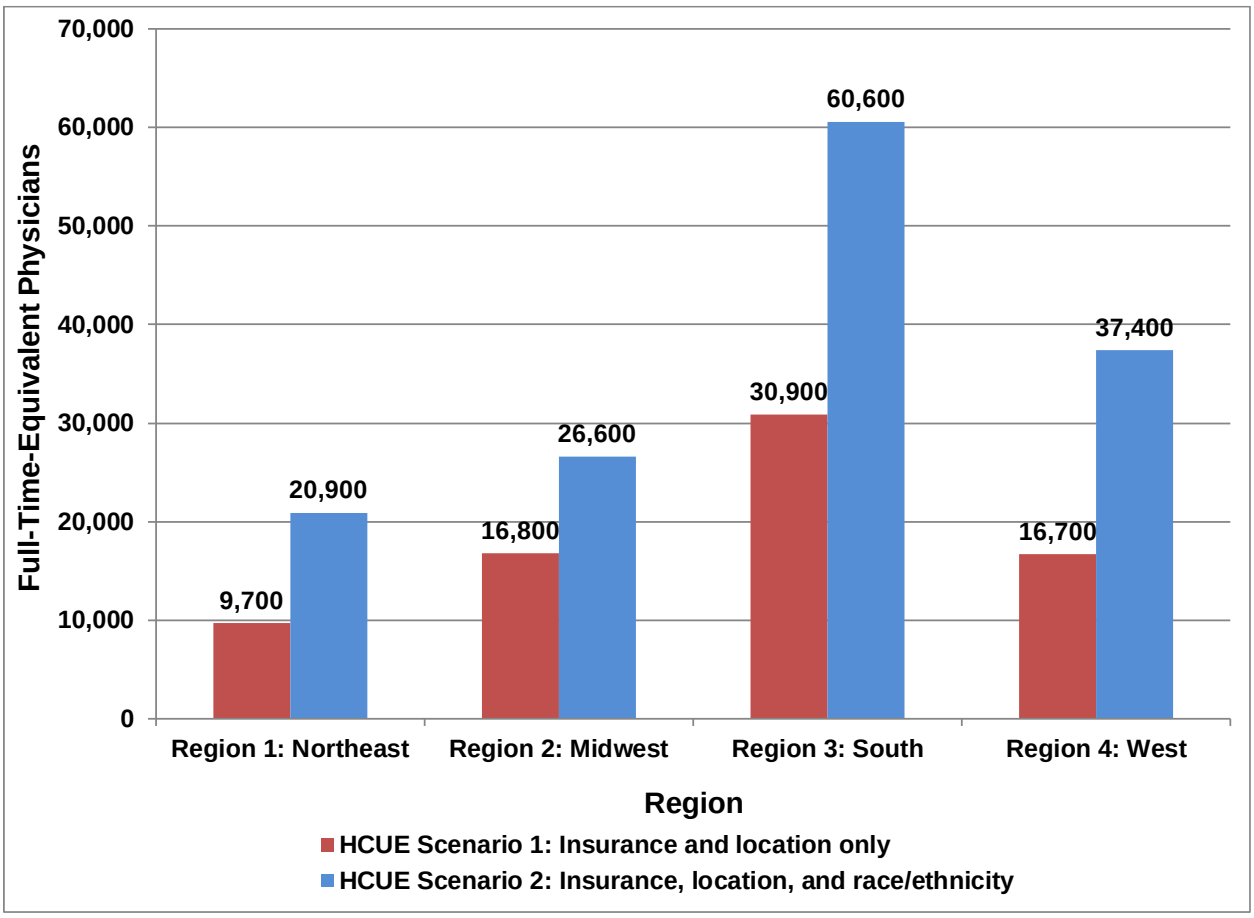


Exhibit 42: Physician Demand by Health Care Utilization Equity Scenario and Region in 2018

Specialty Group and Demand	Region 1: Northeast	Region 2: Midwest	Region 3: South	Region 4: West	U.S. Total
Baseline Demand					
Total	150,600	179,800	313,400	185,400	829,200
Primary Care	43,900	51,200	91,400	56,500	243,000
Non-Primary Care	106,700	128,600	222,000	128,900	586,200
Medical Specialties	25,000	28,600	54,000	29,700	137,300
Surgery	28,100	35,500	57,600	34,000	155,200
Other	47,900	57,500	97,700	58,400	261,500
Hospitalist*	5,700	7,000	12,700	6,800	32,200
Additional Demand From HCUE1 Scenario					
Total	9,700	16,800	30,900	16,700	74,100
Primary Care	2,500	5,300	9,600	4,400	21,800
Non-Primary Care	7,200	11,500	21,300	12,300	52,300
Medical Specialties	2,300	3,700	6,800	3,900	16,700
Surgery	1,900	2,300	5,000	3,600	12,800
Other	2,700	5,100	8,800	4,300	20,900
Hospitalist*	300	400	700	500	1,900
Additional Demand From HCUE2 Scenario					
Total	20,900	26,600	60,600	37,400	145,500
Primary Care	4,400	7,200	16,000	6,900	34,500
Non-Primary Care	16,500	19,400	44,600	30,500	111,000
Medical Specialties	2,500	3,900	6,900	4,900	18,200
Surgery	4,600	4,500	12,100	8,200	29,400
Other	8,800	10,300	24,000	16,200	59,300
Hospitalist*	600	700	1,600	1,200	4,100

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Note: Category totals might not sum to totals because of rounding.

Exhibit 43: Additional Physicians Required to Achieve Health Care Utilization Equity in 2018 by Urban/Rural Area

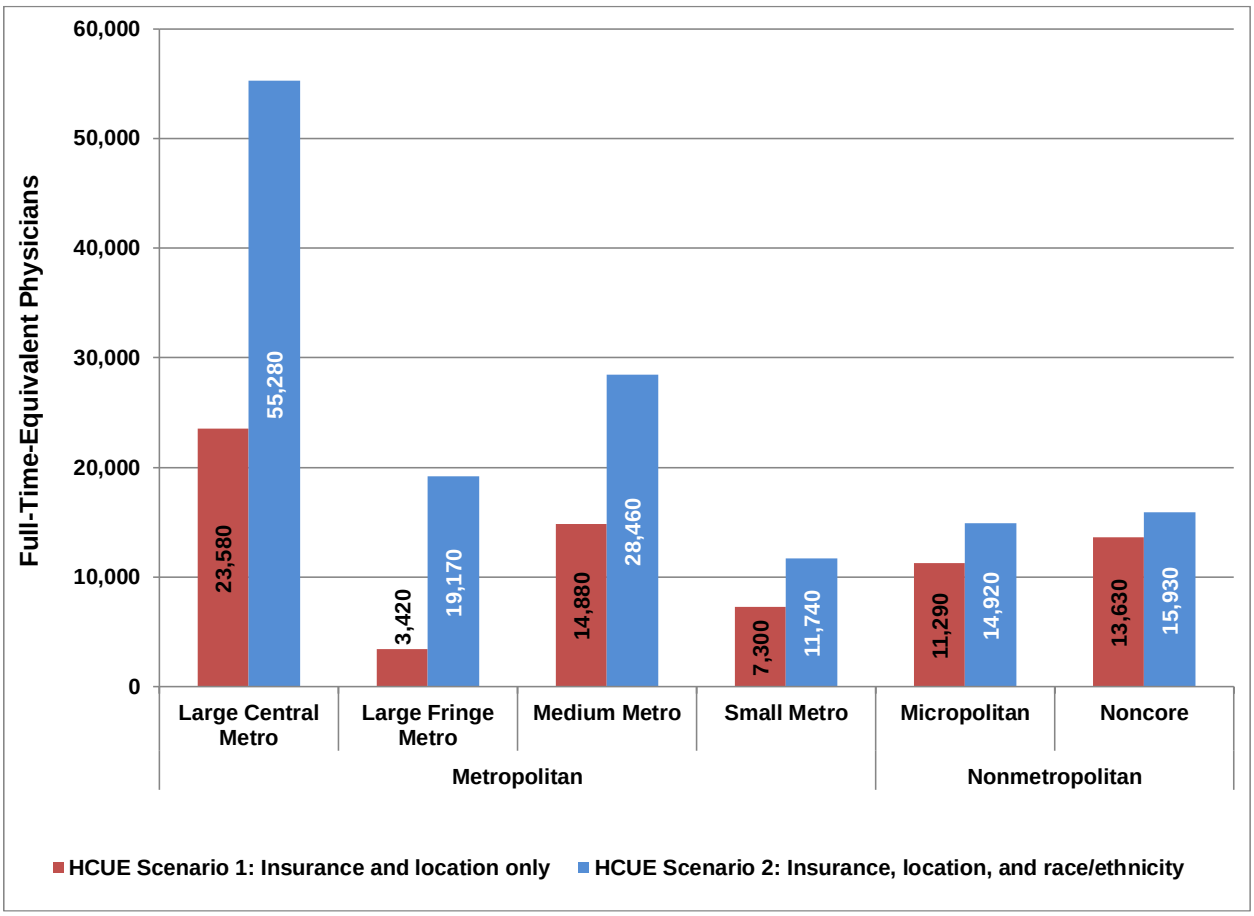


Exhibit 44: Physician Demand by Health Care Utilization Equity Scenario and Urban/Rural Area in 2018

Specialty Group and Demand	Metropolitan				Nonmetropolitan	
	Large Central Metro	Large Fringe Metro	Medium Metro	Small Metro	Micropolitan	Noncore
Baseline Demand						
Total	235,450	220,880	175,020	77,920	77,340	42,590
Primary Care	71,600	64,810	53,520	21,720	19,360	11,990
Non-Primary Care	163,850	156,070	121,500	56,200	57,980	30,600
Medical Specialties	38,850	37,650	29,340	13,060	10,300	8,100
Surgery	39,780	40,490	31,280	14,200	20,440	9,010
Other	76,450	69,720	53,670	25,870	24,380	11,410
Hospitalist*	8,770	8,210	7,210	3,070	2,860	2,080
Additional Demand from HCUE1 Scenario						
Total	23,580	3,420	14,880	7,300	11,290	13,630
Primary Care	4,500	1,400	3,170	3,490	4,260	4,980
Non-Primary Care	19,080	2,020	11,710	3,810	7,030	8,650
Medical Specialties	5,350	500	4,000	1,870	3,120	1,860
Surgery	7,070	880	3,030	1,070	700	50
Other	5,650	560	4,560	640	2,960	6,530
Hospitalist*	1,010	80	120	230	250	210
Additional Demand from HCUE2 Scenario						
Total	55,280	19,170	28,460	11,740	14,920	15,930
Primary Care	10,010	4,200	5,640	4,340	4,900	5,410
Non-Primary Care	45,270	14,970	22,820	7,400	10,020	10,520
Medical Specialties	6,010	860	4,260	1,940	3,220	1,910
Surgery	14,510	4,640	6,150	2,090	1,460	550
Other	22,760	8,930	11,880	3,000	4,970	7,760
Hospitalist*	1,990	540	530	370	370	300

*Includes only hospitalists trained in primary care; hospitalists in non-primary care specialties are included with their individual specialty.

Note: Category totals might not sum to totals because of rounding.

NOTES

a. **Primary Care** consists of family medicine, general internal medicine, general pediatrics, and geriatric medicine. **Medical Specialties** consist of allergy and immunology, cardiology, critical care, dermatology, endocrinology, gastroenterology, hematology and oncology, infectious diseases, neonatal and perinatal medicine, nephrology, pulmonology, and rheumatology. **Surgical Specialties** consist of general surgery, colorectal surgery, neurological surgery, obstetrics and gynecology, ophthalmology, orthopedic surgery, otolaryngology, plastic surgery, thoracic surgery, urology, vascular surgery, and other surgical specialties. The **Other Specialties** category consists of anesthesiology, emergency medicine, neurology, pathology, physical medicine and rehabilitation, psychiatry, radiology, and all other specialties. **Hospitalists** trained in adult primary care are modeled as their own category and have been moved out of the Primary Care category. Hospitalists trained in non-primary care specialties are modeled within their trained specialty.

b. The **Other Specialties** category consists of anesthesiology, emergency medicine, neurology, pathology, physical medicine and rehabilitation, psychiatry, radiology, and all other specialties.

c. Due to sample size limitations in the data, only black or African American and white groups could be analyzed separately; all other race categories (American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, and two or more races) had to be analyzed in aggregate.

d. For information on HPSA designation, see https://data.hrsa.gov/topics/health-workforce/shortage-areas.

e. Clinical nurse specialists (CNSs) are not included in the workforce projections due to lack of data for modeling CNS supply and demand. Whereas other APRNs concentrate on direct patient care, CNSs often work in health care administration and are less likely to affect demand for physicians or directly affect physician productivity than are other APRNs and PAs.

f. In many databases analyzed, such as the Medical Expenditure Panel Size and the Behavioral Risk Factor Surveillance System, the sample sizes are too small to model other groups of interest (e.g., Native Americans, Pacific Islanders, Alaska Natives), especially when dividing up by state, age group, and gender.

g. The National Center for Health Statistics Urban-Rural Classification Scheme for Counties is available at https://www.cdc.gov/nchs/data_access/urban_rural.htm#2013_Urban-Rural_Classification_Scheme_for_Counties.

h. This geographic designation is for large fringe metropolitan counties in metropolitan statistical areas (MSAs) of 1 million or more population that do not qualify as large central medium metro counties in MSAs of 250,000-999,999 population based on the 2013 NCHS Urban-Rural Classification Scheme for Counties. https://www.cdc.gov/nchs/data_access/urban_rural.htm#2013_Urban-Rural_Classification_Scheme_for_Counties.

i. Both the supply and demand models measure full-time equivalents (FTEs) based on the number of physicians who have completed their graduate medical education. To the extent that some physicians-in-training also provide direct patient care, both demand and supply would be adjusted upward by the same amount so any gap between supply and demand would be unchanged.

j. For information on HPSA designation, see https://data.hrsa.gov/topics/health-workforce/shortage-areas.

REFERENCES

1. Morgan PA, Smith VA, Berkowitz TSZ, et al. Impact of physicians, nurse practitioners, and physician assistants on utilization and costs for complex patients. *Health Aff*. 2019;38(6):1028-1036. doi:10.1377/hlthaff.2019.00014.

2. Kleinpell R, Ward NS, Kelso LA, Mollenkopf FP, Houghton D. Provider to patient ratios for nurse practitioners and physician assistants in critical care units. *Am J Crit Care*. 2015;24(3):e16-e21. doi:10.4037/ajcc2015274.

3. Xue Y, Kannan V, Greener E, et al. Full scope-of-practice regulation is associated with higher supply of nurse practitioners in rural and primary care health professional shortage counties. *J Nurs Regul*. 2018;8(4):5-13. doi:10.1016/S2155-8256(17)30176-X.

4. Jha AK, Iliff AR, Chaoui JA, Defossez S, Bombaugh MC, Miller YR. *A Crisis in Health Care: A Call to Action on Physician Burnout*. Waltham, MA: Massachusetts Medical Society; 2018. http://www.massmed.org/News-and-Publications/MMS-News-Releases/Physician-Burnout-Report-2018/. Accessed April 28, 2020.

5. Busis NA, Shanafelt TD, Keran CM, et al. Burnout, career satisfaction, and well-being among US neurologists in 2016. *Neurology*. 2017;88(8):797-808. doi:10.1212/WNL.0000000000003640.

6. Shanafelt TD, Dyrbye LN, West CP. Addressing physician burnout: the way forward. *JAMA*. 2017;317(9):901-902. doi:10.1001/jama.2017.0076.

7. Cimbak N, Stolarski A, Moseley J, O'Neal P, Whang E, Kristo G. Burnout leads to premature surgeon retirement: a nationwide survey. *J Surgery Res*. 2019;2(3):159-169. doi:10.26502/jsr.10020033.

8. Vetter MH, Salani R, Williams TE, Ellison C, Satiani B. The impact of burnout on the obstetrics and gynecology workforce. *Clin Obstet Gynecol*. 2019;62(3):444-454. doi:10.1097/GRF.0000000000000452.

9. Silver MP, Hamilton AD, Biswas A, Warrick NI. A systematic review of physician retirement planning. *Hum Resour Health*. 2016;14(1):67. doi:10.1186/s12960-016-0166-z.

10. Pizer SD, Frakt AB, Sheetz K, Clancy C. Testing novel payment and delivery approaches through the Veterans Health Administration's new Center for Innovation. *Ann Intern Med*. 2019;170(2):112. doi:10.7326/M18-2225.

11. Ramanuj P, Ferenchik E, Docherty M, Spaeth-Rublee B, Pincus HA. Evolving models of integrated behavioral health and primary care. *Curr Psychiatry Rep*. 2019;21(1):4. doi:10.1007/s11920-019-0985-4.

12. Pereira V, Gabriel MH, Unruh L. Multiyear performance trends analysis of primary care practices demonstrating patient-centered medical home transformation: an observation of quality improvement indicators among outpatient clinics. *Am J Med Qual*. 2019;34(2):109-118. doi:10.1177/1062860618792301.

13. Kaufman BG, Spivack BS, Stearns SC, Song PH, O'Brien EC. Impact of accountable care organizations on utilization, care, and outcomes: a systematic review. *Med Care Res Rev*. 2019;76(3):255-290. doi:10.1177/1077558717745916.

14. Vogenberg FR. US healthcare trends and contradictions in 2019. *Am Health Drug Benefits*. 2019;12(1):40-47.

15. Advincula WDC, Choco JAG, Magpantay KAG, et al. Development and future trends in the application of visualization toolkit (VTK): The case for medical image 3D reconstruction. *AIP Conf Proc.* 2019;020022. doi:10.1063/1.5096690.

16 IHS Markit. *The Complexities of Physician Supply and Demand: Projections from 2017 to 2032.* Report, prepared for the AAMC. Washington, DC: AAMC; 2019. https://aamc-black.global.ssl.fastly.net/production/media/filer_public/31/13/3113ee5c-a038-4c16-89af-294a69826650/2019_update_-_the_complexities_of_physician_supply_and_demand_-_projections_from_2017-2032.pdf. Accessed April 28, 2020.

17. U.S. Census Bureau. 2017 national population projections datasets. https://www.census.gov/data/datasets/2017/demo/popproj/2017-popproj.html. Published 2018. Accessed Dec. 12, 2019.

18. Willard-Grace R, Knox M, Huang B, Hammer H, Kivlahan C, Grumbach K. Burnout and health care workforce turnover. *Ann Fam Med*. 2019;17(1):36-41. doi:10.1370/afm.2338.

19. Grumbach K, Knox M, Huang B, Hammer H, Kivlahan C, Willard-Grace R. A longitudinal study of trends in burnout during primary care transformation. *Ann Fam Med*. 2019;17(Suppl 1):S9-S16. doi:10.1370/afm.2406.

20. Abraham CM, Zheng K, Poghosyan L. Predictors and outcomes of burnout among primary care providers in the United States: A systematic review. *Med Care Res Rev*. November 2019:107755871988842. doi:10.1177/1077558719888427.

21. Salsberg E, Quigley L. Are we facing a physician assistant surplus? *JAAPA*. 2016;29(11):40-44. doi:10.1097/01.JAA.0000502865.59093.ef.

22. Hooker RS. When will physician assistant supply exceed demand? *JAAPA*. 2016;29(11):10-12. doi:10.1097/01.JAA.0000502868.43846.31.

23. Morgan P, Leach B, Himmerick K, Everett C. Job openings for PAs by specialty. *JAAPA*. 2018;31(1):45-47. doi:10.1097/01.JAA.0000527701.08322.18.

24. Cawley JF. Will demand for PAs remain strong? *JAAPA*. 2018;31(1):8. doi:10.1097/01.JAA.0000527708.15945.ce.

25. Wachter RM, Goldman L. Zero to 50,000 — the 20th anniversary of the hospitalist. *N Engl J Med*. 2016;375(11):1009-1011. doi:10.1056/NEJMp1607958.

26. Sun R, Karaca Z, Wong HS. Trends in hospital inpatient stays by age and payer, 2000-2015. Healthcare Cost and Utilization Project (HCUP) Statistical Brief #238. Rockville, MD: Agency for Healthcare Research and Quality; 2018. https://www.hcup-us.ahrq.gov/reports/statbriefs/sb235-Inpatient-Stays-Age-Payer-Trends.jsp. Accessed Dec. 4, 2019.

27. Park J, Jones K. Use of hospitalists and office-based primary care physicians' productivity. *J Gen Intern Med*. 2015;30(5):572-581. doi:10.1007/s11606-014-3007-6.

28. Kotala R, West DJ. Performance of hospitalists and inpatient clinical outcomes. *Hosp Top*. 2018;96(4):102-107. doi:10.1080/00185868.2018.1488547.

29. Health Resources and Services Administration. *Technical Documentation for Health Resources Services Administration's Health Workforce Simulation Model*. Rockville, MD: U.S. Department of Health and Human Services; 2019. https://bhw.hrsa.gov/sites/default/files/bhw/health-workforce-analysis/research/projections/technical-documentation-health-workforce-simulation-model.pdf. Accessed April 24, 2020.

30. Medscape. Medscape National Physician Burnout, Depression, and Suicide Report 2020. https://www.medscape.com/slideshow/2020-lifestyle-burnout-6012460. Published 2020. Accessed April 30, 2020.

31. Dewa CS, Loong D, Bonato S, Trojanowski L. The relationship between physician burnout and quality of healthcare in terms of safety and acceptability: a systematic review. *BMJ Open*. 2017;7(6):e015141. doi:10.1136/bmjopen-2016-015141.

32. Gregory ST, Menser T, Gregory BT. An Organizational Intervention to Reduce Physician Burnout. *J Healthc Manag*. 2018;63(5):338-352. doi:10.1097/JHM-D-16-00037.

33. McKinney SM, Sieniek M, Godbole V, et al. International evaluation of an AI system for breast cancer screening. *Nature*. 2020;577(7788):89-94. doi:10.1038/s41586-019-1799-6.

34. Chang HY, Jung CK, Woo JI, et al. Artificial Intelligence in pathology. *J Pathol Transl Med*. 2019;53(1):1-12. doi:10.4132/jptm.2018.12.16.

35. Battafarano DF, Ditmyer M, Bolster MB, et al. 2015 American College of Rheumatology workforce study: supply and demand projections of adult rheumatology workforce, 2015-2030. *Arthritis Care Res*. 2018;70(4):617-626. doi:10.1002/acr.23518.

36. Burton A. How do we fix the shortage of neurologists? *Lancet Neurol*. 2018;17(6):502-503. doi:10.1016/S1474-4422(18)30143-1.

37. Buchman TG, Coopersmith CM, Meissen HW, et al. Innovative interdisciplinary strategies to address the intensivist shortage. *Crit Care Med*. 2017;45(2):298-304. doi:10.1097/CCM.0000000000002209.

38. Stonehocker J, Muruthi J, Rayburn WF. Is there a shortage of obstetrician-gynecologists? *Obstet Gynecol Clin North Am*. 2017;44(1):121-132. doi:10.1016/j.ogc.2016.11.006.

39. Ellison EC, Pawlik TM, Way DP, Satiani B, Williams TE. Ten-year reassessment of the shortage of general surgeons: increases in graduation numbers of general surgery residents are insufficient to meet the future demand for general surgeons. *Surgery*. 2018;164(4):726-732. doi:10.1016/j.surg.2018.04.042.

40. American Association of Nurse Practitioners. NP Fact Sheet. https://www.aanp.org/about/all-about-nps/np-fact-sheet. Published 2019. Accessed Jan. 4, 2020.

41. American College of Nurse Midwives. *Essential Facts About Midwives*. Silver Spring, MD: American College of Nurse Midwives; 2019. http://www.midwife.org/essential-facts-about-midwives. Accessed Jan. 4, 2020.

42. American Association of Nurse Anesthetists. *Certified Registered Nurse Anesthetists Fact Sheet*. Park Ridge, IL: American Association of Nurse Anesthetists; 2018. https://www.aana.com/membership/become-a-crna/crna-fact-sheet. Accessed Jan. 4, 2020.

43. National Commission on Certification of Physician Assistants. *2018 Statistical Profile of Certified Physician Assistants*. Johns Creek, GA: National Commission on Certification of Physician Assistants; 2019. https://prodcmsstoragesa.blob.core.windows.net/uploads/files/2018StatisticalProfileofCertifiedPhysicianAssistants.pdf. Accessed Jan. 4, 2020.

44. Altschuler J, Margolius D, Bodenheimer T, Grumbach K. Estimating a reasonable patient panel size for primary care physicians with team-based task delegation. *Ann Fam Med*. 2012;10(5):396-400. doi:10.1370/afm.1400.

45. Ashwood JS, Gaynor M, Setodji CM, Reid RO, Weber E, Mehrotra A. Retail clinic visits for low-acuity conditions increase utilization and spending. *Health Aff*. 2016;35(3):449-455. doi:10.1377/hlthaff.2015.0995.

46. Mehrotra A, Wang MC, Lave JR, Adams JL, McGlynn EA. Retail clinics, primary care physicians, and emergency departments: a comparison of patients' visits. *Health Aff*. 2008;27(5):1272-1282. doi:10.1377/hlthaff.27.5.1272.

47. Smith J, Pan D, Novelli M. A nurse practitioner-led intervention to reduce hospital readmissions. *J Nurse Pract*. 2016;12(5):311-316. doi:https://doi.org/10.1016/j.nurpra.2015.11.020.

48. Mora K, Dorrejo XM, Carreon KM, Butt S. Nurse practitioner-led transitional care interventions: an integrative review. *J Am Assoc Nurse Pract*. 2017;29(12):773-790. doi:10.1002/2327-6924.12509.

49. Zozaya-Monohon M, Corona AR. Success of a nurse practitioner-led interdisciplinary team. *J Nurse Pract*. 2019;15(7):e143-e146. doi:10.1016/j.nurpra.2019.03.019.

50. Nabagiez JP, Shariff MA, Khan MA, Molloy WJ, McGinn JT Jr. Physician assistant home visit program to reduce hospital readmissions. *J Thorac Cardiovasc Surg*. 2013;145(1097-685X (Electronic)):225-231, 233. doi:10.1016/j.jtcvs.2012.09.047.

51. DeWolfe C, Birch S, Callen Washofsky A, Gardner C, McCarter R, Shah NH. Patient outcomes in a pediatric hospital medicine service staffed with physicians and advanced practice providers. *Hosp Pediatr*. 2019;9(2):121-128. doi:10.1542/hpeds.2018-0028.

52. Kurtzman ET, Barnow BS. A comparison of nurse practitioners, physician assistants, and primary care physicians' patterns of practice and quality of care in health centers. *Med Care*. 2017;55(6):615-622. doi:10.1097/MLR.0000000000000689.

53. Lovink MH, Persoon A, Koopmans RTCM, Van Vught AJAH, Schoonhoven L, Laurant MGH. Effects of substituting nurse practitioners, physician assistants or nurses for physicians concerning healthcare for the ageing population: a systematic literature review. *J Adv Nurs*. 2017;73(9):2084-2102. doi:10.1111/jan.13299.

54. Yang Y, Long Q, Jackson SL, et al. Nurse practitioners, physician assistants, and physicians are comparable in managing the first five years of diabetes. *Am J Med*. 2018;131(3):276-283.e2. doi:10.1016/j.amjmed.2017.08.026.

55. Bachrach D, Frohlich J, Garcimonde A, Nevitt K. *Building a Culture of Health: The Value Proposition of Retail Clinics*. Washington, DC: Robert Wood Johnson Foundation; 2015. http://www.manatt.com/uploadedFiles/Content/5_Insights/White_Papers/Retail_Clinic_RWJF.pdf. Accessed Dec. 4, 2019.

56. Jones Lange LaSalle IP, Inc. Retail and the New Healthcare Consumer. https://www.us.jll.com/content/dam/jll-com/documents/pdf/research/americas/us/am-research-retail-and-the-new-healthcare-consumer.pdf. Published 2019. Accessed Dec. 4, 2019.

57. BlueCross BlueShield. Retail Clinic Visits Increase Despite Use Lagging Among Individually Insured Americans. 2017. https://www.bcbs.com/the-health-of-america/reports/rising-costs-patented-drugs-drive-growth-pharmaceutical-spending-us. Accessed Dec. 4, 2019.

58. National Commission on Certification of Physician Assistants. *2018 Statistical Profile of Recently Certified Physician Assistants: Annual Report*. Johns Creek, GA: National Certification of Physician Assistants; 2019. https://prodcmsstoragesa.blob.core.windows.net/uploads/files/2018StatisticalProfileofRecentlyCertifiedPAs.pdf. Accessed Dec. 4, 2019.

59 Medical Group Management Association. *MGMA 2016 Provider Compensation and Production Report: Based on 2015 Survey Data*. MGMA; 2016.

60. Patel SA, Winkel M, Ali MK, Narayan KMV, Mehta NK. Cardiovascular mortality associated with 5 leading risk factors: national and state preventable fractions estimated from survey data. *Ann Intern Med*. 2015;163(4):245. doi:10.7326/M14-1753.

61. Song M, Giovannucci E. Preventable incidence and mortality of carcinoma associated with lifestyle factors among white adults in the United States. *JAMA Oncol*. 2016;2(9):1154. doi:10.1001/jamaoncol.2016.0843.

62. Mehta NK, Patel SA, Ali MK, Venkat Narayan KM. Preventing disability: the influence of modifiable risk factors on state and national disability prevalence. *Health Aff*. 2017;36(4):626-635. doi:https://doi.org/10.1377/hlthaff.2016.1281.

63. U.S. Department of Health and Human Services Office of Disease Prevention and Health Promotion. Healthy People 2020. https://www.healthypeople.gov/2020/topics-objectives. Accessed April 24, 2020.

64. Su W, Huang J, Chen F, et al. Modeling the clinical and economic implications of obesity using microsimulation*. J Med Econ*. 2015;18(1941-837X (Electronic)):886-897. doi:10.3111/13696998.2015.1058805.

65. Chen F, Su W, Becker SH, et al. Clinical and economic impact of a digital, remotely-delivered intensive behavioral counseling program on Medicare beneficiaries at risk for diabetes and cardiovascular disease. *PLoS One*. 2016;11(1932-6203 (Electronic)):e0163627. doi:10.1371/journal.pone.0163627.

66. Dall TM, Storm MV, Semilla AP, Wintfeld N, O'Grady M, Narayan KM. Value of lifestyle intervention to prevent diabetes and sequelae. *Am J Prev Med*. 2015;48(1873-2607 (Electronic)):271-280. doi:10.1016/j.amepre.2014.10.003.

67. Semilla AP, Chen F, Dall TM. Reductions in mortality among Medicare beneficiaries following the implementation of Medicare Part D. *Am J Manag Care*. 2015;21(1936-2692 (Electronic)):s165-s171.

68. Taylor F, Huffman MD, Macedo AF, et al. Statins for the primary prevention of cardiovascular disease. *Cochrane Database Syst Rev*. 2013;(1469-493X (Electronic)):CD004816. doi:10.1002/14651858.CD004816.pub5.

69. Baguet JP, Legallicier B, Auquier P, Robitail S. Updated meta-analytical approach to the efficacy of antihypertensive drugs in reducing blood pressure. *Clin Drug Investig*. 2007;27(1173-2563 (Print)):735-753. doi:10.2165/00044011-200727110-00001.

70. Sherifali D, Nerenberg K, Pullenayegum E, Cheng JE, Gerstein HC. The effect of oral antidiabetic agents on A1C levels: a systematic review and meta-analysis. *Diabetes Care*. 2010;33(1935-5548 (Electronic)):1859-1864. doi:10.2337/dc09-1727.

71. Proia KK, Thota AB, Njie GJ, et al. Team-based care and improved blood pressure control. *Am J Prev Med*. 2014;47(1):86-99. doi:10.1016/j.amepre.2014.03.004.

72. Costello T, Dorrell M, Kellams T, Kraska K. Review of pharmacologic weight loss medications in a patient-centered medical home. *J Pharm Technol*. 2016;32(1):37-41. doi:https://doi.org/10.1177/8755122515604858.

73. Hibbard JH, Greene J, Sacks RM, Overton V, Parrotta C. Improving population health management strategies: identifying patients who are more likely to be users of avoidable costly care and those more likely to develop a new chronic disease. *Health Serv Res*. 2017;52(4):1297-1309. doi:10.1111/1475-6773.12545.

74. Lauffenburger JC, Shrank WH, Bitton A, et al. Association between patient-centered medical homes and adherence to chronic disease medications: a cohort study. *Ann Intern Med*. 2017;166(2):81. doi:10.7326/M15-2659.

75. Agarwal R, Gupta A, Fendrick AM. Value-based insurance design improves medication adherence without an increase in total health care spending. *Health Aff*. 2018;37(7):1057-1064. doi:10.1377/hlthaff.2017.1633.

76. Look KA. Value-based insurance design and medication adherence: opportunities and challenges. *Am J Manag Care*. 2015;21(1):e78-90.

77. Morgado MP, Morgado SR, Mendes LC, Pereira LJ, Castelo-Branco M. Pharmacist interventions to enhance blood pressure control and adherence to antihypertensive therapy: Review and meta-analysis. *Am J Health Syst Pharm*. 2011;68(3):241-253. doi:2146/ajhp090656.

78. IHS Markit. *The Complexities of Physician Supply and Demand: Projections From 2015 to 2030: 2017 Update*. Report, prepared for the AAMC. Washington, DC: AAMC; 2017. https://aamc-black.global.ssl.fastly.net/production/media/filer_public/a5/c3/a5c3d565-14ec-48fb-974b-99fafaeecb00/aamc_projections_update_2017.pdf.

79. Yang W, Dall TM, Zhang Y, et al. Simulation of quitting smoking in the military shows higher lifetime medical spending more than offset by productivity gains. *Health Aff (Millwood)*. 2012;31(1544-5208 (Electronic)):2717-2726. doi:10.1377/hlthaff.2010.1048.

80. Jha P, Ramasundarahettige C, Landsman V, et al. 21st-Century hazards of smoking and benefits of cessation in the United States. *N Engl J Med*. 2013;368(4):341-350. doi:10.1056/NEJMsa1211128.

81. Centers for Disease Control and Prevention. Smoking and Tobacco Use: Health Effects. https://www.cdc.gov/tobacco/basic_information/health_effects/index.htm. Published 2018. Accessed Dec. 4, 2019.

82. Dall TM, West T, Chakrabarti R, Iacobucci W, Semilla AP, Hansari A. *Health Workforce Model Documentation*. Washington, DC: IHS Markit; 2020. https://cdn.ihs.com/www/pdf/IHS-HDMM-DocumentationMay2020.pdf. https://ihsmarkit.com/products/healthcare-modeling.html. Accessed May 4, 2020.

83. AAMC. Total U.S. Medical School Enrollment by Race/Ethnicity and Sex, 2015-2016 Through 2019-2020. Washington, DC: AAMC; 2019. https://www.aamc.org/system/files/2019-11/2019_FACTS_Table_B-3.pdf.

84. Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health Aff*. 2008;27(3):759-769. doi:10.1377/hlthaff.27.3.759.

85. Orszag PR, Emanuel EJ. Health Care Reform and Cost Control. *N Engl J Med*. 2010;363(7):601-603. doi:10.1056/NEJMp1006571.

86. Obama B. United States health care reform: progress to date and next steps. *JAMA*. 2016;316(5):525. doi:10.1001/jama.2016.9797.

87. Blumenthal D, Abrams M, Nuzum R. The Affordable Care Act at 5 Years. Hamel MB, ed. *N Engl J Med*. 2015;372(25):2451-2458. doi:10.1056/NEJMhpr1503614.

88. Davis K, Abrams M, Stremikis K. How the Affordable Care Act will strengthen the nation's primary care foundation. *J Gen Intern Med*. 2011;26(10):1201-1203. doi:10.1007/s11606-011-1720-y.

89. Koh HK. A 2020 vision for healthy people. *N Engl J Med*. 2010;362(18):1653-1656. doi:10.1056/NEJMp1001601.

90. Milani RV, Lavie CJ. Health care 2020: reengineering health care delivery to combat chronic disease. *Am J Med*. 2015;128(4):337-343. doi:10.1016/j.amjmed.2014.10.047.

91. DeVore S, Champion RW. Driving population health through accountable care organizations. *Health Aff*. 2011;30(1):41-50. doi:10.1377/hlthaff.2010.0935.

92. Thorpe KE, Ogden LL. The foundation that health reform lays for improved payment, care coordination, and prevention. *Health Aff*. 2010;29(6):1183-1187. doi:10.1377/hlthaff.2010.0415.

93. Jacquin L. A strategic approach to healthcare transformation. *Healthc Financ Manage*. 2014;68(4):74-79.

94. Blumenthal D, Anderson G, Burke S, Fulmer T, Jha AK, Long P. *Tailoring Complex-Care Management, Coordination, and Integration for High-Need, High-Cost Patients*. Discussion paper. Washington, DC: National Academy of Medicine; 2016.

95. Cutler DM. From the Affordable Care Act to affordable care. *JAMA*. 2015;314(4):337. doi:10.1001/jama.2015.7683.

96. Casalino LP. The Medicare Access and CHIP Reauthorization Act and the corporate transformation of American medicine. *Health Aff*. 2017;36(5):865-869. doi:https://doi.org/10.1377/hlthaff.2016.1536.

97. Kane CK. *Updated Data on Physician Practice Arrangements: Physician Ownership Drops Below 50 Percent*. Chicago, IL: American Medical Association; 2017. https://www.ama-assn.org/sites/ama-assn.org/files/corp/media-browser/public/health-policy/PRP-2016-physician-benchmark-survey.pdf. Accessed Dec. 4, 2019.

98. Singleton T, Miller P. The physician employment trend: what you need to know. *Fam Pract Manag*. 2015;22(4):11-15.

99. Lagarde M, Blaauw D. Physicians' responses to financial and social incentives: A medically framed real effort experiment. *Soc Sci Med*. 2017;179:147-159. doi:10.1016/j.socscimed.2017.03.002.

100. Singleton T, Miller P. Employment Contracts for Family Physicians in an Evolving Market. *Fam Pract Manag*. 2016;23(4):28-32.

101. Capoccia K, Odegard PS, Letassy N. Medication adherence with diabetes medication: a systematic review of the literature. *Diabetes Educ*. 2016;42(1):34-71. doi:10.1177/0145721715619038.

102. Bansilal S, Castellano JM, Garrido E, et al. Assessing the Impact of Medication Adherence on Long-Term Cardiovascular Outcomes. *J Am Coll Cardiol*. 2016;68(8):789-801. doi:10.1016/j.jacc.2016.06.005.

103. Shillington A, Ganjuli A, Clewell J. The impact of patient support programs on adherence, clinical, humanistic, and economic patient outcomes: a targeted systematic review. *Patient Prefer Adherence*. April 2016:711.

104. Zullig LL, Ramos K, Bosworth HB. Improving medication adherence in coronary heart disease. *Curr Radiol Rep*. 2017;19(11). doi:10.1007/s11886-017-0918-y. Accessed Jan. 29, 2019.

105. Pawloski PA, Asche SE, Trower NK, et al. A substudy evaluating treatment intensification on medication adherence among hypertensive patients receiving home blood pressure telemonitoring and pharmacist management. *J Clin Pharm Ther*. 2016;41(1365-2710 (Electronic)):493-498. doi:10.1111/jcpt.12414.

106. Hawes EM, Lambert E, Reid A, Tong G, Gwynne M. Implementation and evaluation of a pharmacist-led electronic visit program for diabetes and anticoagulation care in a patient-centered medical home. *Am J Health Syst Pharm*. 2018;75(12):901-910. doi:10.2146/ajhp170174.

107. Hamine S, Gerth-Guyette E, Faulx D, Green BB, Ginsburg AS. Impact of mHealth chronic disease management on treatment adherence and patient outcomes: a systematic review. *J Med Internet Res*. 2015;17(2):e52. doi:10.2196/jmir.3951.

108. Thakkar J, Kurup R, Laba T-L, et al. Mobile telephone text messaging for medication adherence in chronic disease: a meta-analysis. *JAMA Intern Med*. 2016;176(3):340. doi:10.1001/jamainternmed.2015.7667.

109. Substance Abuse and Mental Health Services Administration. *Key Substance Use and Mental Health Indicators in the United States: Results From the 2017 National Survey on Drug Use and Health*. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration; 2018. https://www.samhsa.gov/data/sites/default/files/cbhsq-reports/NSDUHFFR2017/NSDUHFFR2017.pdf. Accessed Dec. 4, 2019.

110. Mental Health America. Mental Health in America — Adult Data 2018. http://www.mentalhealthamerica.net/issues/mental-health-america-adult-data-2018. Accessed Dec. 4, 2019.

111. Downey LVA, Zun LS. Identifying undiagnosed pediatric mental illness in the emergency department. *Pediatr Emerg Care*. 2018;34(2):e21-e23. doi:10.1097/PEC.0000000000001151.

112. Han B, Compton WM, Blanco C, Colpe LJ. Prevalence, treatment, and unmet treatment needs of US adults with mental health and substance use disorders. *Health Aff*. October 2017. doi:10.1377/hlthaff.2017.0584. Accessed May 2, 2018.

113. Waserstein G, Partin C, Cohen D, Schettler P, Kinkead B, Rapaport MH. The prevalence and impact of psychiatric symptoms in an undiagnosed diseases clinical program. Reppermund S, ed. *PLoS ONE*. 2019;14(6):e0216937. doi:10.1371/journal.pone.0216937.

114. U.S. Preventive Services Task Force. Recommendation from the Community Preventive Services Task Force for use of collaborative care for the management of depressive disorders. *Am J Prev Med*. 2012;42(5):521-524. doi:10.1016/j.amepre.2012.01.010.

115. Xierali IM, Tong ST, Petterson SM, Puffer JC, Phillips RL, Bazemore AW. Family physicians are essential for mental health care delivery. *J Am Board Fam Pract*. 2013;26(2):114-115. doi:10.3122/jabfm.2013.02.120219.

116. Duggal R, Zhang Y, Diana ML. The association between hospital ACO participation and readmission rates. *J Healthc Manag*. 2018;63(5):e100-e114. doi:10.1097/JHM-D-16-00045.

117. Mehtsun WT, Papanicolas I, Zheng J, Orav EJ, Lillemoe KD, Jha AK. National trends in readmission following inpatient surgery in the Hospital Readmissions Reduction Program era. *Ann Surg*. 2018;267(4):599-605. doi:10.1097/SLA.0000000000002350.

118. Cardarelli R, Bausch G, Murdock J, Chyatte MR. Return-on-investment (ROI) analyses of an inpatient lay health worker model on 30-day readmission rates in a rural community hospital: ROI of a care transition model in Appalachia. *J Rural Health*. 2017;34(4):411-422. doi:10.1111/jrh.12250.

119. Wasfy JH, Zigler CM, Choirat C, Wang Y, Dominici F, Yeh RW. Readmission rates after passage of the Hospital Readmissions Reduction Program: a pre-post analysis. *Ann Intern Med*. 2017;166(5):324. doi:10.7326/M16-0185.

120. Huntley AL, Chalder M, Shaw ARG, et al. A systematic review to identify and assess the effectiveness of alternatives for people over the age of 65 who are at risk of potentially avoidable hospital admission. *BMJ Open*. 2017;7(7):e016236. doi:10.1136/bmjopen-2017-016236.

121. Daly MR, Mellor JM, Millones M. Do avoidable hospitalization rates among older adults differ by geographic access to primary care physicians? *Health Serv Res*. 2018;53:3245-3264. doi:10.1111/1475-6773.12736.

122. Ingber MJ, Feng Z, Khatutsky G, et al. Initiative to reduce avoidable hospitalizations among nursing facility residents shows promising results. *Health Aff*. 2017;36(3):441-450. doi:10.1377/hlthaff.2016.1310.

123. Weinick RM, Burns RM, Mehrotra A. Many emergency department visits could be managed at urgent care centers and retail clinics. *Health Aff*. 2010;29(9):1630-1636. doi:10.1377/hlthaff.2009.0748.

124. Rosenthal MB, Alidina S, Friedberg MW, et al. A difference-in-difference analysis of changes in quality, utilization and cost following the Colorado multi-payer patient-centered medical home pilot. *J Gen Intern Med*. 2016;31(3):289-296. doi:10.1007/s11606-015-3521-1.

125. Green LA, Chang H-C, Markovitz AR, Paustian ML. The reduction in ED and hospital admissions in medical home practices is specific to primary care-sensitive chronic conditions. *Health Serv Res*. 2018;53(2):1163-1179. doi:10.1111/1475-6773.12674.

126. Hawes EM, Smith JN, Pinelli NR, et al. Accountable Care in Transitions (ACTion): a team-based approach to reducing hospital utilization in a patient-centered medical home. *J Pharm Pract*. 2018;31(2):175-182. doi:10.1177/0897190017707118.

127. Truven Health Analytics. Study Finds Most Emergency Room Visits Made by Privately-Insured Patients Avoidable. https://truvenhealth.com/media-room/press-releases/detail/prid/113/study-finds-most-emergency-room-visits-made-by-privately-insured-patients-avoidable. Published 2013. Accessed July 13, 2018.

128. Health Resources and Services Administration. Goal 3: Achieve Health Equity and Enhance Population Health. https://www.hrsa.gov/about/strategic-plan/goal-3.html. Published March 31, 2017. Accessed Jan. 27, 2020.

129. Centers for Disease Control and Prevention. Health Equity. https://www.cdc.gov/chronicdisease/healthequity/index.htm. Published Aug. 28, 2019. Accessed Jan. 27, 2020.

130. American Public Health Association. Achieving Health Equity in the United States. https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2019/01/29/achieving-health-equity. Published Nov. 13, 2018. Accessed Jan. 27, 2020.

131. AAMC. *Policy Priorities to Improve Our Nation's Health: Health Equity*. Washington, DC: AAMC; 2020. https://www.aamc.org/system/files/c/2/472868-healthequity.pdf.

132. Zimmerman FJ, Anderson NW. Trends in health equity in the United States by race/ethnicity, sex, and income, 1993-2017. *JAMA Netw Open*. 2019;2(6):e196386. doi:10.1001/jamanetworkopen.2019.6386.

133. Arroyo-Johnson C, Mincey KD, Ackermann N, Milam L, Goodman MS, Colditz GA. Racial and ethnic heterogeneity in self-reported diabetes prevalence trends across Hispanic subgroups, national health interview survey, 1997-2012. *Prev Chronic Dis*. 2016;13:150260. doi:http://dx.doi.org/10.5888/pcd13.150260.

134. Chang SH, Yu YC, Carlsson NP, Liu X, Colditz GA. Racial disparity in life expectancies and life years lost associated with multiple obesity-related chronic conditions: Racial Disparity and Obesity-Related Conditions. *Obesity (Silver Spring)*. 2017;25(5):950-957. doi:10.1002/oby.21822.

135. Fei K, Rodriguez-Lopez JS, Ramos M, et al. Racial and ethnic subgroup disparities in hypertension prevalence, New York City Health and Nutrition Examination Survey, 2013-2014. *Prev Chronic Dis*. 2017;14:E33. doi:10.5888/pcd14.160478. Accessed Jan. 28, 2019.

136. Heidemann DL, Joseph NA, Kuchipudi A, Perkins DW, Drake S. Racial and economic disparities in diabetes in a large primary care patient population. *Ethn Dis*. 2016;26(1):85-90. doi:10.18865/ed.26.1.85.

137. Rich NE, Oji S, Mufti AR, et al. Racial and ethnic disparities in nonalcoholic fatty liver disease prevalence, severity, and outcomes in the United States: a systematic review and meta-analysis. *Clin Gastroenterol Hepatol*. 2018;16(2):198-210.e2. doi:10.1016/j.cgh.2017.09.041.

138. Saadi A, Himmelstein DU, Woolhandler S, Mejia NI. Racial disparities in neurologic health care access and utilization in the United States. *Neurology*. 2017;88(24):2268-2275. doi:10.1212/WNL.0000000000004025.

139. Maningding E, Dall'Era M, Trupin L, Murphy LB, Yazdany J. Racial/ethnic differences in prevalence of and time to onset of SLE manifestations: the California Lupus Surveillance Project (CLSP). *Arthritis Care Res (Hoboken)*. 2019. doi:10.1002/acr.23887.

140. Naik RP, Irvin MR, Judd S, et al. Sickle cell trait and the risk of ESRD in Blacks. *JASN*. 2017;28(7):2180-2187. doi:10.1681/ASN.2016101086.

141. Reeves SL, Jary HK, Gondhi JP, Kleyn M, Spector-Bagdady K, Dombkowski KJ. Incidence, demographic characteristics, and geographic distribution of sickle cell trait and sickle cell anemia births in Michigan, 1997-2014. *Mol Genet Genomic Med*. 2019;7(8):e795. doi:10.1002/mgg3.795.

142. Health Resources and Services Administration. Health Workforce Projections. https://bhw.hrsa.gov/health-workforce-analysis/research/projections. Published 2019. Accessed Dec. 4, 2019.

143. Brotherton SE, Etzel SI. Graduate medical education, 2018-2019. *JAMA*. 2019;322(10):996. doi:10.1001/jama.2019.10155.

144. Martinez B, Biszewski M. Appendix: osteopathic graduate medical education, 2019. *J Am Osteopath Assoc*. 2019;119(4):268. doi:10.7556/jaoa.2019.044.

145. Shanafelt TD, Dyrbye LN, West CP, Sinsky CA. Potential impact of burnout on the US physician workforce. *Mayo Clin Proc*. 2016;91(11):1667-1668. doi:10.1016/j.mayocp.2016.08.016.

146. Kumar S. Burnout and doctors: prevalence, prevention and intervention. *Healthcare (Basel)*. 2016;4(3):37. doi:10.3390/healthcare4030037.

147. Shanafelt TD, Mungo M, Schmitgen J, et al. Longitudinal Study Evaluating the Association Between Physician Burnout and Changes in Professional Work Effort. *Mayo Clin Proc*. 2016;91(4):422-431. doi:10.1016/j.mayocp.2016.02.001.

Association of
American Medical Colleges
655 K Street, NW, Suite 100, Washington, DC 20001-2399
T 202 828 0400
www.aamc.org

19-359B (06/20)