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Ophthalmology Workforce Projections in the United States, 2020 to 2035

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Purpose: To analyze ophthalmology workforce supply and demand projections from 2020 to 2035.

Design: Observational cohort study using data from the National Center for Health Workforce Analysis (NCHWA).

Methods: Data accessed from the Department of Health and Human Services, Health Resources and Services Administration (HRSA) website were compiled to analyze the workforce supply and demand projections for ophthalmologists from 2020 to 2035.

Main Outcome Measures: Projected workforce adequacy over time.

Results: From 2020 to 2035, the total ophthalmology supply is projected to decrease by 2650 full-time equivalent (FTE) ophthalmologists (12% decline) and total demand is projected to increase by 5150 FTE ophthalmologists (24% increase), representing a supply and demand mismatch of 30% workforce inadequacy. The level of projected adequacy was markedly different based on rurality by year 2035 with 77% workforce adequacy versus 29% workforce adequacy in metro and nonmetro geographies, respectively. By year 2035, ophthalmology is projected to have the second worst rate of workforce adequacy (70%) of 38 medical and surgical specialties studied.

Conclusions: The HRSA's Health Workforce Simulation Model forecasts a sizeable shortage of ophthalmology supply relative to demand by the year 2035, with substantial geographic disparities. Ophthalmology is one of the medical specialties with the lowest rate of projected workforce adequacy by 2035. Further dedicated workforce supply and demand research for ophthalmology and allied professionals is needed to validate these projections, which may have significant future implications for patients and providers.

Financial Disclosure(s): Proprietary or commercial disclosure may be found in the Footnotes and Disclosures at the end of this article. *Ophthalmology 2024;131:133-139 © 2023 by the American Academy of Ophthalmology*

Supplemental material available at www.aaojournal.org.

Health care workforce supply and demand is methodologically complex and often requires assumptions from large databases, surveys, epidemiological studies, and projections based on current trends. Existing simulation methods are limited with regard to assessing the interconnectedness of health care providers and improvements from new technologies.[1] This is particularly meaningful for eye care, which is provided by a network of ophthalmologists, optometrists, technicians, photographers, opticians, and various other allied health professionals.

Since the 1980s, there have been varied findings regarding forecasts for supply and demand for the ophthalmology workforce.[2] At the time, there was concern for physician surplus. As a result, in the 1990s the American Academy of Ophthalmology (AAO) commissioned the RAND Corporation to evaluate the eye care workforce supply requirements, which found a significant excess of eye care providers relative to public health need and demand; however, the findings were dependent on model assumptions in work-time ratio of ophthalmologists and optometrists.[3] In 2003, the aging US population was expected to result in significant growth in demand for surgical services, with ophthalmology having the largest forecasted increase in work due to the increased projected demand for cataract surgery.[4] Between 1995 and 2017, there was a decrease in the national ophthalmologist density from 6.30 to 5.68 ophthalmologists per 100 000, and there was an increased ratio of older to younger ophthalmologists. Despite a modest 2.26% increase in rural ophthalmologist density in the same timeframe, there was persistent disparity with lower mean ophthalmologist density in rural counties compared with nonmetropolitan and metropolitan counties.[5] As a result, there has been growing attention on the study of the adequacy of the ophthalmology workforce. In the past decade, the annual turnover of the ophthalmology workforce ranged from 3.7% to 19.4%, with approximately one-third separating from at least 1 practice[6] and a statistically significant increase in the rate of ophthalmology practice consolidation.[7]

The size and distribution of the current and future workforce have implications for national eye care provision. The density of ophthalmology providers is an important aspect of

https://doi.org/10.1016/j.ophtha.2023.09.018
ISSN 0161-6420/23

access to eye care, prevalence of visual impairment, and visual health outcomes,[8-12] although ultimately use and outcomes are influenced by complex individual and contextual factors.[13-15] Consequently, there are broad public health and policy implications for interventions that influence the supply of ophthalmologists. There is both a high direct and indirect opportunity cost for training a surplus of ophthalmologists,[16-19] which is balanced by a high direct and indirect societal cost of untreated visual impairment.[20-22] The Association of American Medical Colleges anticipates a shortage of between 15 800 and 30 200 for surgical specialties by 2034, which includes ophthalmology.[23,24]

Given the importance of this issue, the authors sought to explore projected eye care supply and demand through the Health Workforce Simulation Model (HWSM), a microsimulation model from the National Center for Health Workforce Analysis (NCHWA), which is part of the Health Resources and Service Administration (HRSA) of the US Department of Health and Human services. The NCHWA informs public and private sector decision makers on health workforce issues by expanding and improving health workforce data, disseminating workforce data to the public, and improving and updating projections of the supply and demand for health workers. Importantly, reduction in barriers to care increase demand and could exacerbate existing supply and demand mismatch. Potential reduction in barriers is incorporated into HWSM scenario analysis. The HWSM has been used to explore shortages in primary care physicians relative to primary physician assistant and nurse practitioners,[25] and the pharmacist labor supply;[26] however, to our knowledge, there are no specific studies using this simulation to study eye care or ophthalmology. We sought to explore the HWSM implications for ophthalmology, optometry, and other eyecare professionals across geographic categories and barrier reduction scenarios.

Methods

This study did not qualify as human subjects research and thus did not require Institutional Review Board approval. Study conduction complied with the Declaration of Helsinki. Informed consent was not required.

Data Sources

Department of Health and Human Services, Health Resources and Services Administration, Health Workforce Projections websites[27] provided the data used for this analysis. Specifically, the authors used the NCHWA Workforce Projections Dashboard.

Projection data from the NCHWA come from the HWSM. The HWSM is an integrated microsimulation model that estimates the current and future supply of and demand for health care workers by occupation, geographic location, and year. Technical documentation for the HRSA's HWSM can be found online.[28]

Workforce supply is defined as the number of workers active in the workforce, which consists of people working and people actively seeking employment. These are calculated on the basis of full-time equivalents (FTEs), which are defined as 40 hours per week; thus, the FTE supply is higher than the count of active physicians. The supply component of HWSM is calculated by using a combination of national surveys, association database, and state licensure files to create a starting year supply. The HWSM simulates the current workforce and labor force participation decisions to project how supply will evolve over time. The addition of new entrants and the subtraction from attrition (those exiting due to mortality, retirement, and career change) lead to the end-of-year supply. For ophthalmology, in 2023, there were 516 entering ophthalmology residency positions.[29] For optometry, there were 1728 graduates from regular and special programs in 2022.[30] The synthetic cohort of new entrants to the ophthalmology workforce is based on the number, characteristics, and geographic distribution of recent entrants and is intended to include the planned expansion of the training pipeline based on base year forecasts.

Demand is defined as the number of workers required to provide a level of services that will be used given patient health-seeking behavior and ability/willingness to pay for services. The main inputs for determining demand projections are (1) US county-level population data used to generate a representative population sample; (2) annual expected health care service use patterns; and (3) physician staffing ratios.

The HWSM models demand for physicians under 2 scenarios: the status quo scenario and reduced barriers scenario. The status quo (base case) scenario models a continuation of recent (2015−2019) national patterns of care use extrapolated to the future population and assesses where the projected future workforce will be sufficient to provide at least the current level of care. The status quo scenario assumes national demand equals national supply in 2020.

The reduced barriers scenario estimates the number of physician FTEs required if populations who historically faced barriers to accessing health care services demonstrated care use patterns comparable to populations perceived to have fewer barriers to accessing care. This scenario assumes populations who have faced barriers to accessing health care services are able to use ophthalmology resources similarly to peers living in metropolitan counties, who are non-Hispanic White, and who have health insurance. This hypothetical reduced barriers scenario describes the implications on physician demand if policies and programs were implemented to reduce access-based disparities to health care services.

Percent adequacy is the relationship between the projected future supply and the projected future demand. Adequacy is calculated by taking projected supply each year divided by projected demand in that year.

Statistical Analysis

Descriptive statistics, workforce ratios, and figures were calculated for each analyzed procedure using Microsoft Excel.

Results

For 2020, there were an estimated 21 250 FTE workers in the ophthalmology workforce. Projected total supply decreased by 2650 FTE workers, representing a 12% decline, by year 2035. For the status quo (base case scenario), total demand in FTEs was matched to total supply for 2020. Projected total demand increased by 5150 FTEs, representing a 24% increase, by year 2035.

Reduced Barriers Scenario

Under the reduced barriers scenario, total projected supply was not adequate to meet total projected demand in any year from 2020 to 2035. In the base year 2020, there is already a supply demand mismatch of 1920 FTEs nationally, which is composed of a surplus of 330 FTE in metro areas and a deficit of 2250 FTEs in nonmetro areas. This is forecast to worsen over time.

As before, projected total supply decreased by 2650 FTEs, representing a 12% decline, by year 2035. Projected total demand

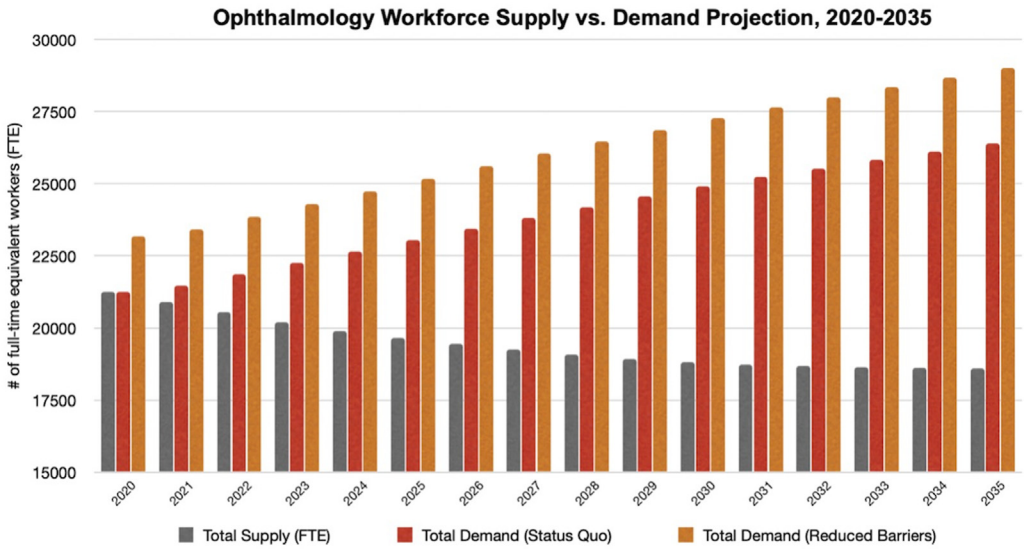

Figure 1. Ophthalmology workforce supply versus demand projection, 2020–2035. Ophthalmologist total demand (status quo) and total demand (reduced barriers) from 2020 to 2035 compared with ophthalmologist total supply. FTE = full-time equivalent.

in this scenario increased by 5840 FTEs, representing a 25% increase, by year 2035 (Table S1, available at www.aaojournal.org).

Adequacy

Adequacy, defined as projected supply over projected demand, steadily decreased year-over-year in both scenarios. For the status quo scenario, where it is assumed that starting supply is adequate to meet total demand, there is 100% adequacy in 2020. Adequacy decreases each year as total projected demand outpaces projected supply. By 2035, the projected ophthalmology workforce adequacy is 70%. Under scenarios where there are reduced barriers to ophthalmology care access, the projected ophthalmology workforce is only 64% adequate to meet the projected demand for ophthalmologic services in 2035 (Fig 1).

The level of inadequacy was markedly different based on rurality, with base year 2020 showing 110% and 41% adequacy for metro compared with nonmetro geographies, respectively. Workforce supply adequacy projects to decrease by year 2035 in both metro (77%) and nonmetro (29%) geographies. Similar decreases in adequacy were noted in metro (70%) and nonmetro (26%) geographies in a scenario where barriers to care were reduced (Fig 2).

Nonphysician Component

There are important nonphysician components to eye care provision including optometrists, opticians, and ophthalmic medical technicians. The current optometry total supply is adequate for demand (100%); however, under the reduced barriers demand scenario there is current inadequacy in base year 2020 (82%), which will persist despite expected growth in the optometry workforce by year 2035 (89%).

In a similar vein, the optician service workforce is adequate for demand in the status quo scenario in 2020 (100%), but there is projected inadequacy (76%) by the year 2035. In the reduced barriers demand scenario, there is current inadequacy (81%) that is projected to worsen by year 2035 (60%). Although there is a lack of workforce supply data on the complex category of ophthalmic medical technicians, the status quo demand is expected to increase by at least 1% to 2% each year, with an additional 17% to 18% increased demand each year under reduced barriers demand scenarios.

Specialty Specific Adequacy

Of the 38 specialty categories in the HRSA dataset, for 2020 ophthalmology ranks 18th of 38 for current projected adequacy (92%) in 2020. Fifteen of the 38 specialties are projected to have adequate (100% or greater) workforce in the status quo and 9 specialties are projected to have adequate (100% or greater) workforce even in the reduced barriers demand scenario by 2035.

By the year 2035 in the status quo scenario, ophthalmology is projected to have the second lowest rate of adequacy (70%) or 37th of 38 specialties, with thoracic surgery having slightly worse adequacy (69%). In the reduced barriers scenario, by 2035, ophthalmology is projected to have the fifth lowest adequacy (64%), or 34th of 38 specialties with other specialist category (63%), neurological surgery (62%), thoracic surgery (62%), and plastic surgery (56%) having slightly lower adequacy (Tables S2-S5, available at www.aaojournal.org).

Discussion

The present analysis of the HRSA HWSM shows that the ophthalmology physician workforce is inadequate to meet the demand for ophthalmologic services, and this inadequacy is expected to increase by the year 2035. There is a projected 30% shortage in ophthalmologist FTEs by the year 2035 relative to demand. This projected shortage expands to 36% if initiatives to reduce barriers to eye care are successful. Ophthalmology is expected to have one of the lowest rates of adequacy relative to other specialties in medicine. The optician workforce is similarly inadequate relative to demand, and optometry is projected to be inadequate as well if there is a reduction in barriers to accessing care.

The findings here corroborate recent work based on American Medical Association Masterfile data and

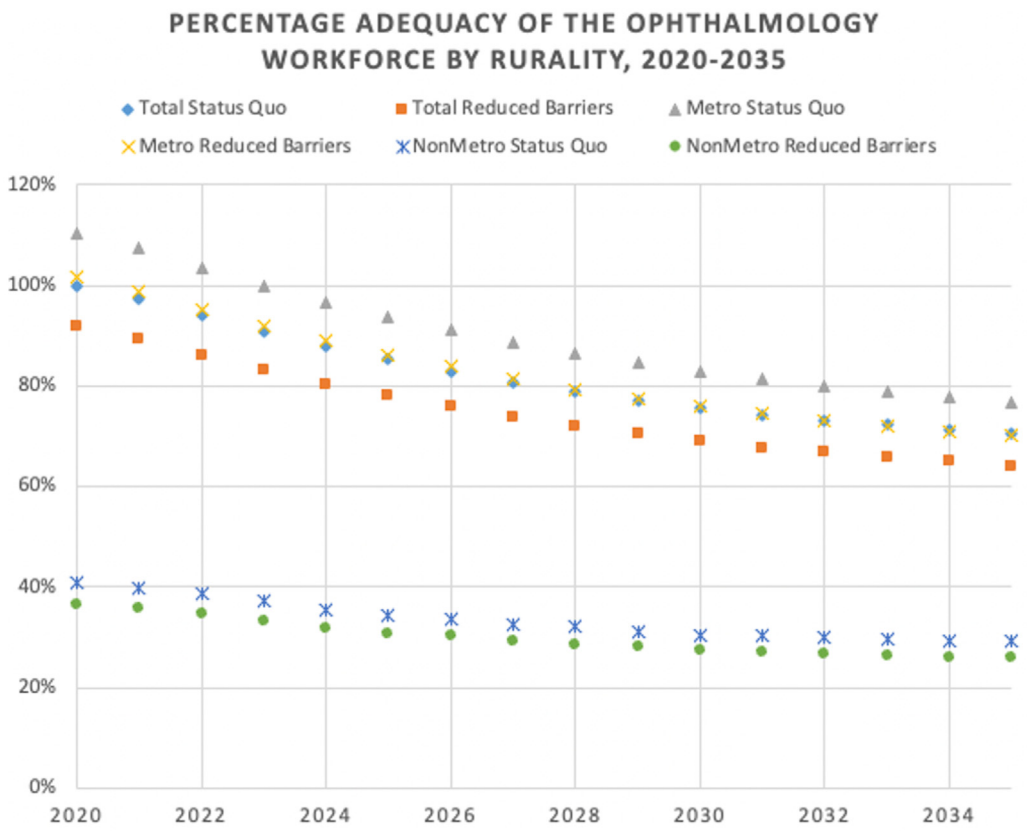

Figure 2. Percentage adequacy of the ophthalmology workforce by rurality, 2020–2035.

population data showing a projected shortage of ophthalmologists from 2030 to 2050 of approximately 1945 to 2928 surgeons, with a median projected demand of 169 million work relative value units by 2050 relative to a capacity of only 146 million work relative value units.[31] The HRSA model here incorporates American Medical Association and other data with similar implications for workforce shortages.

In the status quo scenario, supply adequacy varies greatly across specialties, ranging from 69% (a shortage of 31%) for thoracic surgeons to 174% (a surplus of 74%) for pulmonology physicians or 205% (a surplus of 105%) for nurse practitioners. The specialties with the lowest supply adequacy in 2035 are thoracic surgery (69%), ophthalmology (70%), other specialists (71%), plastic surgery (75%), and nephrology (79%). Given the high cost of workforce surplus as well as demand surplus, it is important to investigate whether the degree of inadequacy in the eye care workforce is due to measurement methodology or a true shortcoming of intervenable trends.

Similar to prior studies,[5] there is projected growth in the supply of rural or nonmetro ophthalmologists; however, the projected growth according to the HWSM remains insufficient for projected demand. There are known associations between ophthalmologist supply and eye health, which have been better demonstrated in specific geographies or for specific eye diseases. For example, access and use of diabetic eye care have been correlated with ophthalmologist supply.[8,10-12] The prevalence of visual impairment was found to be inversely correlated with density of eye care clinicians in California.[9] However, the national correlation between county-level availability of ophthalmologists and optometrists with vision health or eye care use is nuanced and imperfect,[10,15] likely due to dataset limitations, noise, and confounding geography-specific variables, and the known complex individual and contextual factors of health care access and use.[13,14] The HWSM is beneficial in this regard because the microsimulation scenario analysis accounts for a reduced barriers scenario. If certain contextual and individual barriers to care are able to be reduced,[13] in 2035 there is a forecasted adequacy of 70% in metro geographies compared with 26% in nonmetro geographies, which deserves additional research and possible intervention. The current dataset does not provide granular regional data for ophthalmology provider density.

Given the increased anecdotal demand for ophthalmic technicians, eye care staff may represent one factor exacerbating the inadequate supply of the ophthalmology physician workforce. Similar to the ratio in HWSM forecasts, prior work found a median of 2.7 clinical assistants per ophthalmologist; however, the impact on FTE requirements was minimal and found unlikely to result in significantly greater efficiencies in workforce policy.[3] This finding from the 1990s is worth reevaluation given increased nonmedical clinical demands, including documentation, insurance

processing, ancillary testing, and care coordination. Given HRSA and other projections for surplus of nurse practitioner and physician assistant workforces, dedicated fellowships to train ophthalmic nurse practitioners have been proposed.[32] The presence of ophthalmic technicians has been statistically significantly correlated with increased ophthalmologist productivity in the Veterans Affairs Health Care System.[33] To our knowledge, there is a scarcity of data or studies on specific allied ophthalmic personnel such as photographers, who are likewise critical members of the eye care team. Prior work evaluating HWSM noted that unforeseen changes in demand and the generalized framework may limit the applicability of HWSM to the pharmacist labor supply forecasts.[26] Future studies should focus on the degree to which allied health professionals, such as ophthalmic technicians, expand the individual physician's ability to meet patient volume demand within workforce forecast models.

The micro-summation methods of HWSM use multiple data sources and are not powered to study the effects of scope of practice for physicians or nonphysicians relative to demand. The present analysis is not intended to comment on scope of practice, but rather suggests a need for integrated eye care workforce modeling across the spectrum of eye care to inform policy. Specifically, the work of ophthalmologists is not fungible with other allied health professionals, and ophthalmology requires specialized medical and surgical training. Expansion of undergraduate medical education, Graduate Medical Education (GME), loan repayment programs, specialty training, and other efforts may be needed to counteract the steady decrease in ophthalmologist supply compared with demand. Given the consistent trend for inadequacy of the workforce in rural areas, efforts to encourage physician service in underserved geographies could help increase supply while reducing barriers, and this may be captured with reduced barrier scenarios.

In 2023, 69% of total applicants matched into ophthalmology residency with 516 offered positions.[29] There is evidence that GME is a key bottleneck in workforce sufficiency and that capitation of Medicare and other funding sources may limit the expansion of GME programs, although funding alone is not necessarily sufficient to ensure that any expansion of GME aligns with societal need.[34] The Government Accountability Office reported the expansion of GME between 2005 and 2015 was geographically constrained with a relatively unchanged distribution of residents per capita.[35] The HRSA's Council on Graduate Medical Education 2022 report advocated for expanded assessment of rural training programs and linkage of GME funding to population health needs as well as assessment of return on public investment.[36] These efforts must account for the nuances of specialty and subspecialty shortages such as the anticipated shortage of pediatric ophthalmology.[37] Of note, after a 65% increase in available emergency medicine postgraduate year 1 positions since 2015, there was an unprecedented number of unfilled positions in 2022 and 2023, which offers a cautionary tale of the cost of oversupply of GME.[38]

The last commissioned eye care workforce study by the AAO was approximately 3 decades ago,[3] which was subsequently revisted[39] demonstrating the limitations of forecasting eye care demand and supply given evolving technology and interdisciplinary workforce.[40] A recent methodological review found room for improvement across all reviewed studies on needs-based supply of physicians.[41] We believe multiple stakeholders are needed to assess and intervene on potential workforce shortage issues. The AAO and other organizations may benefit from revisiting the eye care workforce study to validate current HWSM predictions and potentially intervene to address long-term societal and local eye care needs.

Study Limitations

The findings here are subject to several limitations, and all workforce forecasting approaches must be interpreted in the context of their methodologic assumptions.[42] First, the HWSM is subject to limitations of the microsimulation approach to supply modeling, with data sourced from professional clinical associations (e.g., the American Medical Association Masterfile), National Surveys (including the American Community Survey and US Bureau of Labor Statistics Survey), as well as association of state-sponsored surveys and state licensure files. It is important to note that inadequacy of the eye care workforce found here under a reduced barriers scenario would imply improved access to care for vulnerable patient populations and could still net positively impact population eye health. Future forecast and microsimulation approaches must account for interconnectedness of allied professionals, scope of practice, geographic trends, telehealth expansion, and a dynamic and aging population and workforce. Furthermore, recent insightful perspective on the ophthalmology workforce found concerning assumptions in HRSA projections from 2005 and 2020 and other prior forecast models.[19] The Association of American Medical Colleges' recent projections of a shortage between 15 800 and 30 200 FTEs for all surgical specialties[24] must be reconciled with the more sizeable shortage forecast by HRSA. Ophthalmic care would benefit from dedicated forecast investment from the AAO, the Association of University Professors of Ophthalmology, and other organizations that are perhaps more capable of anticipating the future of eye care.

Last, the influence of technological advancement on workforce adequacy cannot be overstated. Innovation can rapidly change the standard of care and consequent eye care demand. Telehealth and improved durability of ophthalmologic interventions could greatly reduce demand for ophthalmology FTEs relative to disease prevalence. Although the current HWSM accounts for population-wide implications of Coronavirus Pandemic through population projections, there is a lack of established data on post-pandemic changes in workforce burnout, remote work transitions, and changes in health care use. Therefore, the microsimulation may be limited by prepandemic inputs based on the latest available literature.

Conclusions

The HRSA's HWSM forecasts a sizeable shortage of ophthalmology supply relative to demand by year 2035, with persistent geographic disparities. These forecasts should be interpreted in the context of a complex meshwork of allied health professionals, a dynamic and aging ophthalmology workforce, and diverse and changing patient population who hopefully will have reduced barriers to accessing eye care. Further dedicated workforce supply and demand research for ophthalmology and other professionals is needed to help inform policy decisions and strategy to overcome projected workforce inadequacy.

Footnotes and Disclosures

Originally received: August 22, 2023.
Final revision: September 13, 2023.
Accepted: September 14, 2023.
Available online: September 20, 2023. Manuscript no. OPHTHA-D-23-01536.

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Disclosure(s):

All authors have completed and submitted the ICMJE disclosures form.

The author(s) have made the following disclosure(s):

R.P.: Consultant − Anthem Blue Cross Blue Shield, Apellis Pharmaceuticals, GLG Consultants, Health & Wellness Partners.

S.P.: Stock options, employment − Genentech; Advisory Board − Genentech, Eyepoint; Research grant − Alcon.

A.P.F.: Data safety or advisory board − Allergan, Alimera, Eyepoint, Iveric Bio, Apellis, Genentech; Consultant − Genentech; Receipt of materials −Genentech.

A.E.K.: Grants or contracts − Alcon Research Institute, Genentech/Roche, Macula Society, Annexon, Retina Society, 4DMT; Consultant − Alimera Sciences, Novartis, Allergan, Genentech/Roche, Bausch + Lomb, Recens Medical, Eyepoint Pharmaceuticals, Spark Therapeutics; Payments − Genentech/Roche, IvericBio, Spark Therapeutics; Stock − Recens Medical, Lumata Health

Supported in part by a Research to Prevent Blindness unrestricted grant to the Vanderbilt Eye Institute. The sponsor or funding organization had no role in the design or conduct of this research.

HUMAN SUBJECTS: Human subjects were not included in this study. The institutional review board at Vanderbilt University Medical Center provided a waiver as this study did not qualify as human subjects research. Study conduction complied with the Declaration of Helsinki. Informed consent was not required.

No animal subjects were included in this study.

Author Contributions:

Conception and design: Berkowitz, Finn, Parikh, Kuriyan, Patel

Data collection: Berkowitz, Finn, Parikh, Kuriyan, Patel

Analysis and interpretation: Berkowitz, Finn, Parikh, Kuriyan, Patel

Obtained funding: N/A; Study was performed as part of regular employment. No additional funding was provided.

Overall responsibility: Berkowitz, Finn, Parikh, Kuriyan, Patel

Abbreviations and Acronyms:
AAO = American Academy of Ophthalmology; **FTE** = full-time equivalent; **GME** = Graduate Medical Education; **HRSA** = Health Resources and Service Administration; **HWSM** = Health Workforce Simulation Model; **NCHWA** = National Center for Health Workforce Analysis.

Keywords:
Ophthalmologist supply, Workforce projection.

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