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Comparison of Hospital Outcomes for Patients Treated by Allopathic Versus Osteopathic Hospitalists

An Observational Study

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Background: The United States has 2 types of degree programs that educate physicians: allopathic and osteopathic medical schools.

Objective: To determine whether quality and costs of care differ between hospitalized Medicare patients treated by allopathic or osteopathic physicians.

Design: Retrospective observational study.

Setting: Medicare claims data.

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

Measurements: The primary outcome was 30-day patient mortality. The secondary outcomes were 30-day readmission, length of stay (LOS), and health care spending (Part B spending). Multivariable regression models adjusted for patient and physician characteristics and their hospital-level averages (to effectively estimate differences within hospitals) were estimated.

Results: Of 329 510 Medicare admissions, 253 670 (77.0%) and 75 840 (23.0%) received care from allopathic and osteopathic physicians, respectively. The results can rule out important differences in quality and costs of care between allopathic versus osteopathic physicians for patient mortality (adjusted mortality, 9.4% for allopathic physicians vs. 9.5% [reference] for osteopathic hospitalists; average marginal effect [AME], −0.1 percentage point [95% CI, −0.4 to 0.1 percentage point]; P = 0.36), readmission (15.7% vs. 15.6%; AME, 0.1 percentage point [CI, −0.4 to 0.3 percentage point; P = 0.72), LOS (4.5 vs. 4.5 days; adjusted difference, −0.001 day [CI, −0.04 to 0.04 day]; P = 0.96), and health care spending ($1004 vs. $1003; adjusted difference, $1 [CI, −$8 to $10]; P = 0.85).

Limitation: Data were limited to elderly Medicare patients hospitalized with medical conditions.

Conclusion: The quality and costs of care were similar between allopathic and osteopathic hospitalists when they cared for elderly patients and worked as the principal physician in a team of health care professionals that often included other allopathic and osteopathic physicians.

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Medical education in the United States is done by 2 types of programs—allopathic medical schools that award a Doctor of Medicine, or MD degree, and osteopathic schools that award a Doctor of Osteopathic Medicine, or DO degree. Educational requirements are largely similar for both types of schools (1), with some exceptions, including a more holistic focus and inclusion of manipulation training in osteopathic schools (2). Both allopathic and osteopathic physicians are licensed to practice medicine in every state (3).

Approximately 90% and 10% of practicing physicians in the United States have MD and DO degrees, respectively (4). The number of osteopathic physicians increased 72% from 58 329 in 2010 to 100 379 in 2020, whereas allopathic physicians increased only 16% during the same period (4). The percentage of osteopathic physicians is expected to increase further given a large number of osteopathic physicians in the pipeline: The number of osteopathic medical students has nearly doubled in the past decade, and 1 in 4 U.S. medical students now attends an osteopathic school (5, 6). Osteopathic physicians are more likely to practice in rural and underserved areas and pursue careers in primary care compared with allopathic physicians, contributing to narrowing the gaps in disparities in access to health care in the United States (5, 7, 8).

Evidence is limited as to whether quality and costs of care differ between allopathic and osteopathic physicians. The evidence that exists has largely studied only processes of care and patient experience, has not used national data (therefore, it is unclear whether the findings are generalizable), and has been limited by confounding bias due to the possibility that patients treated by allopathic and osteopathic physicians may differ in unmeasurable ways (9–12). Given the increasingly important role that osteopathic physicians play in patient care (5, 7, 8) and an ongoing debate about differences between the medical education and training that allopathic and osteopathic physicians receive (13, 14), national data on whether quality and costs of care differ between allopathic and osteopathic physicians is critically important. With the rapid growth of osteopathic medical schools and the increasing number of patients treated by osteopathic physicians, it is

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important to assess whether outcomes of patients treated by allopathic and osteopathic physicians differ.

In this context, using nationally representative data on Medicare patients admitted to hospitals with an urgent or emergency medical condition and treated by a hospitalist during 2016 to 2019, we compared quality and costs of care (30-day patient mortality, 30-day readmission, length of stay [LOS], and health care spending) between allopathic and osteopathic physicians. 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 4 data sources: a 20% sample of 2016–2019 Medicare claims (inpatient and carrier files), Medicare Data on Provider Practice and Specialty, a comprehensive physician database assembled by Doximity (15–18), and the American Hospital Association annual survey on hospital characteristics. Medicare Data on Provider Practice and Specialty files were provided by the Centers for Medicare & Medicaid Services, which included physician-level information on birth date, sex, and specialty. Doximity is an online professional network for physicians, with physician-level information on credentials. Prior studies have validated data for a random sample of physicians in the Doximity database using manual audits (15, 16). Using the National Provider Identifier, we were able to match approximately more than 99% and 92% of physicians in the Medicare claims to the Medicare Data on Provider Practice and Specialty files and the Doximity database, respectively. This study was approved by the University of California, Los Angeles Institutional Review Board, and patient consent was not required.

Study Population

We included Medicare fee-for-service beneficiaries aged 65 years or older who were admitted to a hospital with a medical condition from 1 January 2016 through 31 December 2019. We attributed each hospitalization to a physician on the basis of the National Provider Identifier in the carrier file that accounted for the largest number of evaluation and management (E&M) claims during that hospitalization, following prior studies (17–22). We excluded hospitalizations for which more than 1 physician accounted for the same largest number of E&M claims. On average, 51.7%, 20.9%, and 11.3% 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 allopathic and osteopathic physicians may affect patient outcomes, we focused our analyses on patients admitted to hospitals with an urgent or emergency medical condition and treated by a hospitalist (18, 19). We assessed the validity of the assumption that patients are plausibly quasi-randomly assigned to hospitalists on the basis of the timing of patients' admissions and hospitalists' work schedules by testing the balance of patient characteristics. We defined hospitalists as general internists (that is, physicians whose specialty was hospitalist, general practice, internal medicine, family practice, or geriatrics medicine) who filed at least 90% of their total E&M billings in an inpatient setting, an approach validated and used by prior studies (23–26).

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

Identification of Physician Credentials

Information on self-reported physician credentials (allopathic or osteopathic physicians) was available for all physicians in the Doximity database. We restricted analyses to physicians who graduated from allopathic or osteopathic medical schools in the United States, excluding physicians for whom information on medical school attended was unavailable or physicians who graduated from a medical school outside the United States. Information on medical school attended was available for approximately 94% of physicians (27).

Patient Outcomes

The primary outcome was 30-day patient mortality. Information on dates of death was available in Medicare beneficiary summary files. More than 99% of dates of death have been verified by death certificates (28). We excluded patients whose death dates were not validated. Secondary outcomes were 30-day readmission, LOS, and health care spending (total Part B spending [21]).

Adjustment Variables

We adjusted for patient and physician characteristics. Patient characteristics included age, sex, race and ethnicity, primary diagnosis (indicator variable, defined by Medicare Severity Diagnosis Related Group) (29), indicators of 27 coexisting conditions, income level of residence, Medicaid eligibility, year indicators, and day of week indicators. Physician characteristics included age, sex, and patient volume (see **Supplement Method** for details, available at Annals.org). To address the possibility that allopathic and osteopathic hospitalists may practice in hospitals with different patient populations, we used the Mundlak approach (rather than adjusting for hospital fixed effects) (30–33) in which we include hospital-level averages of each covariate as adjustment variables of the regression models (physicians' credentials and other physician and patient characteristics). This approach allowed us to separately estimate differences in outcomes within hospitals for allopathic versus osteopathic hospitalists and differences across hospitals with different shares of osteopathic hospitalists (effect partitioning).

Statistical Analysis

First, we compared characteristics of patients, including primary diagnoses and illness severity, between allopathic and osteopathic hospitalists. We defined patient illness severity by estimating the predicted 30-day mortality

Table 1. Characteristics of the Study Population

Characteristic	Allopathic Hospitalists (MDs) (*n* = 14 229)	Osteopathic Hospitalists (DOs) (*n* = 3689)
Physician		
Mean age (SD), *y*	44.0 (10.5)	40.1 (8.9)
Women, *n* (%)	5206 (36.6)	1448 (39.3)
Median observed number of admissions per physician per year (IQR), *n**	7.0 (3.3–13.0)	8.8 (4.0–15.0)
Primary self-reported specialty, *n* (%)		
Internal medicine	8657 (60.8)	2239 (60.7)
Hospitalist	3038 (21.4)	745 (20.2)
Family practice	2381 (16.7)	679 (18.4)
General practice	73 (0.6)	16 (0.4)
Geriatric medicine	80 (0.5)	10 (0.3)
Patient		
Patients, *n*	253 670	75 840
Mean age (SD), *y*	79.8 (8.8)	79.8 (8.8)
Female, *n* (%)	149 459 (58.9)	44 386 (58.5)
Race and ethnicity, *n* (%)		
Non-Hispanic White	209 491 (82.6)	65 067 (85.8)
Non-Hispanic Black	23 546 (9.3)	5045 (6.7)
Hispanic	10 269 (4.0)	3154 (4.2)
Other	10 364 (4.1)	2574 (3.4)
Median household income (IQR), *$*	58 530 (47 416–76 750)	57 500 (47 271–73 340)
Medicaid eligible, *n* (%)	56 239 (22.2)	16 047 (21.2)
Selected coexisting conditions, *n* (%)		
Congestive heart failure	131 691 (51.9)	39 603 (52.2)
Chronic obstructive pulmonary disease	102 311 (40.3)	31 995 (42.2)
Diabetes	111 412 (43.9)	33 670 (44.4)
Chronic kidney disease	164 733 (64.9)	49 553 (65.3)
Cancer	48 133 (19.0)	14 233 (18.8)
Depression	102 178 (40.3)	31 211 (41.2)
Alzheimer disease	37 567 (14.8)	11 299 (14.9)
Death within 30 d of admission, *n* (%)	23 830 (9.4)	7115 (9.4)

DO = Doctor of Osteopathic Medicine; IQR = interquartile range; MD = Doctor of Medicine.
* Observed number of admissions per physician per year in our sample. Note that our sample was 20% random sample of fee-for-service Medicare beneficiaries, that the proportion of all Medicare beneficiaries with Medicare Advantage plans is about 36% in 2016 to 2019 (37), and that Medicare beneficiaries (including fee-for-service plus Medicare Advantage) make up 40% of all hospital admissions in the United States (38).

rate on the basis of patient characteristics, using a hospitalization-level logistic regression model. We compared physician characteristics between allopathic and osteopathic hospitalists as well as structural characteristics of hospitals in which they worked. We showed the variation across hospitals in the percentage of patients treated by osteopathic hospitalists and the outcomes.

Second, we examined the association between allopathic versus osteopathic training and patients' 30-day mortality using a multivariable logistic regression model with hospital-level clustered SEs, adjusting for patient and physician characteristics and hospital-level averages of each covariate (31, 33). We calculated adjusted 30-day mortality rates using marginal standardization (34). To improve interpretability of findings, we calculated average marginal effects (AME) of allopathic versus osteopathic training (instead of odds ratios), which represents the differences in the adjusted mortality rates.

Third, we compared secondary outcomes between allopathic and osteopathic hospitalists using a similar method to the analysis of mortality. For LOS and health care spending, we used γ regression models with a log link instead of logistic regression models.

Fourth, we assessed whether differences in patient outcomes between allopathic and osteopathic hospitalists differed according to the primary condition for which a patient was admitted. We evaluated the 8 most common medical conditions treated by hospitalists in the Medicare data, determined by using Medicare Severity Diagnosis Related Group codes (see Supplement Table 1, available at Annals.org).

Finally, we assessed whether differences in patient outcomes between allopathic and osteopathic hospitalists varied according to illness severity, on the basis of a patient's predicted 30-day mortality. We categorized patients into terciles of predicted mortality and separately repeated analyses.

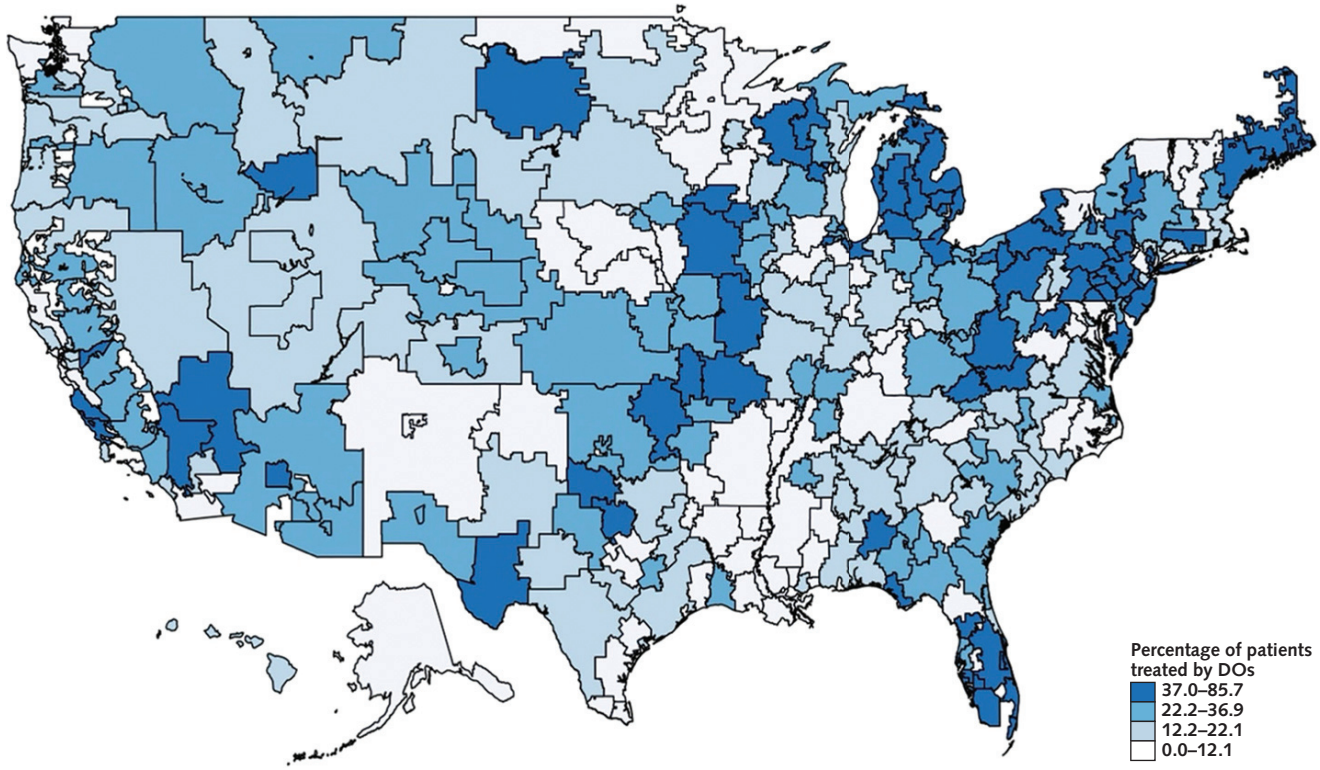
Secondary Analyses

We evaluated differences in outcomes between hospitals rather than within hospitals (that is, how outcomes would have differed if a patient had been treated in a hospital with a high percentage of osteopathic physicians [75th percentile] instead of a hospital with a low percentage of osteopathic physicians [25th percentile], holding constant patient and physician characteristics [35]).

As an additional stratified analysis, we assessed whether the association between allopathic versus osteopathic training and patient outcomes varied according to structural characteristics of hospitals.

We also conducted several sensitivity analyses. First, to assess whether practice patterns differ between

Figure 1. Hospitalized patients treated by osteopathic hospitalists (DOs) in 2016 to 2019, by hospital referral regions.



The 306 hospital referral regions were categorized into quartiles according to the percentage of hospitalized patients treated by osteopathic hospitalists. DO = Doctor of Osteopathic Medicine.

allopathic and osteopathic hospitalists, we compared several process measures between these 2 types of hospitalists, including numbers of consultations to specialists, patient discharge dispositions, intensive care unit (ICU) transfer, imaging study spending, and laboratory test spending. Second, to address the possibility that differential distributions of specialty between allopathic and osteopathic hospitalists affected our findings, we repeated our analyses, additionally adjusting for physician specialties or by excluding geriatric hospitalists. Third, to minimize concerns that some patients in the sample might be attributed to ICU physicians, we reanalyzed the data, restricting to hospitals without medical or cardiac ICUs. Fourth, to test the generalizability of our findings, we repeated our analyses among general internists overall. Fifth, to examine whether our findings were sensitive to how we assigned patient outcomes to physicians, we tested alternative attribution rules: attributing patients to physicians who billed the first E&M claim for a given admission ("admitting physician"), attributing patients to hospitalists who accounted for 50% or more of E&M claims during hospitalization, and attributing patients to hospitalists who accounted for 100% of E&M claims during hospitalization. Sixth, we restricted analyses to hospitalizations in which all hospitalists' billing of E&M claims were billed by (single or a group of) allopathic versus osteopathic physicians. Seventh, we defined hospitalists as general internists who filed at least 95% (a stricter definition than using a threshold of 90% for our main analysis) of their total E&M billings in an inpatient setting. Eighth, to test the possibility that the residency program in which a physician trained (which may correlate with which medical school a physician attended) is associated with physician outcomes, we further adjusted for residency program attended (that is, indicator variables for each program). Finally, although we adjusted for many covariates and used the hospitalist model as a natural experiment to account for unmeasured confounding (that is, patients were quasi-randomly assigned to a hospitalist on service), it is still possible that patient outcomes differ between allopathic and osteopathic hospitalists, but differences were masked by unmeasured confounding (biasing estimates toward the null). To address this possibility, we calculated E-values to formally examine how strongly unmeasured confounders would need to be associated with patient outcomes to obtain a null relationship between osteopathic versus allopathic training and patient outcomes (36). 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 and conduct of the study; collection, management, analysis, and interpretation of the data; or preparation, review, or approval of the manuscript.

Table 2. Outcomes of Hospitalized Patients Treated by Allopathic and Osteopathic Hospitalists Within Hospitals

Outcome	Hospitalizations (Physicians), *n*	Adjusted Values (95% CI)*		AME for MDs Versus DOs (95% CI)†
		Allopathic Hospitalists (MDs)	Osteopathic Hospitalists (DOs)	
Primary				
30-d mortality rate, %	329 510 (17 918)	9.4 (9.3 to 9.5)	9.5 (9.3 to 9.7)	−0.1 (−0.4 to 0.1)
Secondary				
30-d readmission rate, %	314 203 (17 809)	15.7 (15.5 to 15.8)	15.6 (15.3 to 15.9)	0.1 (−0.4 to 0.3)
LOS, *d*	329 510 (17 918)	4.5 (4.5 to 4.6)	4.5 (4.5 to 4.6)	−0.001 (−0.04 to 0.04)
Part B spending per hospital admission, $‡	329 510 (17 918)	1004 (996 to 1011)	1003 (993 to 1012)	1 (−8 to 10)

AME = average marginal effect; DO = Doctor of Osteopathic Medicine; LOS = length of stay; MD = Doctor of Medicine.
* We used logistic regression models for mortality and readmission and γ regression models with a log link for LOS and Part B spending. Models adjusted for patient characteristics (sex, age, race and ethnicity, Medicaid eligibility, median income level of residence, 27 coexisting conditions, primary diagnosis [Diagnosis Related Group category indicators], year indicators, date indicators), physician characteristics (sex, age category, number of hospital admissions per year), and their hospital-level mean (known as the Mundlak approach) to separate differences within hospitals from differences between hospitals. SEs were clustered at the hospital level. Adjusted outcomes and differences for MDs versus DOs were calculated using predictive margins (marginal standardization method).
† AMEs (instead of odds/risk ratios) were calculated and reported. The unit of AME was percentage points for mortality and readmission rates.
‡ Costs were adjusted for inflation in 2019 U.S. dollars.

RESULTS

Characteristics of the Study Population

The study sample included 329 510 hospitalizations treated by 17 918 hospitalists at 3438 hospitals. Among these physicians, 79.4% (14 229 of 17 918) graduated from an allopathic medical school and 20.6% (3689 of 17 918) graduated from an osteopathic medical school (Table 1). Compared with allopathic hospitalists, osteopathic hospitalists were younger and more likely to be women and were more likely to provide care to Medicare patients. The distribution of specialties was similar between allopathic and osteopathic hospitalists. Patients treated by geriatric hospitalists were slightly older than patients treated by other hospitalists (Supplement Table 2, available at Annals.org). We observed no clinically relevant difference in patient characteristics by credentials (Table 1; Supplement Table 3, available at Annals.org), including the distributions of primary diagnosis and predicted 30-day mortality (Supplement Figures 1 and 2, available at Annals.org). The percentage of hospitalized patients treated by osteopathic physicians varied widely by hospital referral regions (Figure 1). Osteopathic physicians were more likely to practice in the Northeast and Midwest census regions and in minor teaching and public hospitals (Supplement Table 4, available at Annals.org). The hospitals differed widely in the proportion of osteopathic hospitalists and the outcomes (Supplement Figures 3 and 4, available at Annals.org)

Allopathic Versus Osteopathic Training and Patient Outcomes

The overall unadjusted 30-day mortality rate was 9.4% (30 945 of 329 510). After multivariable adjustment (Table 2), the difference in 30-day mortality between allopathic and osteopathic physicians was clinically small (adjusted mortality rate, 9.4% for allopathic hospitalists and 9.5% for osteopathic hospitalists [reference]; AME for allopathic vs. osteopathic training, −0.1 percentage points [95% CI, −0.4 to 0.1 percentage points]; $P = 0.36$). The narrow CI for the difference ruled out an important difference in 30-day mortality.

The results could also rule out important differences between allopathic and osteopathic hospitalists in 30-day readmissions (15.7% vs. 15.6%; AME, 0.1 percentage point [CI, −0.4 to 0.3 percentage point]; $P = 0.72$), LOS (4.5 vs. 4.5 days; AME, −0.001 days [CI, −0.04 to 0.04 day]; $P = 0.96$), or total Part B spending per admission ($1004 vs. $1003; AME, $1 [CI, −$8 to $10]; $P = 0.85$).

Patient Outcomes by Primary Diagnoses

In subgroup analyses based on primary diagnoses of admissions, differences in 30-day mortality between allopathic and osteopathic physicians were small in magnitude across all conditions examined, despite wide CIs that do not rule out the possibility of important differences (Figure 2; Supplement Table 5, available at Annals.org). The differences in patient readmission rates, LOS, and health care spending were also clinically small between allopathic and osteopathic physicians across the 8 medical conditions (Supplement Tables 6 to 8, available at Annals.org).

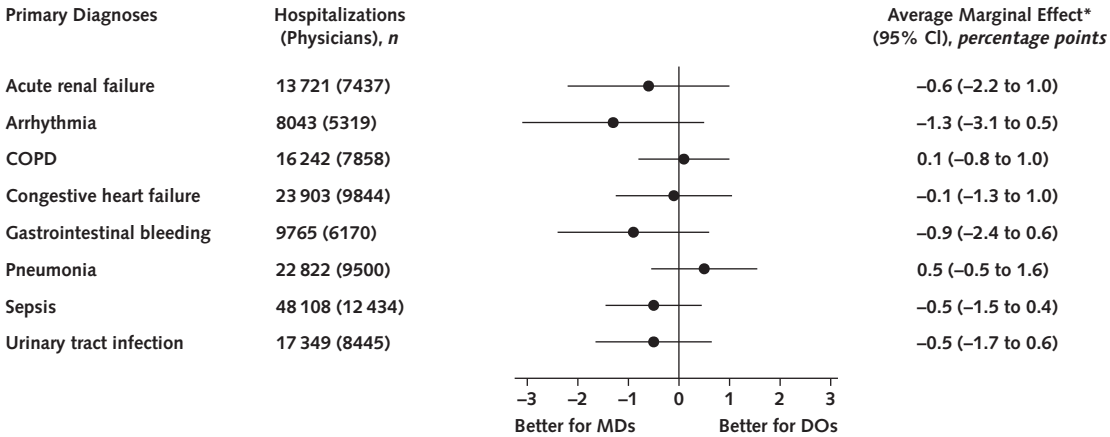
Patient Outcomes by Severity of Illness

In subgroup analyses based on severity of illness, the difference in 30-day mortality between allopathic and osteopathic hospitalists was clinically small across categories of illness severity (Table 3). The narrow CIs ruled out important differences in 30-day mortality. Results for patients' readmission rates, LOS, and health care spending also ruled out important differences between allopathic and osteopathic hospitalists across all severity categories.

Secondary Analyses

Our results could rule out important differences in outcomes between hospitals with different percentage of patients treated by osteopathic hospitalists (Supplement Table 9, available at Annals.org). Findings were largely unaffected when stratified by hospital characteristics, including hospital size, teaching status, ownership status, regions, and rural–urban status (Supplement Tables 10 to 13, available at Annals.org).

Figure 2. Average marginal effects in 30-day mortality of hospitalized patients treated by allopathic hospitalists (MDs) versus osteopathic hospitalists (DOs), by primary diagnoses of admission.



COPD = chronic obstructive pulmonary disease; DO = Doctor of Osteopathic Medicine; MD = Doctor of Medicine.
* Calculated using logistic regression models adjusting for patient characteristics, physician characteristics, and their hospital-level means with SEs clustered at the hospital level.

The process measures were largely similar between allopathic and osteopathic hospitalists (**Supplement Table 14**, available at Annals.org). Our findings were qualitatively unchanged after further adjusting for physician specialties (**Supplement Table 15**, available at Annals.org), by excluding geriatric hospitalists (**Supplement Table 16**, available at Annals.org), by restricting to hospitals without ICUs (**Supplement Table 17**, available at Annals.org), among general internists overall (**Supplement Table 18**, available at Annals.org), by using alternative rules for attributing patients to physicians (**Supplement Tables 19–21**, available at Annals.org), when we restricted to hospitalizations in which all hospitalists' E&M claims were billed by allopathic versus osteopathic physicians (**Supplement Table 22**, available at Annals.org), when using a stricter definition to identify hospitalists (**Supplement Table 23**, available at Annals.org), and by additionally adjusting for residency program attended (**Supplement Table 24**, available at Annals.org).

Given that the smallest E-value (1.41) we found was larger than the association of congestive heart failure or chronic kidney disease with patient mortality, the effect of unmeasured confounders on patient mortality would need to be larger than these major comorbidities to explain away our null findings, which we believe is unlikely (**Supplement Table 25**, available at Annals.org).

DISCUSSION

Using a nationally representative sample of Medicare patients aged 65 years or older hospitalized during 2016 to 2019 and treated by a hospitalist, we found no clinically important differences in quality and costs of care between allopathic and osteopathic hospitalists. These findings were consistent across a range of medical conditions and across severity of patient's illness, indicating that any differences between allopathic and osteopathic medical schools, either in training or the types of students who enroll, are not associated with differences in costs or quality of care in the inpatient setting.

There are several potential explanations as to why quality and costs of care do not differ between allopathic and osteopathic physicians. First, both allopathic and osteopathic medical schools are required to deliver standardized medical education to their students on the basis of accreditation systems. Although allopathic and osteopathic medical schools are separately accredited by different national accrediting bodies recognized by the U.S. Department of Education, both types of programs comply with similar, stringent accreditation standards (1), including a 4-year curriculum that consists of science courses and clinical rotations. Furthermore, standardized tests required of all physicians regardless of what type of medical school they attended (the United States Medical Licensing Examination for allopathic physicians and the Comprehensive Osteopathic Medical Licensing Examination for osteopathic physicians) may function as a safeguard toward excluding nonqualified medical students from either type of school (39). Second, the residency and fellowship training physicians receive after graduating from medical school may contribute to the standardization of how physicians practice medicine. Since the 1990s, most osteopathic physicians have been trained alongside allopathic physicians in residency programs accredited by the Accreditation Council for Graduate Medical Education (osteopathic students who passed the United States Medical Licensing Examination were eligible for the same residency programs as allopathic physicians) (40–42). Opportunities for allopathic and osteopathic physicians to be trained together in residency programs will continue to expand because since 2020, allopathic and osteopathic residency programs for graduate medical education have been merged into a single accreditation system (3). Third, most osteopathic

Table 3. Outcomes of Hospitalized Patients Treated by Allopathic and Osteopathic Hospitalists, by Patient Severity*

Outcome	Hospitalizations (Physicians), *n*	Adjusted Values (95% CI)†		AME for MDs Versus DOs (95% CI)†
		Allopathic Hospitalists (MDs)	Osteopathic Hospitalists (DOs)	
30-d mortality rate, % (percentage points for average marginal effect)				
Low	109 528 (15 826)	1.7 (1.6 to 1.7)	1.6 (1.4 to 1.8)	0.04 (−0.2 to 0.3)
Medium	109 527 (15 641)	5.7 (5.6 to 5.9)	6.1 (5.7 to 6.4)	−0.3 (−0.8 to 0.1)
High	109 527 (15 530)	20.8 (20.6 to 21.0)	20.9 (20.4 to 21.5)	−0.1 (−0.8 to 0.6)
30-d readmission rate, % (percentage points for average marginal effect)				
Low	107 573 (15 772)	14.4 (14.2 to 14.6)	14.3 (13.7 to 14.8)	0.1 (−0.5 to 0.8)
Medium	106 055 (15 547)	16.4 (16.1 to 16.7)	16.1 (15.5 to 16.6)	0.3 (−0.3 to 1.0)
High	99 702 (15 212)	16.3 (16.0 to 16.6)	16.6 (16.0 to 17.2)	−0.3 (−1.0 to 0.3)
LOS, *d*				
Low	109 528 (15 826)	3.7 (3.6 to 3.7)	3.7 (3.6 to 3.7)	−0.01 (−0.1 to 0.04)
Medium	109 527 (15 641)	4.5 (4.4 to 4.5)	4.5 (4.4 to 4.6)	−0.02 (−0.1 to 0.04)
High	109 527 (15 530)	5.5 (5.4 to 5.5)	5.5 (5.4 to 5.5)	0.02 (−0.1 to 0.05)
Part B spending per hospital admission, $				
Low	109 528 (15 826)	815 (808 to 823)	817 (806 to 827)	−1 (−12 to 9)
Medium	109 527 (15 641)	979 (970 to 988)	979 (966 to 992)	0 (−14 to 13)
High	109 527 (15 530)	1221 (1209 to 1233)	1219 (1203 to 1236)	2 (−15 to 18)

AME = average marginal effect; DO = Doctor of Osteopathic Medicine; LOS = length of stay; MD = Doctor of Medicine.
* Patient severity was determined by the tertile of predicted 30-day mortality rates.
† Models adjusted for patient characteristics, physician characteristics, and their hospital-level means. SEs were clustered at the hospital level.

physicians today rarely use osteopathic manipulative treatment due to structural barriers (for example, lack of time, institutional support, and reimbursement) (43). Thus, there may be little difference between allopathic and osteopathic physicians in their practices. Finally, our study compared allopathic and osteopathic physicians within the same hospital, and hospitals' system-wide efforts to ensure quality of care may minimize the effect of variation in individual physicians' practice patterns. However, prior studies that have compared different types of physicians within the same hospital found clinically important differences in costs and patient outcomes (17, 18), suggesting that hospitals' quality improvement efforts may not fully explain our findings.

Our study adds to a limited body of work evaluating differences in practice patterns between allopathic and osteopathic physicians. Reid and colleagues (9) examined the relationship between physician characteristics and 124 process of care measures among Massachusetts physicians and found no difference in most process measures, except that osteopathic physicians showed higher quality performance in care specific to male patients. Regarding patient experience, a study of Cleveland Clinic Health System physicians found that osteopathic physicians had slightly higher or similar patient empathy compared with allopathic physicians (10), whereas another study using a physician rating database found that osteopathic primary care physicians in the Northeast were rated slightly lower than their allopathic peers (11). Although informative, evidence is limited regarding whether quality and costs of care differ between allopathic and osteopathic physicians using the national data. Research on practice patterns has shown that osteopathic physicians work in more rural and underserved areas than allopathic physicians (5, 8), and the value of osteopathic physicians from a societal perspective may be large, independent of the outcomes we have evaluated in this study.

Our study had limitations. First, although we focused on hospitalists to account for confounding due to unmeasured patient characteristics, we could not eliminate the possibility of residual confounding. However, we found similar patient characteristics between allopathic and osteopathic hospitalists within the same hospital, supporting the validity of using hospitalists as a natural experiment. Second, our outcomes were limited to specific measures of quality of care and resource use, and our findings may not be generalized to other outcomes, such as long-term mortality and patient experience. Third, we analyzed data on elderly Medicare patients hospitalized with medical conditions and treated by hospitalists; therefore, our findings may not be generalizable to younger patients, commercially insured patients, patients treated by other specialists, or patients treated in an outpatient setting. Our analysis may not reflect the full set of ways in which physician quality may differ (for example, in other domains of care, such as ambulatory care, and in other aspects of quality, such as interpersonal dynamics and team-based care).

In conclusion, we found that allopathic and osteopathic physicians performed similarly in terms of patient mortality after hospital admission, readmissions, LOS, or health care spending when they cared for elderly patients and worked as the principal physician in a team of health care professionals that often included other allopathic and osteopathic physicians. These findings should be reassuring for policymakers, medical educators, and patients because they suggest that any differences between allopathic and osteopathic medical schools, either in terms of educational approach or students who enroll, are not associated with differences in quality or costs of care, at least in the inpatient setting.

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