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Comparison of Hospital Mortality and Readmission Rates by Physician and Patient Sex

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Background: Little is known as to whether the effects of physician sex on patients' clinical outcomes vary by patient sex.

Objective: To examine whether the association between physician sex and hospital outcomes varied between female and male patients hospitalized with medical conditions.

Design: Retrospective observational study.

Setting: Medicare claims data.

Patients: 20% random sample of Medicare fee-for-service beneficiaries hospitalized with medical conditions during 2016 to 2019 and treated by hospitalists.

Measurements: The primary outcomes were patients' 30-day mortality and readmission rates, adjusted for patient and physician characteristics and hospital-level averages of exposures (effectively comparing physicians within the same hospital).

Results: Of 458 108 female and 318 819 male patients, 142 465 (31.1%) and 97 500 (30.6%) were treated by female physicians, respectively. Both female and male patients had a lower patient mortality when treated by female physicians; however, the benefit of receiving care from female physicians was larger for female patients than for male patients (difference-in-differences, −0.16 percentage points [pp] [95% CI, −0.42 to 0.10 pp]). For female patients, the difference between female and male physicians was large and clinically meaningful (adjusted mortality rates, 8.15% vs. 8.38%; average marginal effect [AME], −0.24 pp [CI, −0.41 to −0.07 pp]). For male patients, an important difference between female and male physicians could be ruled out (10.15% vs. 10.23%; AME, −0.08 pp [CI, −0.29 to 0.14 pp]). The pattern was similar for patients' readmission rates.

Limitation: The findings may not be generalizable to younger populations.

Conclusion: The findings indicate that patients have lower mortality and readmission rates when treated by female physicians, and the benefit of receiving treatments from female physicians is larger for female patients than for male patients.

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Sex disparities in health care quality and hospital care outcomes are well documented (1, 2). Studies show that female patients are less likely to receive intensive care and procedures (3–5), more likely to experience delayed diagnoses (6, 7), and have more negative patient experiences (8) compared with male patients. Studies have also shown that female patients are more likely than their male counterparts to have their concerns dismissed or to experience discrimination (9) and to have their pain (10) and cardiovascular symptoms underestimated (11, 12). Given the body of literature showing that physician practice patterns vary by provider sex (13–15), understanding the role that physician sex plays in these sex disparities in care is essential.

Studies have shown that treatment by female physicians leads to improved communication effectiveness (16–19), better rapport (20), and greater agreement about advice provided (21) in female patients, but these associations are inconclusive for male patients. Some studies also suggest that seeing a female physician is associated with higher quality-of-care processes, especially in female patients (22–24). However, despite a growing body of literature on the importance of physician sex in patient clinical outcomes (14, 25), evidence is limited as to whether the effect of physician sex on clinical outcomes varies by patient sex. To our knowledge, there has been only 1 study done in the United States on this topic for medical conditions, which found that survival benefits from treatment by female physicians were larger for female patients than for male patients with acute myocardial infarction in Florida (26). However, this study was done on patients in a single state with a single medical condition, and therefore, it remains unclear whether these findings can be generalized to other regions or conditions.

To address this important knowledge gap, using a random sample of Medicare beneficiaries hospitalized with medical conditions, we examined how the association between physician sex and clinically important

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patient outcomes, such as 30-day patient mortality and 30-day readmissions, varied by patient sex. To minimize the possibility that patients may have elected specifically to see a same-sex physician, we exploited the quasi-random assignment of hospitalists to emergency or urgent admissions (27, 28). Because hospitalists typically work in shifts, patients are plausibly quasi-randomly assigned to hospitalists on the basis of physicians' work schedules—a natural experiment.

METHODS

Data Sources

We linked 2 data sources: a 20% sample of 2016 to 2019 Medicare claims (Inpatient and Carrier Files) and Medicare Data on Provider Practice and Specialty (MD-PPAS) (29). The MD-PPAS files were provided by the Centers for Medicare & Medicaid Services, which included physician-level information on sex, birth date, and specialty. We were able to match more than 99% of physicians in the Medicare claims to the MD-PPAS files using the National Provider Identifier. This study was approved by the University of California, Los Angeles Institutional Review Board, and patient consent was not required.

Study Population

Our study population included Medicare fee-for-service beneficiaries aged 65 years or older who were hospitalized between 1 January 2016 and 31 December 2019. The population was restricted to patients who were hospitalized with a medical condition, as defined by the presence of a medical diagnosis-related group (Medicare Severity Diagnosis Related Group [MS-DRG]). As such, hospitalizations with surgical or obstetric MS-DRGs were excluded. We attributed each hospitalization to a physician based on the National Provider Identifier in the Carrier File that accounted for the largest number of evaluation and management (E&M) claims during that hospitalization, according to prior studies (14, 28, 30, 31). We excluded hospitalizations for which multiple physicians were identified as those accounting for the largest number of E&M claims. In our data, on average, 49.6%, 21.1%, and 11.8% of total E&M claims were accounted for by the physician with the first, second, and third highest number of E&M claims, respectively.

To minimize the possibility that unobserved differences in clinical severity in patients seen by female and male physicians may affect patient outcomes, we focused our analyses on patients who were hospitalized for treatment of an urgent or emergent medical condition (that is, we excluded elective admissions) and treated by a hospitalist. Hospitalists typically work in scheduled shifts or blocks (for example, 7 days on, 7 days off) and in general do not treat patients in the outpatient setting. Therefore, within the same hospital, patients are plausibly quasi–randomly assigned to hospitalists on the basis of the timing of patients' admissions and hospitalists' work schedules (27, 31). We assessed the validity of this assumption by testing the balance of patient characteristics between female and male physicians for each patient sex. We defined hospitalists as general internal medicine physicians (hospitalist, general practice, internal medicine, family practice, or geriatrics medicine in the MD-PPAS data) who filed at least 90% of their total E&M billings in an inpatient setting, a claims-based approach validated and used in previous studies (31–35). In our data, hospitalizations treated by a hospitalist accounted for 71.8% of total hospitalizations treated by general internal medicine physicians (including both hospitalists and nonhospitalists) for an urgent or emergent medical condition.

We further restricted our analysis to patients treated at acute care hospitals and excluded patients who left against medical advice. To ensure a sufficient follow-up period, patients admitted in December 2019 were excluded from the analyses of 30-day mortality and patients discharged in December 2019 were excluded from the analyses of 30-day readmissions.

Combinations of Patient and Physician Sex

On the basis of the a priori hypothesis that the association between physician sex and outcomes may be modified by patient sex (26, 36, 37), the exposure variables were 4 patient–physician sex dyads: female patient–female physician, female patient–male physician, male patient–female physician, and male patient–male physician. Information on patient sex (categorized as female or male) was available for more than 99% of hospitalizations in the Medicare claims data. Information on physician sex (categorized as female or male) was available for more than 99% of the physicians in the MD-PPAS files, which included self-reported information on physician sex extracted from the National Plan and Provider Enumeration System database. Patients and physicians missing or reporting "unknown" for sex were excluded.

Outcome Variables

The primary outcomes were 30-day mortality from the date of hospital admission and 30-day readmission from the date of hospital discharge. Information on dates of death was available in Medicare Beneficiary Summary files, where more than 99% of death dates were validated using death certificates (38). We excluded patients whose death dates were not validated.

We assessed several secondary outcomes, including length of stay, health care spending (Part B spending per hospital admission) (39), proportion of E&M claims with high intensity (calculated by number of claims with high-severity Healthcare Common Procedure Coding System codes [99223 and 99233] divided by number of all E&M claims) (40), and discharge to home. These outcomes were chosen as they may provide a channel through which patient–physician sex dyads may influence patient outcomes.

Adjustment Variables

We adjusted for patient characteristics and physician characteristics (other than patient sex and physician sex). Patient characteristics included age; race and ethnicity; reason for hospitalization (indicators of primary diagnoses, defined by MS-DRG) (41); indicators of 27 coexisting conditions; median household income level of residence, an indicator for dual eligibility for Medicare–Medicaid coverage; year indicators; and day of week indicators. Physician characteristics included age, credentials (MD vs. DO), and patient volume (**Supplement Method**, available at Annals.org). Given that patient case mix, acuity, and hospital resources vary greatly across hospitals, we compared patients treated at the same hospital by using the effect partitioning approach in which we included hospital-level averages of exposures (patient–physician sex dyads) as adjustment variables of the regression models (42, 43). This approach allowed us to estimate differences in outcomes within hospitals (similar to adjusting for hospital fixed effects) among the 4 groups on the basis of patient–physician sex combinations.

Statistical Analysis

First, we displayed patient characteristics, including reason for hospitalization and illness severity, and compared them by physician sex for female and male patients separately. We defined patient illness severity by estimating predicted 30-day mortality in a hospitalization-level logistic regression model with 30-day mortality as an outcome and the patient characteristics listed above as explanatory variables (14, 31, 44). We also compared physician age, credentials, and patient volumes between female and male physicians. The purpose of these analyses was to assess whether patient and physician characteristics were similar between female and male physicians, a requirement for a natural experiment.

Second, we examined the association between patient–physician sex dyads and 30-day patient mortality using a hospitalization-level multivariable logistic regression model, adjusted for patient and physician characteristics and hospital-level averages of exposure variables. We pooled female and male patients for this analysis and set 4 patient–physician sex dyads as exposure variables. Standard errors were clustered at the hospital level (42). We calculated adjusted 30-day mortality rates for each of the 4 patient–physician dyads using marginal standardization (45). To improve interpretability of findings, we calculated and reported average marginal effects (AMEs) of being treated by female physicians (instead of odds ratios) separately for the female patients and male patients by estimating contrasts of margins (46). We also reported the difference-in-differences (differences in the AME between female and male patients) to examine whether the benefit of being treated by female physicians varied by patient sex. We also evaluated the relationship between patient–physician sex dyads and 30-day readmission using a similar method to the analysis of mortality.

Finally, we repeated the same set of analyses using the secondary outcomes (length of stay, health care spending, proportion of E&M claims with high intensity, and discharge to home), except for using negative binomial models for length of stay and health care spending (after identifying an overdispersion issue) and using a linear regression model for proportion of E&M claims with high intensity. In these analyses, we included hospital fixed effects in the model, instead of hospital-level averages of exposure variables.

Sensitivity Analyses

We conducted several sensitivity analyses. First, hospital care is provided by a team as much as individuals. We tested 3 alternative attribution rules to focus on physicians more responsible for patient care in a given hospitalization: restricting analyses to hospitalists who accounted for 50% or more of total E&M claims during a given hospitalization, restricting analyses to patients treated by a single hospitalist during a given hospitalization, and restricting the analysis to physicians who saw the patient first and who also accounted for the largest number of E&M claims during a given hospitalization. Second, to minimize confounding by resident physicians in the relationship between attending hospitalists and patient outcomes, we reanalyzed the data after excluding patients treated by resident physicians (identified by using the Healthcare Common Procedure Coding System "GC" modifier [47]). Third, because patient–physician sex dyads may influence mortality outcomes through differences in end-of-life care decisions (for example, female patients may be more amenable to hospice care when cared for by a female physician), we excluded patients discharged to hospice or with a diagnosis of cancer. Fourth, to test whether our findings were sensitive to follow-up periods for measuring patient outcomes, we used 60- and 180-day mortality instead of 30-day patient mortality. Fifth, to test the generalizability of our findings, we repeated our analyses among general internal medicine physicians overall (including both hospitalists and nonhospitalist general internal medicine physicians). Sixth, we excluded hospital-level averages of exposures from the model and repeated the analyses. Finally, to investigate the possibility that the hospitalist team structure may serve as an unmeasured confounder and explain observed differences in patient mortality, we quantified how strongly this variable needs to be associated with physician sex and patient mortality to explain away the observed difference in patient mortality treated by female physicians versus male physicians by calculating an E-value (48).

Secondary Analyses

We conducted several subgroup analyses. First, we examined whether the association between physician sex and patient outcomes in female and male patients varied by patients' primary diagnoses. To define the primary diagnosis, we evaluated the 6 most common Major Diagnostic Categories treated by hospitalists in our data (accounting for approximately 80% of hospitalizations): respiratory system conditions, circulatory system conditions, infectious diseases, kidney and urinary conditions, digestive system conditions, and nervous system conditions. The Major Diagnostic Categories were mutually exclusive major organ system–based categories and were determined on the basis of MS-DRG codes.

Second, we examined whether the association between physician sex and patient outcomes in female and male patients varied by patient illness severity. Illness severity was defined on the basis of a patient's predicted 30-day mortality by categorizing patients into terciles of predicted mortality. Within each predicted mortality tercile, we separately examined patient outcomes among patient–physician sex dyads, adjusting for patient and physician characteristics and hospital-level averages of exposure variables.

Data preparation was done using SAS, version 9.4 (SAS Institute), and analyses were done using Stata, version 16 (StataCorp).

Role of the Funding Source

The funding sources had no role in the design or conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript.

RESULTS

Characteristics of the Study Population

Among 776 927 hospitalized patients treated by 42 114 physicians, 239 965 (30.9%) patients received treatment from female physicians. By patient sex, 142 465 (31.1%) of the 458 108 female patients and 97 500 (30.6%) of the 318 819 male patients were treated by female physicians. We observed no clinically meaningful difference in patient characteristics between female versus male physicians for both female and male patients (**Table 1**), including reason for hospitalization and patient severity as defined by predicted 30-day mortality (**Supplement Figures 1** and **2**, available at Annals.org).

Physician Sex and Patient Mortality, by Patient Sex

Unadjusted mortality was 9.08% (70 513 of 776 927) overall, 8.42% (38 594 of 458 108) for female patients, and 10.01% (31 919 of 318 819) for male patients. After adjustment for patient characteristics, physician characteristics, and hospital-level averages of exposures (**Table 2**), both female and male patients had a lower mortality rate when treated by a female physician. The difference between female and male physicians was clinically important for female patients (adjusted rates, 8.15% for female vs. 8.38% for male physician; AME, −0.24 percentage points [pp] [95% CI, −0.41 to −0.07 pp]). For male patients, the difference between female and male physicians was small and not statistically significant, allowing us to rule out clinically important differences (10.15% vs. 10.23%; AME, −0.08 pp [CI, −0.29 to 0.14 pp]). The benefit of receiving care from a female physician was larger for female patients than for male patients (difference-in-differences, −0.16 pp [CI, −0.42 to 0.10 pp]), although this result did not reach conventional levels of statistical significance.

Physician Sex and Patient Readmissions, by Patient Sex

The unadjusted 30-day readmission rate was 15.83% (117 484 of 742 097) overall, 15.23% (66 889 of 439 305) for female patients, and 16.71% (50 595 of 302 792) for male patients. We found that both female and male patients had a lower adjusted readmission rate when treated by a female physician. For female patients, the difference between female and male physicians was clinically important (15.51% vs. 16.01%; AME, −0.48 pp [CI, −0.72 to −0.24 pp]) (**Table 2**). For male patients, the difference in readmission rates was small and not statistically significant, allowing us to rule out an important difference between female and male physicians (15.65% vs. 15.87%; AME, −0.23 pp [CI, −0.52 to 0.06 pp]). The benefit of receiving care from a female physician was larger for female patients than for male patients (difference-in-differences, −0.25 pp [CI, −0.61 to 0.11 pp]), although the result did not achieve conventional levels of statistical significance.

Physician Sex and Secondary Outcomes, by Patient Sex

The differences in secondary outcomes, including length of stay, Part B spending, proportion of intensive E&M claims, and likelihood of discharge to home, were clinically small between female and male physicians among female patients and male patients (**Supplement Table 1**, available at Annals.org).

Sensitivity Analyses

Our findings were qualitatively unaffected by restricting analyses to hospitalists who billed 50% or greater (**Supplement Table 2**, available at Annals.org), by restricting to patients who were treated by a single hospitalist (**Supplement Table 3**, available at Annals.org), by restricting to physicians who saw the patient first (**Supplement Table 4**, available at Annals.org), by excluding patients who were treated by resident physicians (**Supplement Table 5**, available at Annals.org), by excluding patients who were discharged to hospice or with a diagnosis of cancer (**Supplement Table 6**, available at Annals.org), when using 60- and 180-day mortality instead of 30-day patient mortality (**Supplement Table 7**, available at Annals.org), and by including nonhospitalist general internal medicine physicians

Table 1. Characteristics of Physicians and Patients

Characteristic	Female Patients			Male Patients		
	Female Physicians	Male Physicians	Standardized Mean Difference	Female Physicians	Male Physicians	Standardized Mean Difference
Physician characteristics						
Physicians, *n*	14 512	25 268	–	13 819	24 357	–
Mean age (SD), *y*	40.3 (8.3)	42.8 (10.0)	0.28	40.3 (8.3)	42.9 (10.0)	0.28
Osteopathic degree, *n* (%)	1972 (13.6)	3008 (11.9)	−0.051	1880 (13.6)	2873 (11.8)	−0.054
Mean observed admissions per year (SD), *n*	8.3 (7.2)	10.8 (9.9)	0.29	8.6 (7.2)	11.1 (9.8)	0.29
Patient characteristics*						
Patients, *n*	142 465	315 643	–	97 500	221 319	–
Mean age, *y*	81.0	81.0	0.006	79.1	79.1	0.008
Race and ethnicity, *n* (%)						
White	117 354 (82.4)	259 337 (82.2)	0.007	79 611 (81.7)	181 202 (81.9)	−0.008
Black	13 369 (9.4)	30 343 (9.6)	−0.010	9035 (9.3)	20 335 (9.2)	0.004
Hispanic	6804 (4.8)	15 188 (4.8)	−0.002	4814 (4.9)	10 642 (4.8)	0.008
Others	4938 (3.4)	10 775 (3.4)	0.003	4040 (4.1)	9140 (4.1)	0.001
Median ZIP code household income, $	64 561	64 409	0.008	64 784	64 655	0.007
Medicaid eligible, *n* (%)	35 504 (24.9)	79 557 (25.2)	−0.008	18 067 (18.5)	41 137 (18.6)	−0.002
Chronic conditions, *n* (%)						
Congestive heart failure	73 700 (51.7)	164 353 (52.1)	−0.009	51 823 (53.2)	118 767 (53.7)	−0.013
Chronic obstructive pulmonary disease	56 588 (39.7)	126 854 (40.2)	−0.012	41 588 (42.7)	94 419 (42.7)	<0.001
Diabetes	61 241 (43.0)	135 830 (43.0)	−0.001	47 175 (48.4)	106 919 (48.3)	0.002
Chronic kidney disease	89 843 (63.1)	198 716 (63.0)	0.003	68 328 (70.1)	154 204 (69.7)	0.011
Depression	65 462 (45.9)	144 024 (45.6)	0.008	32 912 (33.8)	74 918 (33.9)	−0.003
Cancer	24 711 (17.3)	55 387 (17.5)	−0.007	20 673 (21.2)	46 907 (21.2)	<0.001
Predicted mortality rate, %†	8.45	8.41	0.004	10.06	10.00	0.007

* Adjusted for the hospital where a patient was treated by using hospital fixed effects and estimating standardized marginal effects. Linear probability models were used for binary variables.

† Calculated by regressing 30-d mortality on patient characteristics using a logistic regression model.

(**Supplement Table 8**, available at Annals.org). Without adjustment for hospital, the difference between female and male physicians in mortality was modestly larger than with adjustment for hospital, suggesting the presence of confounding by hospital (**Supplement Table 9**, available at Annals.org). The E-value was 1.25 for 30-day mortality of female patients, indicating the observed difference could be explained away by an unmeasured confounder (for example, hospitalist team structure) that was associated with both the exposure (physician sex) and outcome by a relative risk of 1.25 (**Supplement Table 10**, available at Annals.org). Given that this was larger than the observed association of congestive heart failure or chronic kidney disease with patient mortality in our model, the effect of unmeasured confounders on patient mortality would need to be larger than those of these major comorbidities to explain away our findings, which we believe is unlikely (49, 50).

Secondary Analyses

For male patients, the differences in patient mortality between female and male physicians were small in magnitudes across primary diagnoses, although wide CIs did not rule out the possibility of important differences (**Figure**; **Supplement Table 11**, available at Annals.org). Among female patients, a trend toward lower patient mortality was seen among female physicians across several conditions that we examined, although the magnitude of the differences varied by conditions. In particular, patients treated by female physicians had a lower 30-day mortality rate than those treated by male physicians for nervous system diseases (AME, −0.89 pp [CI, −1.60 to −0.18 pp]). The differences in 30-day readmission rates were also small in magnitudes between female and male physicians for any specific condition among male patients. However, female patients treated by female physicians had a lower readmission rate for kidney and urinary conditions (AME, −1.20 pp [CI, −1.88 to −0.52 pp]). The benefit of receiving care from a female physician was larger for female patients than for male patients across all conditions except circulatory conditions for mortality and nervous conditions for readmission, although the results did not achieve conventional levels of statistical significance.

We could rule out important differences in adjusted 30-day mortality rates between female and male physicians for any illness severity group among male patients (**Table 3**). Among female patients, 30-day mortality was lower when patients with high illness severity were treated by female physicians compared with male physicians (18.30% vs. 19.03%; AME, −0.77 pp [CI, −1.21 to −0.33 pp]), and the benefit of receiving care from a female physician was larger for female patients than for male patients (difference-in-differences, −0.51 pp [CI, −1.14 to 0.12 pp]). In addition, the benefit of receiving care from a female physician in readmission rates was larger for female patients than for male patients across illness severity groups, although the results did not achieve conventional levels of statistical significance.

Table 2. Physician Sex and 30-Day Patient Mortality and Readmission Among Female and Male Patients

Outcome	**Patients (Physicians), *n***	**Adjusted Rate (95% CI), %***		**AME (95% CI), *pp*†**	**Difference-in-Differences (95% CI), *pp*†**
		Female Physician	**Male Physician**		
30-d mortality					
Female patients	458 108 (39 768)	8.15 (7.99 to 8.30)	8.38 (8.26 to 8.50)	−0.24 (−0.41 to −0.07)	−0.16 (−0.42 to 0.10)
Male patients	318 819 (38 167)	10.15 (9.94 to 10.36)	10.23 (10.07 to 10.39)	−0.08 (−0.29 to 0.14)	Reference
30-d readmission					
Female patients	439 305 (39 465)	15.51 (15.28 to 15.74)	16.01 (15.84 to 16.18)	−0.48 (−0.72 to −0.24)	−0.25 (−0.61 to 0.11)
Male patients	302 792 (37 768)	15.65 (15.39 to 15.91)	15.87 (15.69 to 16.06)	−0.23 (−0.52 to 0.06)	Reference

AME = average marginal effect; pp = percentage point.

* We pooled female and male patients for this analysis and set 4 patient–physician sex dyads as exposure variables. We used multivariable logistic regression models that adjusted for patient characteristics (age category, race and ethnicity, Medicaid eligibility, median income in ZIP code of residence, 27 coexisting conditions, primary diagnosis [Diagnosis Related Group category indicators], year indicators, date indicators), physician characteristics (age category, credentials, number of hospital admissions per year), and hospital-level averages of exposure variables (to effectively compare physicians within the same hospital). Standard errors were clustered at the hospital level. Adjusted rates were calculated using predictive margins.

† Average marginal effects (instead of odds ratios) for female versus male physicians were calculated separately for both female and male patients by estimating contrasts of margins. We calculated the differences in the AMEs between female and male patients to examine whether the benefits of being treated by female physicians vary by patient sex.

Discussion

Using a nationally representative sample of Medicare patients aged 65 years or older who were hospitalized during 2016 to 2019 and treated by hospitalists, we found that both female and male patients had lower patient mortality and readmission rates when treated by female physicians. The benefit of receiving care from a female physician was larger for female patients than for male patients; the differences between female and male physicians were clinically important among female patients but not male patients. Length of stay, Part B spending, proportion of intensive E&M claims, and likelihood of discharge to home were similar between patients treated by female and male physicians, for both female and male patients. The observed differences in mortality among female patients were particularly notable among those who were severely ill. Taken together, these findings suggest that treatment by female physicians may have a beneficial impact on female patients (especially severely ill female patients) but not necessarily on male patients.

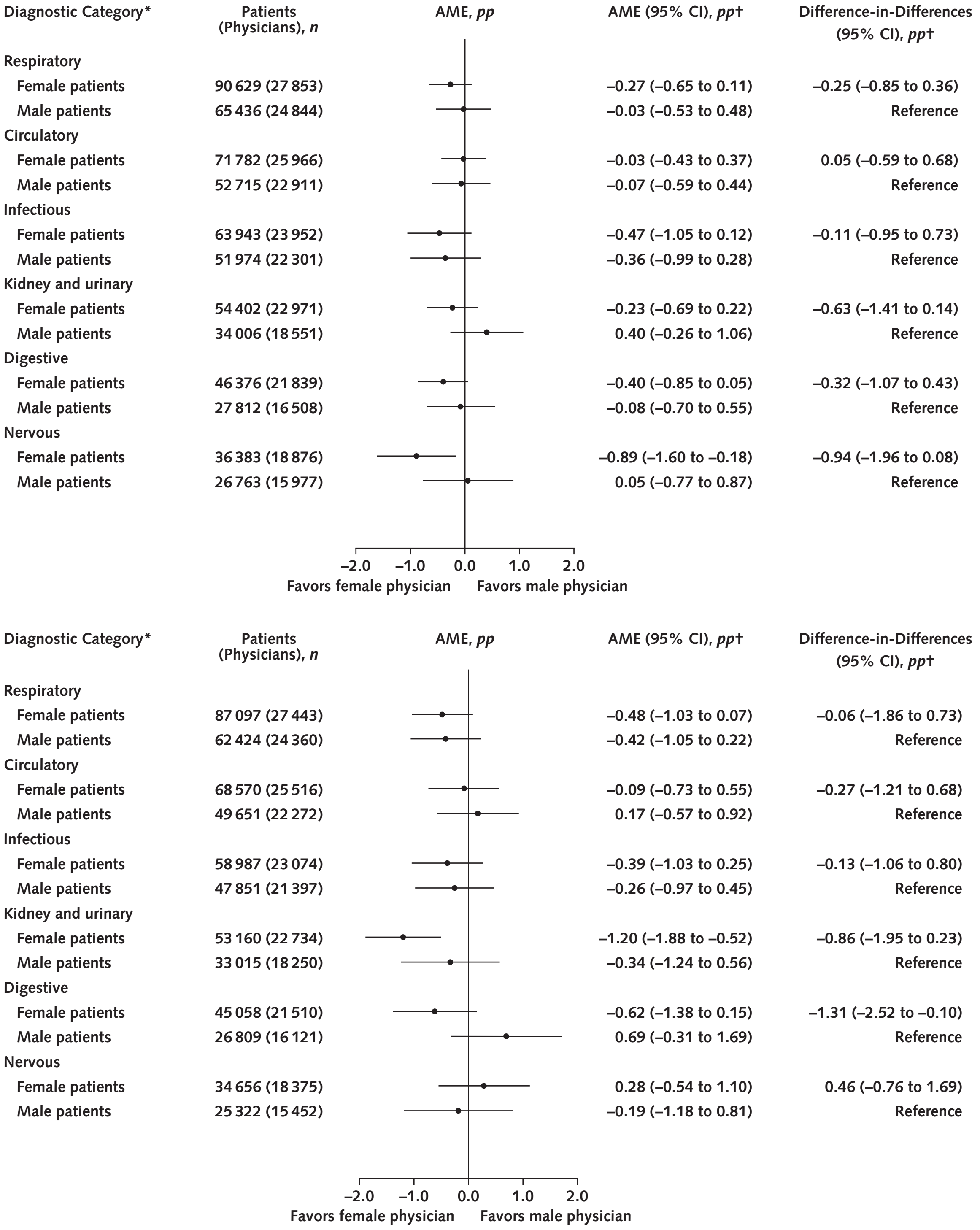
Our results indicate that the difference in mortality rates between female and male physicians in female patients (difference, 0.24 pp) may be interpreted as decomposing into a benefit from being treated by a female physician independent of patient sex (0.08 pp) and an additive interaction effect between patients' female sex and treatment by female physicians (0.16 pp). Although both estimates of the decomposed parts did not reach statistical significance, the magnitudes of the point estimates suggest the importance of patient–physician sex interactions.

There are several potential mechanisms through which treatment by female physicians may be associated with better outcomes among female patients but not among male patients. First, male physicians may underestimate illness severity among female patients. Studies have found sex differences in the reported patterns of pain (10), gastrointestinal symptoms (51), and cardiovascular symptoms (11, 12), with health care providers—particularly male providers—tending to underestimate such symptoms when experienced by women (11, 52, 53). One study reported that male physicians were more likely than their female counterparts to underestimate women's stroke risks (54). Underappreciation of symptoms and risks among female patients may result in delayed or incomplete care, ultimately leading to poorer patient outcomes. These issues may be exacerbated by the limited opportunities for systematic medical training in women's health in general medical curricula (55). Second, being treated by female physicians may be associated with patient-centered and effective communication among female patients, as previous studies in primary care and obstetrics and gynecology settings have reported (16–19). Ineffective communication hinders patients from providing crucial information for accurate diagnoses and treatment, potentially leading to suboptimal outcomes. Third, treatment by female physicians may help alleviate embarrassment, discomfort, and sociocultural taboos during sensitive examinations and conversations (for example, involving private body parts) for female patients (56–59). Female patients who receive care from male physicians may experience incomplete physical examinations.

Although the differences in patient mortality and readmission between female and male physicians among female patients were modest, the 0.24 pp difference in mortality and the 0.48 pp difference in readmission corresponded to 1 death per 417 Medicare hospitalizations and 1 readmission per 208 Medicare hospitalizations, which arguably are clinically meaningful differences given more than 4 million Medicare hospitalizations per year for a medical condition in the United States (60).

Our findings are consistent with prior studies in different clinical contexts that suggest that treatment

Figure. Physician sex and 30-day patient mortality (*top*) and readmission (*bottom*) rates among female and male patients, stratified by major diagnosis category.



Diagnostic Category*	Patients (Physicians), *n*	AME (95% CI), *pp*†	Difference-in-Differences (95% CI), *pp*†
Respiratory			
Female patients	90 629 (27 853)	−0.27 (−0.65 to 0.11)	−0.25 (−0.85 to 0.36)
Male patients	65 436 (24 844)	−0.03 (−0.53 to 0.48)	Reference
Circulatory			
Female patients	71 782 (25 966)	−0.03 (−0.43 to 0.37)	0.05 (−0.59 to 0.68)
Male patients	52 715 (22 911)	−0.07 (−0.59 to 0.44)	Reference
Infectious			
Female patients	63 943 (23 952)	−0.47 (−1.05 to 0.12)	−0.11 (−0.95 to 0.73)
Male patients	51 974 (22 301)	−0.36 (−0.99 to 0.28)	Reference
Kidney and urinary			
Female patients	54 402 (22 971)	−0.23 (−0.69 to 0.22)	−0.63 (−1.41 to 0.14)
Male patients	34 006 (18 551)	0.40 (−0.26 to 1.06)	Reference
Digestive			
Female patients	46 376 (21 839)	−0.40 (−0.85 to 0.05)	−0.32 (−1.07 to 0.43)
Male patients	27 812 (16 508)	−0.08 (−0.70 to 0.55)	Reference
Nervous			
Female patients	36 383 (18 876)	−0.89 (−1.60 to −0.18)	−0.94 (−1.96 to 0.08)
Male patients	26 763 (15 977)	0.05 (−0.77 to 0.87)	Reference

Diagnostic Category*	Patients (Physicians), *n*	AME (95% CI), *pp*†	Difference-in-Differences (95% CI), *pp*†
Respiratory			
Female patients	87 097 (27 443)	−0.48 (−1.03 to 0.07)	−0.06 (−1.86 to 0.73)
Male patients	62 424 (24 360)	−0.42 (−1.05 to 0.22)	Reference
Circulatory			
Female patients	68 570 (25 516)	−0.09 (−0.73 to 0.55)	−0.27 (−1.21 to 0.68)
Male patients	49 651 (22 272)	0.17 (−0.57 to 0.92)	Reference
Infectious			
Female patients	58 987 (23 074)	−0.39 (−1.03 to 0.25)	−0.13 (−1.06 to 0.80)
Male patients	47 851 (21 397)	−0.26 (−0.97 to 0.45)	Reference
Kidney and urinary			
Female patients	53 160 (22 734)	−1.20 (−1.88 to −0.52)	−0.86 (−1.95 to 0.23)
Male patients	33 015 (18 250)	−0.34 (−1.24 to 0.56)	Reference
Digestive			
Female patients	45 058 (21 510)	−0.62 (−1.38 to 0.15)	−1.31 (−2.52 to −0.10)
Male patients	26 809 (16 121)	0.69 (−0.31 to 1.69)	Reference
Nervous			
Female patients	34 656 (18 375)	0.28 (−0.54 to 1.10)	0.46 (−0.76 to 1.69)
Male patients	25 322 (15 452)	−0.19 (−1.18 to 0.81)	Reference

AME = average marginal effect; pp = percentage point.

* Subgroup analyses were done for the 6 most common diagnostic categories (accounting for approximately 80% of all hospitalizations) according to the Major Diagnostic Categories for each primary outcome.

† Calculated using logistic regression models that adjusted for patient characteristics, physician characteristics, and hospital-level averages of exposure variables (patient-physician sex dyads). Average marginal effects are contrasts of margins. Difference-in-differences are differences in AMEs.

Table 3. Physician Sex and 30-Day Patient Mortality and Readmission Rates Among Female and Male Patients, Stratified by Patients' Severity of Illness

Illness Severity*	Patients (Physicians), *n*	Adjusted Rate (95% CI), %†		AME (95% CI), *pp*†	Difference-in-Differences (95% CI), *pp*†
		Female Physician	Male Physician		
30-d mortality					
Low					
Female patients	165 745 (33 871)	1.31 (1.20 to 1.42)	1.42 (1.34 to 1.49)	−0.12 (−0.26 to 0.02)	−0.15 (−0.37 to 0.06)
Male patients	92 798 (29 294)	1.86 (1.67 to 2.06)	1.81 (1.67 to 1.96)	0.04 (−0.15 to 0.22)	Reference
Medium					
Female patients	152 041 (32 928)	5.02 (4.81 to 5.22)	4.87 (4.72 to 5.01)	0.17 (−0.09 to 0.42)	0.13 (−0.26 to 0.52)
Male patients	106 502 (30 313)	6.61 (6.26 to 6.97)	6.57 (6.32 to 6.83)	0.04 (−0.28 to 0.35)	Reference
High					
Female patients	139 589 (31 723)	18.30 (17.92 to 18.67)	19.03 (18.74 to 19.31)	−0.77 (−1.21 to −0.33)	−0.51 (−1.14 to 0.12)
Male patients	118 953 (30 654)	21.88 (21.41 to 22.35)	22.15 (21.79 to 22.51)	−0.26 (−0.75 to 0.24)	Reference
30-d readmission					
Low					
Female patients	163 050 (33 703)	13.92 (13.58 to 14.25)	14.41 (14.16 to 14.66)	−0.48 (−0.86 to −0.10)	−0.21 (−0.80 to 0.38)
Male patients	90 908 (29 076)	14.27 (13.81 to 14.73)	14.54 (14.20 to 14.87)	−0.27 (−0.77 to 0.23)	Reference
Medium					
Female patients	147 648 (32 657)	16.27 (15.89 to 16.66)	16.89 (16.61 to 17.17)	−0.60 (−1.01 to −0.18)	−0.22 (−0.84 to 0.40)
Male patients	103 050 (29 973)	16.29 (15.85 to 16.73)	16.65 (16.33 to 16.98)	−0.38 (−0.88 to 0.12)	Reference
High					
Female patients	127 953 (30 896)	16.58 (16.17 to 16.99)	17.01 (16.71 to 17.30)	−0.40 (−0.83 to 0.02)	−0.37 (−0.99 to 0.26)
Male patients	108 325 (29 674)	16.37 (15.95 to 16.80)	16.41 (16.11 to 16.71)	−0.04 (−0.83 to 0.02)	Reference

AME = average marginal effect; pp = percentage point.

* Patient severity was determined by the tercile of predicted 30-day mortality rates.

† Calculated by predictive margins using logistic regression models that adjusted for patient characteristics, physician characteristics, and hospital-level averages of exposure variables (patient–physician sex dyads). Average marginal effects are contrasts of margins. Difference-in-differences are differences in AMEs.

by female physicians is associated with better patient outcomes, especially for female patients. In an analysis of patients admitted to Florida hospitals for acute myocardial infarction between 1991 and 2010, Greenwood and colleagues (26) found that both male and female patients had lower mortality rates when treated by female physicians than when treated by male physicians, but the benefits of treatment by female physicians were larger for female patients than for male patients. Research on surgical care has found that receiving surgery, especially elective surgery, from a female surgeon was associated with a slightly lower mortality in both female and male patients (37, 61). By examining the association of physician sex with key health care outcomes for female and male patients in a large Medicare data set, and leveraging the plausible quasi-random assignment of patients to hospitalist physicians, our study significantly expands the generalizability and rigor of existing research on this topic.

Our study has several limitations. First, as with any observational study, we could not eliminate the possibility of unmeasured confounding. However, it is important to note that we used the hospitalist model as a natural experiment to at least partially account for unmeasured confounding. We tested the validity of this natural experiment by comparing observed characteristics of patients, including reason for diagnosis, illness severity, and clinical and demographic factors, all of which were balanced between patients treated by female and male physicians within the same hospital, supporting the validity of our approach. Second, due to limited clinical information available in claims data, we could not identify the specific mechanisms underlying improved outcomes for female patients treated by female physicians. Our analysis of secondary outcomes suggests that factors like length of stay, health care spending, and proportion of high-intensity E&M claims do not account for the observed lower mortality and readmission rates. Third, we defined sex of beneficiaries and physicians as a binary construct using the sex variable available in the Medicare Master Beneficiary Summary File and MD-PPAS files. However, it is important to note that for gender minority (transgender or gender nonbinary) beneficiaries, their gender identity may not align with the information provided in this variable or may be categorized as missing or unknown. Fourth, our outcomes were limited to specific measures of quality of care and resource use, and our findings may not generalize to other outcomes, such as long-term mortality and patient satisfaction. Finally, we focused on older patients admitted to hospitals for medical conditions and treated by hospitalists. Hence, our findings may not be generalizable to younger patients, commercially insured patients, those treated by other specialists, or patients receiving care in an outpatient setting.

In conclusion, we found that patients generally have lower mortality and readmission rates when treated by female physicians, and the benefit of receiving treatments from female physicians is larger for female patients than for male patients, at least in the inpatient setting. These findings underscore the need for continued efforts to improve sex diversity within the physician workforce, especially to guarantee that female patients receive high-quality care. Future research is needed to identify the underlying mechanisms that lead to differences in patient outcomes between female and male physicians and to understand why female patients benefit more from having a female physician than male patients.

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