Physician-Level Variation in Outcomes of Mechanically Ventilated Patients

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Abstract

Rationale: Physicians are increasingly being held accountable for patient outcomes, yet their specific contribution to the outcomes remains uncertain.

Objectives: To determine variation in outcomes of mechanically ventilated patients among intensivists, as well as associations between intensivist experience and patient outcomes.

Methods: We performed a retrospective cohort study of mechanically ventilated Medicare fee-for-service patients in acute care hospitals in Pennsylvania using administrative, clinical, and physician data from Centers for Medicare and Medicaid Services and the American Medical Association from 2008 and 2009. We identified intensivists by training background, board certification, and claims for services provided to patients admitted to an intensive care unit. We assigned patients to intensivists for outcome attribution based on submitted claims for critical care and in-patient services. We estimated the physician-specific adjusted odds ratios (ORs) for 30-day mortality using a hierarchical model with a random effect for physician, adjusted for patient and hospital characteristics. We tested for independent association of physician experience with patient outcomes using mixed-effects regression for the primary outcome of

30-day mortality. We defined physician experience in two ways: years since training completion (“duration”) and annual number of mechanically ventilated patients (“volume”).

Results: We assigned 345 physicians to 11,268 patients. The 30-day mortality was 43% and median hospital length of stay was 11 days (interquartile range = 6–18). The physician adjusted OR varied from 0.72 to 1.64 (median = 0.99; interquartile range = 0.92–1.09). A total of 48% of physicians was outliers, with an adjusted OR significantly different from 1. However, among intensivists, physician experience was not associated with 30-day mortality (duration OR = 1.00 per additional year; 95% confidence interval = 1.00–1.01; volume OR = 1.00 per additional patient; 95% confidence interval = 1.00–1.00).

Conclusions: Intensivists independently contribute to outcomes of Medicare patients who undergo mechanical ventilation, as evidenced by the variation in risk-adjusted mortality across intensivists. However, physician experience does not underlie this relationship between intensivists, suggesting the need to identify modifiable physician factors to improve outcomes.

Keywords: intensive care; critical care outcomes; respiration; artificial; physician

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By some estimates, more than 750,000 patient admissions to acute-care hospitals in the United States each year include mechanical ventilation (1, 2). In-hospital mortality for such patients nears 40% (1, 3). Several landmark clinical trials have provided evidence-based treatments to reduce mortality in mechanically ventilated admissions (4–7). However, uptake of the evidence has been slow and uneven (8–12), and admission outcomes have not appreciably changed over time and remain highly variable (13, 14).

Physicians seem natural targets to improve quality of care and adherence to evidence-based medicine. They are primarily responsible for clinical decision making, and some studies suggest that different physician characteristics can explain some of the variability in patient outcomes (15–17). Therefore, better understanding the role of physicians in outcome of mechanically ventilated patients may inform strategies to improve their care.

One specific physician attribute that may be associated with outcomes is experience in caring for mechanically ventilated patients. Indeed, evidence in many fields supports an experience–outcome relationship: hospitalists achieve better outcomes for medical in-patients than nonhospitalists (18, 19); obstetricians with more years of experience have fewer maternal complications (20); institutions that care for more patients requiring certain services, including mechanical ventilation, achieve better outcomes than lower-volume hospitals (14, 18, 21–30); and critical care physicians may achieve better outcomes than non-critical care physicians for intensive care unit (ICU) patients overall (31, 32). On the other hand, one study demonstrated that specialized ICUs perform no better than general ICUs (33); another study found that physicians with greater experience achieve worse outcomes for patients with ischemic stroke (34); and yet another demonstrated that initial skill of obstetricians explains more of the variation in physician performance than experience itself (35).

We aimed to define the relationship between critical care experts (“intensivists”) and the outcomes of mechanically ventilated patients. To do so, we sought to quantify the variation in patient outcomes attributable to the physician as well as to test the hypothesis that greater physician experience would be associated with improved patient outcomes.

Methods

We performed a retrospective cohort study of patients undergoing mechanical ventilation in an ICU in an acute care hospital in the Commonwealth of Pennsylvania between 2008 and 2009. We selected this population because hospital discharge data collected by the Pennsylvania Health Care Cost Containment Council during these years included a measure of risk of in-hospital mortality based on a multivariable prediction model using patient clinical and physiological data, thereby enabling risk adjustment superior to what would typically be possible using administrative data (30); 2009 was the most recent year when complete mortality-risk data were collected. The study was approved by the Institutional Review Board of the University of Pennsylvania.

Data Sources

We used data from several sources. First, we obtained administrative data from the Centers for Medicare and Medicaid Services, including the Medicare Provider and Analysis Review Files, Beneficiary Summary Files, and the Carrier Files from 2008 and 2009 to obtain patient-level hospital admission data, 30-day mortality, and final action fee-for-service (FFS) claims submitted by individual physicians. Second, we obtained in-patient discharge data from the Pennsylvania Health Care Cost Containment Council for the same hospital admissions, which included a predicted probability of in-hospital death for a sample of patients with select in-patient diagnoses based on the MediQual Atlas, which uses physiologic variables collected at the time of hospital admission (36). Third, we obtained physician data from the American Medical Association (AMA) Physician Masterfile, including current and historical data regarding physician education, training, and professional certification. Fourth, we obtained historical data on hospitals’ affiliations with medical training programs from the Accreditation Council for Graduate Medical Education website (37). The online supplement provides further details of the data sources.

Study Population

We included all hospital admissions from January 1, 2008 through December 1, 2009 that included an ICU stay according to the

Centers for Medicare and Medicaid Services revenue center code (38) of Medicare FFS beneficiaries aged 18 years or older. We identified patients who underwent invasive mechanical ventilation according to the presence of International Classification of Diseases, Ninth Revision, Clinical Modification procedure codes for mechanical ventilation (96.7x) (39). For patients who underwent interhospital transfers (defined as admission to a hospital within one calendar day of another hospital discharge for the same beneficiary), we combined the hospital admissions and considered the first hospital admission that included an ICU stay to be the start of the entire hospitalization (40). We excluded admissions with a length-of-stay of less than one calendar day (i.e., admitted and discharged on the same date), because these admissions would be unlikely to be affected by an individual physician.

Physician Assignment Strategy

To assign admissions to intensivist physicians, we first defined the physicians eligible for assignment as those physicians who had either: 1) critical care board certification (through internal medicine, surgery, or anesthesia) in 2008 or 2009, and in-patient claims for at least nine ICU admissions in 2008 (the 25th percentile of volume of Medicare FFS ICU admissions among physicians with critical care board certification); or 2) in-patient claims for at least 48 ICU admissions in 2008 (the median volume of Medicare FFS ICU admissions among physicians with critical care board certification). In the absence of a gold standard definition of an “intensivist,” we chose this definition to capture the population of physicians who are most likely to care for ICU patients. Next, we assigned an intensivist to an admission based on Current Procedural Terminology codes for in-patient initial and subsequent care (99221, 99222, 99223, 99231, 99232, 99233) and critical care services (99291, 99292). We assigned a physician if a single intensivist submitted at least 50% of all claims for critical care services submitted by all intensivists. Some admissions had no claims for critical care services by eligible intensivists. For these admissions, we assigned a physician if a single intensivist submitted at least 50% of all claims for any type of in-patient services submitted by any intensivist. Admissions unassigned in either of these steps were excluded.

Study Variables

The primary exposure variable was intensivist experience, defined in two ways: duration of practice and incident volume during the study period. Duration of practice equaled the number of years

between the year of the services provided by a physician and the completion of terminal residency or fellowship training. Incident volume equaled the total number of mechanically ventilated admissions for whom the physician submitted any type of

in-patient service claim in 2008. We also defined a third exposure variable as four categories of experience, combining binary definitions (high or low, based on median values) of duration and volume. The primary outcome was mortality within 30

Figure 1. Selection of study population. *Eligible visits included Medicare fee-for-service (FFS) patients admitted between January 1, 2008, and December 1, 2009, to an intensive care unit (ICU) within an acute care hospital in Pennsylvania who underwent mechanical ventilation, aged 18 years or older, and discharged by the end of the 2009 calendar year. CC = critical care.

days of hospital admission. Secondary outcomes were hospital length-of-stay and hospital discharge destination.

We identified potential confounders among patient, hospital, and physician variables *a priori*, as further detailed in the online supplement. We classified admissions as medical or surgical according to the Medicare Severity-Diagnosis Related Group. Because we found that the MediQual Atlas predicted mortality score was missing for approximately 11% of the study population, we adjusted for severity of illness in primary analyses using the components of the Acute Organ Failure Score, a risk adjustment methodology for ICU admissions using administrative data (41). We obtained physician specialty background from the AMA database. When missing (i.e., no record of residency training or board certification), we performed web searches for publicly available board certification data. We defined hospital volume of mechanically ventilated patients as the number of Medicare FFS beneficiaries who were admitted and underwent mechanical ventilation in 2008.

Statistical Analysis

We restricted all analyses to intensivist physicians and hospitals with at least 10 assigned patients for stability of multivariable regression models. To explore the overall contribution of intensivists to patients' 30-day mortality, we first estimated physicians' adjusted odds ratios (ORs) to visually inspect physician variability in outcomes. To do so, we fit multivariable logistic regression models, including all patient and hospital variables and a random effect term for physicians, as further detailed in the online supplement. The resultant adjusted ORs are derived from the empirical Bayes estimates of the physician effect and reflect the OR for 30-day mortality attributable to the physician. We classified physicians as outliers if the 95% credible intervals of the adjusted OR did not include 1. We then estimated the median OR and its 95% credible interval as a measure of among-physician variance (42). The median OR is the median value of the set of ORs that could be obtained by comparing otherwise identical patients (according to the values of all covariates included in the model) assigned to two different, randomly chosen physicians. In other words, it is the median OR between

the patient assigned to the physician with a higher risk-adjusted mortality rate compared with the one assigned to the physician with lower risk-adjusted mortality. Because it is mathematically comparable to ORs for patient or hospital characteristics, its use enables direct comparisons of the contributions of physician assignment and other factors, such as patient characteristics, to outcomes. Last, we estimated the intraclass correlation, which compares within- and between-physician variance, as a final way to examine physician-attributable contributions to patients' 30-day mortality.

For primary analyses of 30-day mortality, we estimated a series of mixed-effects logistic regression models, as detailed further in the online supplement. The fully adjusted models included all patient, physician, and hospital variables, and a random effect for physician to account for clustering. We selected this modeling strategy for two main reasons: 1) because it would permit us to account for two levels of clustering if necessary—the physician and the hospital; and 2) because it would allow for cluster-level variables, including the exposures of interest, to be included in the models. As detailed in the online supplement, the addition of a random effect

for hospital was deemed unnecessary. One model included only the duration experience variable; another model included the volume experience variable; a third model included the categorical variable for experience that combined duration and volume definitions; and a fourth model included both experience variables plus a multiplicative interaction term. We also prespecified tests for effect modification by 1) medical versus surgical status and 2) hospital volume, and accordingly built models, including multiplicative interaction terms of each experience variable with these factors. We then estimated Cox proportional hazards models for each definition of physician experience to study the secondary outcome of hospital length of stay, with censoring on death and using shared-frailty models to incorporate a random effect for physician (43). Last, we estimated mixed effects logistic regression models to study the secondary outcome of likelihood of discharge to home among survivors.

We performed five prespecified sensitivity analyses. First, we restricted the definition of intensivist to only those with critical care board certification during 2008 or 2009. Second, we restricted analyses to admissions where 100% of claims for critical

Table 1. Participant characteristics and outcomes

Characteristics	Outcome (n = 11,268)
Age, yr, median (IQR)	76 (66–83)
Male sex, n (%)	5,601 (50)
Chronic comorbidities*, n (%)	
Congestive heart failure	1,447 (13)
Chronic pulmonary disease	1,130 (10)
Neurological disorders	1,090 (10)
Hypertension	952 (8)
Renal failure	833 (7)
Diabetes	680 (6)
Liver disease	232 (2)
Admission source, n (%)	
Emergency department	7,343 (65)
Direct admission	2,873 (26)
Outside hospital transfer	1,046 (9)
Unknown	6 (<1)
Surgical MS-DRG, n (%)	4,140 (37)
Weekend admission, n (%)	3,022 (27)
30-day mortality, n (%)	4,840 (43)
Discharged to home, n (%)	2,184 (19)
Hospital length of stay, median (IQR)†	11 (6–18)

Definition of abbreviations: IQR = interquartile range; MS-DRG = Medicare Severity-Diagnosis Related Group.

*As classified according to Elixhauser, only if coded as present on admission.

†Total number of calendar days in the hospital (e.g., admission and discharge on the same day would be one calendar day)

care services were submitted by a single intensivist. Third, we included all physicians and hospitals with less than 10 patient assignments. Fourth, we repeated the analyses using the MediQual predicted mortality instead of the Acute Organ Failure Score for severity of illness risk adjustment. Fifth, we repeated the analyses modeling the exposure variables using restricted cubic splines with knots according to percentiles as recommended by Harrell (44).

We considered a two-sided *P* value of 0.05 as the threshold for statistical significance in all analyses. All analyses were performed using Stata 14.2 (StataCorp LLC).

Role of the Funding Source

The funders 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; or in the decision to submit the paper for publication.

Results

Among 23,545 admissions of mechanically ventilated, FFS Medicare patients to Pennsylvania hospitals during the study period, we assigned 345 intensivists to 11,268 of these patients (48%) in 104 hospitals (Figure 1). Table 1 summarizes admission characteristics and outcomes. Admissions that were and were not able to be assigned to intensivists according to the primary strategy were similar (*see* Table E1 in the online supplement).

The median number of patients assigned to a physician was 25 (interquartile range [IQR] = 16–40), and to a hospital was 75 (IQR = 21–155). Table 2 details hospital and physician characteristics. Most hospitals were in metropolitan locations and were not primary sites for critical care training programs. The median age of physicians was 46 years (IQR = 40–53), and a majority of physicians had a background in internal medicine. Median duration of experience was 11 years (IQR = 4–19), and median volume of admissions of mechanically ventilated patients in 2008 was 36 (IQR = 23–57). Among 329 intensivists who had data available for both duration and volume of experience, there was no correlation between the two experience definitions (Spearman's $\rho = 0.06$, $P = 0.21$; Figure E1).

Figure 2 illustrates variability in physician-adjusted OR, accounting for patient and hospital characteristics. The median physician-adjusted OR was 0.99 (IQR = 0.92–1.09); 166 physicians (48%) were classified as outliers, in that they had adjusted ORs with 95% credible intervals that did not include 1. The median value of the ORs comparing otherwise identical patients assigned to different physicians was 1.26 (95% credible interval = 1.19–1.35). Given a baseline 30-day mortality risk of 43%, this OR translates into a mortality risk of 49%, or a median absolute risk difference of 6%. The intracluster correlation, a measure of the variance in outcomes explained by the physician, was 0.018 (95% confidence interval [CI] = 0.010–0.030).

In all mixed-effects logistic regression models with a random effect for physician, there was no statistically significant association of intensivist experience with 30-day mortality (Table 3 and Table E2). In models with four categories of experience combining binary definitions of duration and volume, there was similarly no association of any category of experience with 30-day mortality. There was also no statistically significant interaction between experience and either medical versus surgical status or hospital volume, or between duration and volume of experience (Table E3). Results were nearly identical in all prespecified sensitivity analyses (Table E4).

Intensivist experience was also not associated with hospital length of stay

Table 2. Physician and hospital characteristics in 2008

Characteristics	Outcome (<i>n</i> = 345)
Physician characteristics	
Age, median (IQR)*	46 (40–53)
Years since med school graduation, median (IQR)	19 (12–26)
Years since completion of terminal training program, median (IQR) [†]	11 (4–19)
Graduation from non-U.S. medical school, <i>n</i> (%)	93 (27)
Board certified in any CC specialty, <i>n</i> (%)	289 (84)
Specialty background, <i>n</i> (%) [‡]	
Internal medicine	303 (88)
Surgery	40 (12)
Anesthesia	15 (4)
Emergency Medicine	3 (1)
Family practice	3 (1)
Volume of ICU patients for whom any in-patient claims were filed in 2008, median (IQR) [§]	101 (67–156)
Volume of MV patients for whom any in-patient claims were filed in 2008, median (IQR) [§]	36 (23–57)
Hospital characteristics (<i>n</i> = 104)	
Urbanicity, <i>n</i> (%)	
Metropolitan location	92 (88)
Nonmetropolitan, but urban location	12 (12)
Affiliation with CC program, <i>n</i> (%)	
CC training program	13 (13)
Other training programs	44 (42)
No training programs	47 (45)
Volume of Medicare FFS patients admitted to an ICU in 2008, median (IQR)	352 (192–472)
Volume of mechanically ventilated Medicare FFS patients in 2008, median (IQR)	64 (36–120)
Percentage of patients with any claims by an intensivist, median % (IQR)	77 (58–84)

Definition of abbreviations: CC = critical care; FFS = fee for service; ICU = intensive care unit; IQR = interquartile range; MV = mechanically ventilated.

*Data available for 341 physicians.

[†]Data available for 339 physicians.

[‡]A total of 22 (6%) physicians have more than one specialty background; no specialty data were available for three (1%) physicians.

[§]A total of 335 physicians have claims for patients in 2008.

^{||}Includes both assigned and unassigned Medicare FFS patients admitted in 2008.

Figure 2. Distribution of adjusted odds ratios (ORs) among physicians with patient assignments. The red line indicates an adjusted odds ratio of 1. All models were mixed-effects logit models with a random effect for physician assigned. Covariates included were participant characteristics (age, race, sex, medical vs. surgical diagnosis, acute organ failure score categories, Elixhauser comorbidities, admission source, weekend vs. weekday admission) and hospital characteristics (urbanicity, type of affiliation with critical care training program, hospital volume of mechanically ventilated patients, and percentage of patients within a hospital with claims by an intensivist). Data presented are the adjusted odds ratio with 95% credible interval.

(hazard ratio = 1.00; 95% CI = 1.00–1.01 for duration of experience; and hazard ratio = 1.00; 95% CI = 1.00–1.00 for volume of experience). In addition, among patients who survived to discharge, there was also no association of intensivist experience with the odds of being discharged to home (OR = 0.99; 95% CI = 0.99–1.00 for duration of experience; and OR = 0.99; 95% CI = 0.99–1.00 for volume of experience).

Discussion

This study of over 11,000 patients undergoing mechanical ventilation within 104 hospitals provides evidence that 30-day mortality varies widely by physicians, suggesting that physicians indeed contribute to their patients' outcomes. However, despite the acuity and complexity of this population, physician experience in managing mechanically ventilated patients is not associated with patient mortality. This finding appears to be robust, as it did not differ across several definitions of experience, across predefined patient subgroups, across hospitals with variable

institutional experience and volume of mechanically ventilated patients, or in any of several sensitivity analyses, including one where a single physician was responsible for all critical care services. Furthermore, physician experience was not associated with differences in hospital length of stay or likelihood of being discharged to home.

Our study has several strengths. It is the first, to our knowledge, to evaluate the specific role of physicians in outcomes of mechanically ventilated patients, a population at high risk of morbidity and mortality. Furthermore, it includes a large number of organizationally diverse practice settings, increasing the generalizability of the results. In conjunction, it uses advanced statistical methods to account for potential confounding. However, it also has several notable limitations. First, although we selected outcomes that are objective, frequently used, and highly unlikely to be inaccurate given their close ties to reimbursement, other study variables may have been misclassified. Second, as with any observational study, there are risks of bias related to unmeasured confounding. However, in the face of such confounding, it

would be unusual to observe effects so precisely null, and particularly unusual to find null effects across different methods of risk adjustment. Third, the mixed effects modeling strategy by design accounts for low numbers of observations within clusters, adjusting estimates of smaller clusters toward a null value. Although this is desirable in many uses of random effects, such as performance assessment, this strategy may minimize the effect of volume (45), one of our two exposure definitions. However, there was no correlation between duration and volume experience, so we would not expect this issue to affect the analyses using the duration of experience as the exposure definition. Fourth, the population was limited to Medicare FFS beneficiaries. Whether volume of this patient population correlates with overall volume of mechanically ventilated patients is unknown, and if poor, would bias the results toward the null. Furthermore, our results may not generalize to other populations of mechanically ventilated patients. Fifth, it is possible that our definitions of experience poorly capture the actual underlying construct. However, the

Table 3. Variables associated with 30-day mortality among mechanically ventilated Medicare patients

Level	Variable	Definition of Physician Experience					
		Years Since Completion of Training*			Volume of MV Patients in 2008†		
		OR	95% CI	P Value	OR	95% CI	P Value
Physician	Experience	1.00	1.00–1.01	0.11	1.00	1.00–1.00	0.82
	IM specialty background	1.09	0.90–1.32	0.38	1.09	0.90–1.32	0.39
	Foreign medical school	0.92	0.81–1.04	0.17	0.88	0.78–0.99	0.03
Patient	Age, yr						
	>74	Reference			Reference		
	65–74	0.61	0.55–0.67	<0.01	0.60	0.55–0.66	<0.01
	55–64	0.44	0.38–0.51	<0.01	0.44	0.38–0.51	<0.01
	45–54	0.35	0.29–0.43	<0.01	0.35	0.29–0.43	<0.01
	<45	0.24	0.18–0.31	<0.01	0.24	0.18–0.31	<0.01
Hospital	Female sex	0.86	0.79–0.93	<0.01	0.86	0.80–0.94	<0.01
	Medical diagnosis	2.80	2.56–3.07	<0.01	2.81	2.57–3.08	<0.01
	Metropolitan location	0.92	0.68–1.26	0.62	0.93	0.69–1.23	0.60
	CC program affiliation						
	None	Reference			Reference		
	Some training program	0.99	0.85–1.16	0.85	1.01	0.87–1.18	0.89
	Primary CC program	1.10	0.90–1.33	0.90	1.13	0.92–1.38	0.24

Definition of abbreviations: CC = critical care; CI = confidence interval; IM = internal medicine; MV = mechanically ventilated; OR = odds ratio.

All models were mixed-effects logit models with a random effect for physician assigned. Other covariates included, but not shown, were white versus non-white race, acute organ failure score categories, Elixhauser comorbidities, admission source, weekend versus weekday admission, hospital volume of mechanically ventilated patients, and percentage of patients within a hospital with claims by an intensivist.

*n = 11,119 patients assigned to 339 physicians.

†*n* = 11,152 patients assigned to 335 physicians.

observation of similarly null findings using two different measures of experience as well as a third, combined measure, limits this concern. Last, the study period was approximately 8 years ago, and delivery of care to mechanically ventilated patients has possibly changed over time. We chose the study population during this specific period due to the availability of a risk adjustment variable that was superior to administrative risk adjustment alone, and we felt that a relationship between physician experience and outcomes should not change from one practice era to another; however, it is possible that organizational factors (such as intensivist staffing models or interprofessional rounding) that may have changed over time could influence our results.

We had hypothesized that physician experience would be associated with these patient outcomes, because institutional volume is related to outcomes for mechanically ventilated patients (14, 30), and physician experience is related to outcomes of patients with other conditions (25, 34, 46–51). There are several potential

explanations for our failure to find similar associations. One possibility is that physician experience truly plays no role in how physicians care for mechanically ventilated patients along dimensions that affect outcomes. Such a conclusion is plausible in the settings of ICUs, where interprofessional teams of clinicians and other organizational factors may effectively compensate for or buffer against the contributions from individual physicians (32, 52–58). Alternatively, the null findings could be attributable to the innate challenges of attributing outcomes of complex patients to individual physicians. Many patients who undergo mechanical ventilation have complex medical issues and are comanaged by several different physicians from different specialties, such that assigning responsibility to a single physician for outcomes may be unrealistic.

A third potential explanation is that our strategy for physician assignment may have led to misclassification of the exposure. We found little precedent for attributing outcomes of mechanically ventilated patients, and a claims-based strategy may

simply be inadequate to identify the most responsible physician. One previous study of ICU patients with pneumonia that used claims to assign physicians for outcome attribution did find that increasing physician experience was associated with decreased patient mortality (59). However, the strategy for physician assignment was not described in this study, and the data reflect patients and physicians in Taiwan, where physician staffing and care delivery may differ substantially from Pennsylvania hospitals. We did find associations between certain physician characteristics (such as location of medical school graduation) and patient outcomes similar to those previously reported (15), suggesting that our strategy for physician assignment was appropriate. Furthermore, our results were preserved in multiple sensitivity analyses, including one restricted to patients for whom all intensivist critical care claims were by a single intensivist, providing further support for these findings.

Although physician experience did not to contribute to patient outcomes, we nonetheless observed considerable

variability in patient outcomes depending on their assigned physician. The median OR of 1.26 is greater than the ORs of patient characteristics with well-accepted associations with mortality, such as sex (1.16 for males). Our study cannot elucidate whether this variability is attributable to differences in skill managing mechanical ventilation or other physiologic or clinical elements that are not related to experience, differences in propensities to engage in goals of care conversations and set limits on life

support, or other factors. However, whereas many patient characteristics are fixed, physician characteristics may be modified or overcome by organizational interventions. Therefore, a deeper understanding of which physician characteristics explain this variability may reveal novel targets for future interventions to improve patient outcomes overall.

In summary, we find that the outcomes of mechanically ventilated patients vary

according to which physician cares for them, but this variability is not explained by the number of years physicians have been in practice or by their prior experience managing mechanically ventilated patients. These findings suggest that further study is needed to better understand, and therefore address, physician-level variability in patient outcomes. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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