Gender-Specific Trends in Ophthalmologist Medicare Collections

SUMAYYA AHMAD, PRADEEP RAMULU, ESEN AKPEK, AVNISH DEOBHAKTA, AND JANEK KLAWE

• PURPOSE: **To assess the factors influencing the Medicare collections disparity between male and female ophthalmologists.**
• DESIGN: **Retrospective cohort study.**
• METHODS: **The Medicare Provider Utilization and Payment Data from 2012-2015 were combined with the 2015 Physician Compare National Downloadable file and US Census data. Three complementary regression models were generated for number of patients seen, number of services performed per patient, and the amount collected per service. Predictor variables included gender, calendar year, geography, years since medical school graduation, and subspecialty.**
• RESULTS: **After adjusting for age, geography, and subspecialty, women ophthalmologists collected 42% less as compared to male ophthalmologists, with the median male ophthalmologist out-earning the 75th-percentile female ophthalmologist across almost all age groups, practice categories, and geographic regions. Although women are entering more lucrative subspecialties (cataract and retina) at a higher rate than before, the percentage of women pursuing these subspecialties remains lower than that of men.**
• CONCLUSIONS: **Compared with men, women ophthalmologists see fewer patients and have lower Medicare collections. The observed gender gap in collections was highly persistent across years in practice, subspecialty, and geographic region. Future studies are warranted to examine whether the observed gender collections gap results from structural inequities, social circumstances, or personal choices. (Am J Ophthalmol 2020;214: 32–39. © 2020 Elsevier Inc. All rights reserved.)**

A SIGNIFICANT DIFFERENCE IN COMPENSATION HAS been noted between practicing male and female physicians.[1–4] This discrepancy will become increasingly relevant in future years given that in 2017-2018, for the first time, women exceeded the number of men matriculating in US medical schools (50.7% of the 21,338 matriculates).[5] Ophthalmology mirrors this trend. Although only 24% of practicing ophthalmologists are women, in 2017, the female-male ratio in training programs reached 1:1.[6]

In 2012, the Centers for Medicare and Medicaid Services (CMS) began to release physician reimbursements provided for in the Medicare Fee-for-Service (FFS) program. This comprehensive data set includes information about patient volume, compensation for current Health Care Financing Administration Common Procedural Coding System (HCPCS) codes, and geographic information for physicians participating in the FFS program. A prior study demonstrated a significant Medicare collections gap between genders, with the gap being greatest for surgical subspecialties, in which women on average earn 41% of what men earn, and least for hospital-based specialties, where women earn 71% of what men earn.[4] A single prior study in the field of ophthalmology showed similar results where women ophthalmologists were observed to earn 56% as much in total collections compared to men.[7]

As of this writing, there are no studies that examine the factors affecting the gender gap in Medicare collections among ophthalmologists. Therefore, we used FFS data from 2012-2015 to explore the reasons behind the total collections gap: specifically, whether the gap reflected the number of distinct patients seen, number of billable services per patient, or collections per service. Additionally, we examined whether gender differences in total collections persisted after controlling for geography, number of years since medical school graduation, and practice category.

MATERIALS AND METHODS

THIS STUDY WAS DETERMINED TO BE EXEMPT BY THE INSTITUTIONAL Review Board at the Icahn School of Medicine of Mt. Sinai as all data were available in the public domain.

• DATA SOURCES: Our primary data source was the 2012-2015 Medicare Provider Utilization and Payment Data, specifically the Physician and Other Supplier Public Use Files (PUF)[8–15] which comprehensively describe the Medicare billing activity of all US physicians during this time period. Physicians were identified by their National Provider Identifier (NPI). For each physician and each year, the data set describes the physician's collections,

AJO.com Supplemental Material available at AJO.com.
Accepted for publication Dec 20, 2019.

From the Icahn School of Medicine of Mount Sinai (S.A., A.D.), New York, New York; The Wilmer Eye Institute, Johns Hopkins University School of Medicine (P.R., E.A.), Baltimore, Maryland, USA; New York, NY 10075, USA (J.K.)
Inquiries to Sumayya Ahmad, Department of Ophthalmology, Icahn School of Medicine at Mount Sinai, 1 Gustave L. Levy Pl, New York, NY 10029, USA; e-mail: Sumayya.ahmad@mountsinai.org

0002-9394/$36.00
https://doi.org/10.1016/j.ajo.2019.12.024

number of distinct patients seen, and number of services rendered. These statistics are available as a combined total for the physician, and also broken out by HCPCS service code. To maintain patient anonymity, statistics for an individual HCPCS code are included only if the physician performed that service for at least 10 distinct patients. Thus, although all of a physician's activity is summarized in aggregate form, only 95% of dollars collected (averaged across physicians) are attributed to specific HCPCS codes. The PUF data also include the specialty and practice ZIP code of all physicians, as well as the gender and credentials of most physicians. Six percent of entries in the file are missing a gender, although most of these cases appear to be organizations rather than people. Among the remaining 94% with gender, 3% have no credentials listed.

We augmented the PUF data with several auxiliary sources. The 2015 Physician Compare National Downloadable File contains demographic information for Medicare physicians including NPI and the year of graduation from medical school.[16] However, not all physicians represented in the PUF appear in the Physician Compare data set, and vice versa; those without data available from both data sets were excluded in all analyses as either graduation year or collection details were unavailable. The US Department of Housing and Urban Development (HUD) provides a mapping from ZIP codes to Federal Information Processing Standard Publication (FIPS) county codes and their encompassing US states.[17] County codes were then classified as "metro" or "non-metro" using the US department of Agriculture county classification system.[18] States were then grouped into one of 4 major geographic regions using the US Census Bureau classification system.[19]

• **INCLUSION CRITERIA:** We restricted our data set to ophthalmologists, including only physicians where the PUF files listed their specialty as "ophthalmology" and their credentials as including "MD," "DO," or equivalent (see Appendix for details).

We organized our data set into 60,203 physician-years, each summarizing the collections of one physician for one particular year between 2012 and 2015. Each physician-year was also characterized by gender, geographic region, geographic rurality, years since graduation from medical school, practice category, total collections, total number of distinct patients, and total number of services provided. Here "distinct patients" counted each patient just once, even if they were seen multiple times in a year. And each "service" was defined as a single HCPCS code for one patient, such that multiple services could have been billed by the same physician on the same patient on any given day. (The exact specifications of all variables are detailed in the Appendix.) We did not include physician-years in which physicians had less than 5 or more than 59 years from medical school graduation, reasoning that physicians less than 5 years from graduation were likely still in training, whereas those 59 years out were likely near retirement. Also, a poorer model fit was seen when individuals in these ranges were included.

Ophthalmologists were grouped into 7 broad practice categories based on their yearly billing activity: retina surgery (n = 1,610), cornea surgery (n = 606), glaucoma surgery (n = 1,053), oculoplastics surgery (n = 1,503), cataract surgery (n = 9,319), medical retina (n = 1,514), and general medical (n = 4,349).

For each category, we identified the billing codes we felt best characterized that category and included a physician-year in the category if the physician submitted a minimum number of those procedures matching those codes in that year. (See Appendix for the complete list of billing codes for each category.) For physicians who qualified for multiple categories, we used 3 additional rules to select a single category. If one category was deemed "more specialized" than other, we used the more specialized one; for example, cornea surgeons often perform cataract surgery, but not vice versa. However, if the categories were at the same level of specialization, we used the category in which the greatest number of characteristic procedures were submitted. To break any remaining ties, we used the first category in the ordering above (eg, retina, then cornea, etc).

The most specialized categories were retina, cornea, and glaucoma; a physician fell into one of these if they submitted at least 12 procedures in that category in a given year. Next were plastics and cataract surgery, with thresholds of 12 procedures. Any other physician would be categorized as medical retina if he or she submitted at least 60 medical retina procedures. The remaining physicians were categorized as general medical.

We began with a data set containing 19,303 physicians: those listed in the PUF under "Ophthalmology." A total of 3,338 were excluded for not having MD-equivalent credentials (n = 348), inability to identify a state based on ZIP code or the physician being located in Puerto Rico (n = 208), the physician not being present in the National Compare data set or their graduation year not being available (n = 2,420), or the time since graduation being less than 5 years or greater than 59 years (n = 317), leaving an analytic sample of 16,010 physicians.

• **STATISTICAL ANALYSIS:** To understand the factors affecting ophthalmologist collections, we fit a linear model with the log of the collections considered as the outcome variable, using generalized estimating equations to account for correlations between calendar years of the same physician. Gender was considered as the primary predictor variable, whereas additional predictor variables included calendar year, geographic region, metro vs rural status, time since graduation (in 5-year buckets), and practice category. All of these covariates were treated as categorical variables. Correlation between observations from a single physician was modeled as exchangeable.

To better understand the specific components contributing to collections, we assessed the 3 components of "total collections" in separate regression models using the same predictor variables as described above: (1) number of distinct patients seen (in that year), (2) number of services billed per distinct patient, and (3) average collections per service. A physician's total collections number is the product of these 3 components, such that the percentage decrease in total collections can be broken down into the factors contributing to collections. For example, our model finds that women collect 58% as men, which can be decomposed into 64% as many unique patients, 94% as many services per patient, and 93% as much collected per service. (Thus, 64% × 94% × 93% ≈ 58%, with a slight mismatch introduced by the use of the general estimating equations.) Python software, version 2.7.12 (Delaware, United States), was used to analyze the data. The libraries used were StatsModels (0.8.0), Pandas (0.22.0), and Seaborn (0.7.1).[20,21] More detailed information regarding the statistical analysis is included in the Appendix.

RESULTS

• **POPULATION STATISTICS:** The proportion of women ophthalmologists increased over time: among ophthalmologists practicing in 2015, 18% (95% confidence interval (CI): 17%-20%) of those who graduated between 1980 and 1989 were women, compared with 36% (CI: 34%-37%) graduating between 2000 and 2009. The number of physicians classified as medical retina or any type of surgeon (those who collect the most from Medicare) also increased for both genders. However, a smaller proportion of women are entering these specialties: among 2000-2009 graduates, the proportions were 75% of men and 66% of women, whereas among 1980-1989 graduates, these subspecialties were made up of 80% of men and 70% of women (Supplementary Figure 1).

• **FACTORS INFLUENCING TOTAL COLLECTIONS, UNADJUSTED ANALYSIS:** The collections, number of distinct patients seen, and average collections per patient for male and female ophthalmologists are shown in the table. In unadjusted analyses, men collected 1.84-fold more than women (84% more), saw 1.63-fold more patients (64% more), and collected 1.14-fold more per patient (14% more) as compared to a woman.

Discrepancies in collections were also observed across the 7 practice categories (cornea, glaucoma, retina surgery, cataract, oculoplastics, medical retina, and general medical). Of note, the median male ophthalmologist in our sample out-earned the 75th percentile female in all practice categories except for general medical (Figure 1, Supplementary Table).

Total collections for both genders increased with years since medical school graduation, up to 30 years after graduation, at which point the trend reversed (Figure 2). Within each 5-year cohort, men had higher total collections than women, with the median male ophthalmologist in each cohort in our sample earning at or near the 75th percentile for women.

When we examine the interaction between years since graduation and practice category, we find that the collections gap between genders persists across age groups, but not across practice categories (Supplementary Figure 2). In particular, the gap is very pronounced among retina and cataract specialists, and much weaker among general medical and general surgical practitioners. (That said, the former 2 groups are much larger and more clearly defined than the latter.)

Although women were less likely than men to work in a non-metro setting (5%, CI: 4%-6%, vs 7%, CI: 7%-8%) and more likely to work in the Northeast (28%, CI: 26%-29%, vs 23%, CI: 22%-24%), the discrepancy in collections was roughly the same between men and women across all geographic regions.

• **REGRESSION ANALYSES:** In our regression analysis (adjusting for category of physician, years since graduation, rurality, and geographic area) women collected approximately 58% as much as men (95% CI: 56%-60%) (Table). They also saw fewer distinct patients than men (64% of male numbers, CI: 62%-67%), had lower collections per service (93% of male levels, CI: 92%-94%), but performed about the same number of services per patient as men (94% as many, CI: 93%-96%).

Practice category was also associated with total collections, with retina surgeons and glaucoma specialists collecting 5.48 (CI: 5.16, 5.81) and 4.25 (CI: 4.03, 4.47) times as much, respectively, as general medical ophthalmologists. Among retina surgeons, the higher collections are mainly due to the higher number of distinct patients seen (2.81, CI: 2.69-2.95, as many as a general medical ophthalmologist), and partially due to the higher number of collections per service and number of services per patient (1.75, CI: 1.69-1.81, and 0.98, CI: 0.96-1.0, respectively). Glaucoma surgeons also collected significantly more per patient (1.24, CI: 1.22-1.27) and also saw more distinct patients (2.65, CI: 2.54-2.77).

Adjusted collections increased with time from graduation up to the 25-29-year bracket (1.74 as much as recent graduates), then declined through the 55-59-year bracket (0.98 as much as recent graduates). These differences were largely driven by number of distinct patients seen, with physicians 25-29 years out seeing 1.64 as many patients.

Finally, geography had a modest influence on total collections, with Southern doctors collecting 14% more than Midwest doctors (CI: 9%-18%), and also seeing 8% more distinct patients (CI: 5%-12%).

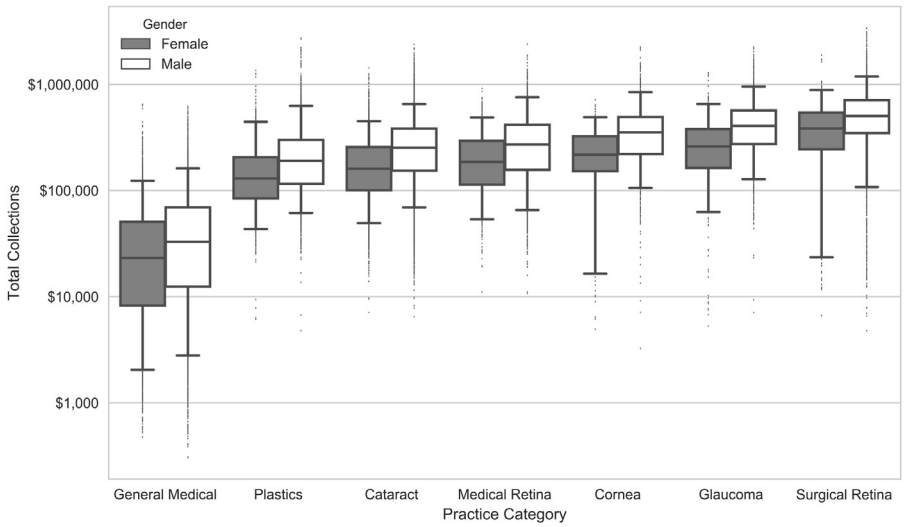

FIGURE 1. Collections by practice category and gender.

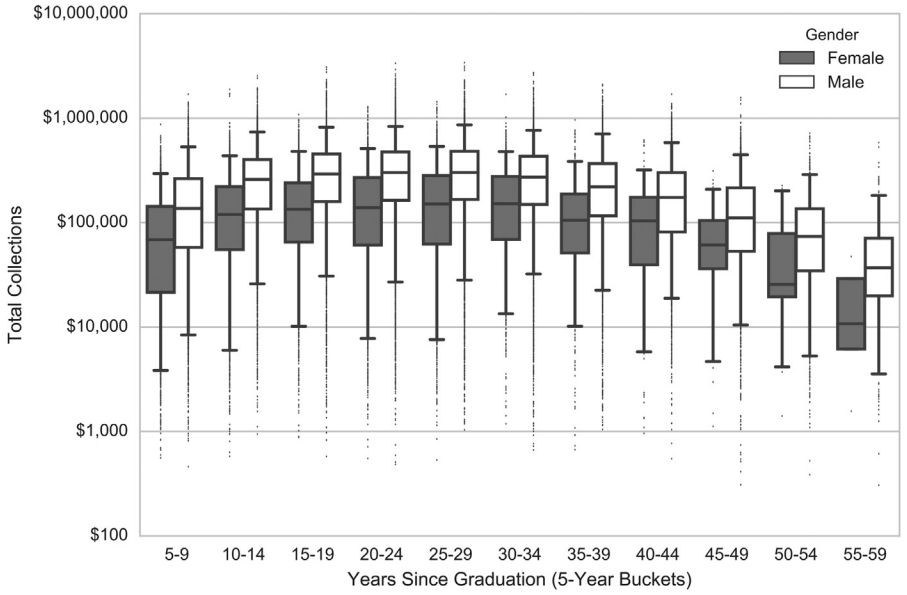

FIGURE 2. Collections by age and practice category.

We also found that over the course of our 4-year sample, total collections decreased, likely reflecting lower reimbursement rates by CMS. Physicians in 2015 collected approximately 98% of what they collected in 2012, mostly due to lower collections per service.

DISCUSSION

BETWEEN 2012 AND 2015, THE AVERAGE MALE OPHTHALMOLogist collected higher than $133,289 more per year than the median female ophthalmologist; furthermore, the median man out-earned the 75th-percentile female ophthalmologist in Medicare collections. This quartile difference in collections was observed across age groups, practice categories, and geography. This gap was largely driven by differences in the number of distinct patients seen: the average man ophthalmologist saw more than 300 more distinct Medicare patients per year than the average woman. Although women are entering the more lucrative fields in ophthalmology (surgical retina, glaucoma, and cornea) at a higher rate than in the past, the rate remains lower than for men.

The consistent finding of a gender gap in collections across years in practice was surprising, as we initially

TABLE. Unadjusted and Adjusted Factors Affecting Collections (Log Transformed)

	Unadjusted Statistics			Rate Ratio[a], 95% CI			
	Number of Observations (Physician-Years)	Mean Number of Patients	Mean Collections ($)	Number of Patients	Services per Patient	Collections per Service	Total Collections
Intercept (n)				192.0 (184-202)	2.43 (2.38-2.49)	$87 (85-88)	$36,941 ($34,991- $38,999)
Gender							
Male	12,394	863	291,164	Ref	Ref	Ref	Ref
Female	3,618	527	157,875	0.64 (0.62-0.67)	0.94 (0.93-0.96)	0.93 (0.92-0.94)	0.58 (0.56-0.6)
Practice type							
BL CTG–general medical	4,349	263	47,430	Ref	Ref	Ref	Ref
CTG– cataract	9,319	956	275,508	2.45 (2.37-2.53)	1.17 (1.16-1.19)	1.15 (1.14-1.16)	3.49 (3.35-3.63)
CTG–cornea	606	927	374,468	2.53 (2.41-2.66)	1.19 (1.16-1.21)	1.24 (1.22-1.26)	3.97 (3.73-4.22)
CTG–glaucoma	1,053	1,119	427,699	2.65 (2.54-2.77)	1.24 (1.22-1.27)	1.18 (1.17-1.2)	4.25 (4.03-4.47)
CTG–retina surgical	1,610	1,043	557,737	2.81 (2.69-2.95)	1.75 (1.69-1.81)	0.98 (0.96-1.0)	5.48 (5.16-5.81)
CTG–plastics surgical	1,503	555	228,250	2.06 (1.97-2.14)	1.3 (1.27-1.33)	1.12 (1.1-1.14)	3.17 (3.01-3.33)
CTG–retina medical	1,514	634	299,958	2.5 (2.38-2.62)	1.75 (1.69-1.8)	0.91 (0.89-0.93)	4.41 (4.16-4.67)
Years in practice							
BL 5-9 YSG	2,937	454	152,722	Ref	Ref	Ref	Ref
10-14 YSG	3,040	682	254,596	1.26 (1.23-1.29)	1.06 (1.04-1.07)	1.0 (0.99-1.01)	1.36 (1.33-1.4)
15-19 YSG	3,050	816	296,693	1.45 (1.41-1.49)	1.08 (1.06-1.09)	0.99 (0.98-1.0)	1.59 (1.55-1.64)
20-24 YSG	3,370	891	313,187	1.58 (1.53-1.62)	1.07 (1.06-1.09)	0.97 (0.96-0.98)	1.71 (1.66-1.77)
25-29 YSG	3,462	946	323,881	1.64 (1.59-1.69)	1.06 (1.05-1.08)	0.95 (0.94-0.96)	1.74 (1.68-1.8)
30-34 YSG	3,202	941	300,936	1.64 (1.59-1.69)	1.05 (1.03-1.07)	0.93 (0.92-0.94)	1.69 (1.63-1.75)
35 YSG	2,444	855	258,937	1.59 (1.54-1.65)	1.02 (1.0-1.04)	0.9 (0.89-0.92)	1.54 (1.49-1.6)
40 YSG	1,532	785	214,398	1.51 (1.46-1.57)	0.97 (0.95-0.99)	0.88 (0.86-0.89)	1.36 (1.3-1.41)
45 YSG	941	646	152,483	1.38 (1.33-1.45)	0.93 (0.91-0.96)	0.85 (0.83-0.86)	1.16 (1.1-1.22)
50 YSG	399	487	99,153	1.22 (1.14-1.29)	0.91 (0.88-0.94)	0.82 (0.8-0.84)	0.96 (0.9-1.03)
55 YSG	129	318	59,424	0.98 (0.89-1.08)	0.87 (0.83-0.92)	0.82 (0.78-0.85)	0.74 (0.66-0.84)
Practice location							
BL region–Midwest	3,310	796	252,208	Ref	Ref	Ref	Ref
Region–Northeast	3,862	716	239,846	0.96 (0.93-1.0)	1.09 (1.06-1.11)	1.02 (1.0-1.03)	1.07 (1.02-1.12)
Region–South	5,638	895	291,487	1.08 (1.05-1.12)	1.03 (1.01-1.05)	1.02 (1.0-1.03)	1.14 (1.09-1.18)
Region–West	3,459	694	250,296	0.83 (0.8-0.87)	1.06 (1.03-1.08)	1.07 (1.05-1.08)	0.94 (0.9-0.99)
Practice geography							
BL Rurality–Metro	14,997	771	258,740	Ref	Ref	Ref	Ref
Rurality–Nonmetro	1,080	1,055	314,247	1.36 (1.3-1.43)	1.0 (0.98-1.03)	0.97 (0.96-0.99)	1.33 (1.26-1.39)
Study Year							
BL Year–2012							
Year–2013	14,830	800	264,247	1.01 (1.0-1.01)	1.02 (1.01-1.02)	0.96 (0.96-0.97)	0.98 (0.98-0.99)
Year–2014	15,266	782	258,795	1.0 (0.99-1.01)	1.03 (1.03-1.04)	0.96 (0.95-0.96)	0.99 (0.98-0.99)
Year–2015	15,690	774	251,474	1.01 (1.0-1.02)	1.05 (1.05-1.06)	0.93 (0.92-0.93)	0.98 (0.97-0.99)

BL= baseline, CI = confidence interval, CTG = category, YSG = years since graduation from medical school.

[a]Refers to the ratio of patients seen, services provided per patient, collections per service, or total collections in the group shown as compared to the relevant reference group.

hypothesized that women early in their careers (ie, during child-rearing years) would collect less than their male counterparts, but might catch up over time. One possible explanation of our findings is that early interruptions in one's career have long-term effects that cannot be overcome. Another possibility is that women are electing for a certain lifestyle, whether it be part-time work or a decision to see fewer distinct patients, and this choice persists across the entirety of their career and is not necessarily age-related (such as with maternity leave). Our geographic analysis also did not reveal any significant discrepancy between genders. What was noteworthy was that women tended to work disproportionately in the Northeast and in metro areas. This pattern is well documented; labor economists have found that there's a trend of educated women being over-

represented in larger metropolitan areas, of which there are more in the Northeast.[22]

Finally, we also hypothesized that practice category might explain the difference: perhaps women are disproportionately entering fields with lower collections. Indeed, they are—but the pattern persists within categories as well. The median male cataract and retina specialists in each age group collected at the 75th percentile of women in the same age group and subspecialty. Others have found this as well: Danesh-Meyer also found fewer female surgical retina specialists and cornea specialists, with a pay gap that was persistent across subspecialty.[23] Among a survey of Canadian ophthalmologists, female refractive surgeons had less operating room time than their male counterparts despite similar work hours and clinical volume.[24]

Our regression models suggest that the difference in total collections is largely driven by a difference in the number of distinct patients seen. This has been demonstrated in both medical and surgical subspecialties.[25] A few possible explanations for this include part-time or more limited-hours work due to family obligations; career interruptions such as maternity leave; behavioral differences such as spending more time per patient or electing to have a lighter schedule per workday for work-life balance. It is also possible that there are structural inequities in the workplace where access to services with higher billing and collections might be restricted. Studies examining this question have showed varied findings. Reports from New Zealand ophthalmologists and US primary care physicians have found that women are more likely to work part-time.[26,27] However, Weeks and Wallace conducted a survey of male and female ophthalmologists in the United States and found that women reported a similar number of working hours to men but saw fewer patients and had lower compensation.[28]

Aside from part-time work, early career interruptions may have a sizeable impact on short- and long-term collections. Labor economists have conjectured that the wage discrepancy is more pronounced in fields where there is a higher penalty for interruptions in work, in particular for those jobs that "require being in contact with others, maintaining and establishing interpersonal relationships, adhering to preset schedules, and doing work where others cannot substitute," such as surgical subspecialties.[29,30] Indeed, developing a robust ophthalmology practice incorporates nearly all of these components.

Finally, behavioral differences may also contribute to lower patient volume. There is evidence that female physicians spend an average of 2 minutes more with patients than men in the primary care setting[31]; in a volume-driven field such as ophthalmology, where a typical visit may last 10 minutes, this difference could significantly reduce patient volume and collections, but also may be related to the lower malpractice rate among women in the field.[32] Furthermore, although collection differences were largely driven by the number of distinct patients seen, women also performed fewer services per patient (perhaps corresponding to less testing) and collected less per service (either performing less lucrative services or selecting more conservative codes for the same service).

Our Medicare findings show that after adjusting for age, practice category, and geography, women collect 58% of what men collect and see 64% as many distinct patients. Our study also generates several questions that should be investigated in future research. First, are women voluntarily choosing to see fewer patients and enter less lucrative subspecialties, or are they facing discrimination from educators, employers, or patients? If it is by choice, then they may be satisfying fundamentally different preferences; perhaps they are opting to work part-time because of familial obligations, reducing patient schedules to spend more time with each patient, or avoiding the stress of a heavily surgical practice. If not, however, then it is incumbent on our community to explore why women are not enabled to see equal numbers of patients as men, for example, as a result of discrimination against women during training, in the hiring process, or after being hired. Are women who are interested in higher-paying specialties such as retina being dissuaded from entering them? Also, is the distribution of the kind and number of patients equal between young male and female hires, or are men enabled to see more patients because of societal mores or more favorable conditions at work? These questions deserve deeper investigation, and the true causes for our findings are likely multifactorial and may stem from both active choices and structural inequities.

There are several limitations to our study. Because the database excludes codes submitted fewer than 10 times, physicians who submitted a small number but high diversity of codes in a particular specialty may not qualify for that classification. The categorization is also biased against specialists who tend to have a younger patient population that do not qualify for Medicare. This may particularly affect both the cornea and retina surgical categories, because many of the patients requiring cornea or retina surgery are often younger and/or the average cornea surgeon performs many more cataract surgeries but may not submit many cornea codes to Medicare. A surgical retina practice may also disproportionately take care of patients with diabetic retinopathy, who tend to be younger than the average Medicare recipient.[33] Our categorization scheme is an oversimplification, because "general medical ophthalmologist" likely encompasses a wide range of subspecialties. This category likely includes the clinical practices of pediatric ophthalmologists whose collections are not accurately represented by our findings, because most of their patients do not qualify for Medicare. Indeed, of all the subspecialties within ophthalmology, strabismus has the highest proportion of women.[32] As these data become more widely analyzed, future studies should exclude pediatric ophthalmologists, whose practice patterns are not accurately represented here. Medicare also represents only a portion of the total payments that most ophthalmologists accept; a study

including all insurance panels might show different results. Our analysis also excludes 17% of the physicians in the Medicare data set, mostly for missing data; this exclusion may introduce further bias. Women working part time also may be skewing our results, because we excluded physicians who performed so few services that they were not included in the data set. Omitting these women may underestimate the true gender difference as well.

In summary, this study presents the most comprehensive review as of this writing of the collection patterns of male and female ophthalmologists in the United States. The trends we find suggest several avenues for further study. We propose a widely distributed survey collecting data on compensation, hours worked per week, time spent per patient, career trajectory and interruptions, and motivations for career choices. Alternatively, a study of data from private insurance physicians or human resources systems might provide a more objective view of compensation patterns. Future studies could also compare total time spent at work, time spent per patient, and number of hours spent per day to determine whether the lower volume is a reflection of practice differences. If organizational inequalities are indeed found to be a factor in the pay gap, then raising awareness among both practice owners and employees may be the first step to maximizing revenue, providing better patient care, and simultaneously closing the gender gap.

SUMAYYA AHMAD WAS SUPPORTED IN PART BY A GRANT FROM THE NEW YORK EYE AND EAR FOUNDATION.

REFERENCES

1. Baker LC. Differences in earnings between male and female physicians. *N Engl J Med* 1996;334(15):960–964.
2. Esteves-Sorenson C, Snyder J. The gender earnings gap for physicians and its increase over time. *Econ Lett* 2012; 116(1):37–41.
3. Jena AB, Olenski AR, Blumenthal DM. Sex differences in physician salary in US public medical schools. *JAMA Intern Med* 2016;176(9):1294–1304.
4. Mahr MA, Hayes SN, Shanafelt TD, Sloan JA, Erie JC. Gender differences in physician service provision using Medicare claims data. *Mayo Clin Proc* 2017;92(6): 870–880.
5. Association of American Medical Colleges. Table A-1: U.S. Medical School Applications and Matriculants by School, State of Legal Residence, and Sex, 2017-2018. Washington, DC: Association of American Medical Colleges; 2019.
6. Parke DW. Gender and leadership. EyeNet Magazine; June 2017.
7. Reddy AK, Bounds GW, Bakri SJ, et al. Differences in clinical activity and Medicare payments for female vs male ophthalmologists. *JAMA Ophthalmol* 2017;135(3):205–213.
8. Medicare Physician and Other Supplier National Physician Identifier (NPI) Aggregate Report. Available at; 2012. https://data.cms.gov/Medicare-Physician-Supplier/Medicare-Physician-and-Other-Supplier-National-Pro/i587-8mbi. Accessed February 6, 2018.
9. Medicare Physician and Other Supplier National Physician Identifier (NPI) Aggregate Report. Available at; 2013. https://data.cms.gov/Medicare-Physician-Supplier/Medicare-Physician-and-Other-Supplier-National-Pro/3zix-38y3. Accessed February 6, 2018.
10. Medicare Physician and Other Supplier National Physician Identifier (NPI) Aggregate Report. Available at; 2014. https://data.cms.gov/Medicare-Physician-Supplier/Medicare-Physician-and-Other-Supplier-National-Pro/4a3h-46r6. Accessed February 6, 2018.
11. Medicare Physician and Other Supplier National Physician Identifier (NPI) Aggregate Report; 2015
12. Medicare physician utilization and payment data: physician and other supplier. Available at; 2012. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Physician-Charge-Data/Physician-and-Other-Supplier.html. Accessed February 6, 2018.
13. Medicare physician utilization and payment data: physician and other supplier. Available at; 2013. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Physician-Charge-Data/Physician-and-Other-Supplier.html. Accessed February 6, 2018.
14. Medicare physician utilization and payment data: physician and other supplier. Available at; 2014. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Physician-Charge-Data/Physician-and-Other-Supplier.html. Accessed February 6, 2018.
15. Medicare physician utilization and payment data: physician and other supplier. Available at; 2015. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Physician-Charge-Data/Physician-and-Other-Supplier.html. Accessed February 6, 2018.
16. Physician Compare datasets. Available at; 2015. https://data.medicare.gov/data/physician-compare. Accessed February 6, 2018.
17. HUD USPS Zip Code Crosswalk Files, Select "ZIP-COUNTRY," "4th Quarter 2017". Available at; 2017. https://www.huduser.gov/portal/datasets/usps_crosswalk.html. Accessed February 8, 2018.
18. Rural-Urban Continuum Codes, 2013. Available at; 2013. https://www.ers.usda.gov/webdocs/DataFiles/53251/ruralurbancodes2013.xls. Accessed February 6, 2018.
19. Geographic Terms and Concepts—Census Divisions and Census Regions. Available at; 2010. https://www.census.gov/geo/reference/gtc/gtc_census_divreg.html. Accessed February 6, 2018.
20. Seabold S, Perktold J. Statsmodels: Econometric and Statistical Modeling with Python. Paper presented at Proceedings of the 9th Python in Science Conference 2010.
21. McKinney W. Data structures for statistical computing in Python. Paper presented at Proceedings of the 9th Python in Science Conference. June 28-July 3, 2010. Austin, Texas.

22. Compton J, Pollak RA, National Bureau of Economic Research. Why are power couples increasingly concentrated in large metropolitan areas. NBER working paper series, Working paper 10918. Cambridge, MA: National Bureau of Economic Research; 2004.
23. Danesh-Meyer HV, Deva NC, Ku JY, Carroll SC, Tan YW, Gamble G. Differences in practice and personal profiles between male and female ophthalmologists. *Clin Exp Ophthalmol* 2007;35(4):318–323.
24. McAlister C, Jin YP, Braga-Mele R, DesMarchais BF, Buys YM. Comparison of lifestyle and practice patterns between male and female Canadian ophthalmologists. *Can J Ophthalmol* 2014;49(3):287–290.
25. Holliday EB, Brady C, Pipkin WC, Somerson JS. Equal pay for equal work: Medicare procedure volume and reimbursement for male and female surgeons performing total knee and total hip arthroplasty. *J Bone Joint Surg Am* 2018;100(4):e21.
26. Uhlenberg P, Cooney TM. Male and female physicians: family and career comparisons. *Soc Sci Med* 1990;30(3):373–378.
27. McMurray JE, Cohen M, Angus G, et al. Women in medicine: a four-nation comparison. *J Am Med Womens Assoc (1972)* 2002;57(4):185–190.
28. Weeks WB, Wallace AE. Gender differences in ophthalmologists' annual incomes. *Ophthalmology* 2007;114(9):1696–1701.
29. Goldin C. A grand convergence: its last chapter. *Am Econ Rev* 2014;104(4):1091–1119.
30. Bertrand M, Goldin C, Katz LF. Dynamics of the gender gap for young professionals in the financial and corporate sectors. *Am Econ J Appl Econ* 2010;2(3):228–255.
31. Roter DL, Hall JA, Aoki Y. Physician gender effects in medical communication: a meta-analytic review. *JAMA* 2002;288(6):756–764.
32. Fountain TR. Ophthalmic malpractice and physician gender: a claims data analysis (an American Ophthalmological Society thesis). *Trans Am Ophthalmol Soc* 2014;112:38–49.
33. Lee R, Wong TY, Sabanayagam C. Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss. *Eye Vis (Lond)* 2015;2:17.