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Variation in Emergency Department Physician Admitting Practices and Subsequent Mortality

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Key Points

Question: By how much does the propensity to admit patients vary across physicians within a given emergency department (ED), and do higher admission propensities result in lower patient mortality?

Findings: Using electronic health record data pertaining to 2 million ED visits treated by 2,098 physicians across 105 EDs, we find being treated by a physician with an admission propensity at the 90th percentile relative to one at the 10th percentile nearly doubles a patient's probability of being admitted to the hospital but does not reduce their subsequent mortality rate.

Meaning: Higher admission propensities do not appear to reduce patient mortality.

Abstract

Importance: An emergency department (ED) physician's decision to admit a patient to the hospital plays a pivotal role in determining the type and intensity of care that patient will receive. ED physicians vary widely in their propensity to admit patients, but it is unknown whether higher admission propensities result in lower subsequent mortality rates.

Objective: To measure the variation in ED physicians' admission propensities and estimate their relationship with patients' subsequent mortality rates.

Design: Cross-sectional study of January 2011 to December 2019 nationwide Veterans Affairs (VA) electronic health record data, comparing physicians practicing within the same ED. Analyses were performed May 2022 to October 2024.

Setting: 105 VA EDs.

Participants: Patients visiting the ED with one of the three most frequent chief complaints in US EDs (chest pain, shortness of breath, and abdominal pain).

Exposure: VA ED physicians with a range of admission propensities.

Main Outcomes and Measures: Variation in physicians' adjusted admission rates, short inpatient stays (<24 hours), 30-day mortality.

Results: Our sample included 2,098 physicians seeing 2,137,681 patient visits across 105 EDs. The average admission rate was 41.2%, and the average 30-day mortality rate was 2.48%. We found that physicians' adjusted admission rates varied greatly within the same ED (e.g., for chest pain: 90th percentile of physicians 56.6% admitted and 10th percentile 32.6% admitted; difference 24.0 percentage points), despite finding no relationship between these adjusted admission rates and patients' prior health status as measured by their Elixhauser comorbidity score prior to the ED visit. However, patients admitted by physicians with higher admission rates were more likely to be discharged within 24 hours (e.g., 31.0% vs. 24.8%), while patients of physicians with higher admission rates had subsequent mortality rates that were no less than those of patients of physicians with lower admission rates.

Conclusions and Relevance: ED physicians vary widely in their admission propensity, despite seeing patients with similar prior health status. Patients treated by physicians with higher admission propensities are more likely to be discharged after only a short inpatient stay and experience no reduction in subsequent mortality rates.

Introduction

The decision by an emergency department (ED) physician to admit a patient is a consequential one. Admissions are not only expensive,[1,2] but they can fill limited inpatient beds and stress inpatient physicians and nurses,[3] and can lead to ED boarding and stress ED physicians and nurses. Admissions may expose patients to healthcare-associated infections,[4] and the disruption of hospitalization has been described as traumatic.[5] On the other hand, admitted patients can receive monitoring and care that they cannot receive in other settings.

ED physicians have been found to vary greatly in their propensity to admit a patient, even within in the same ED,[6-11] but large-scale evidence of clinical implications of this variation is lacking. Given the costly and consequential nature of admissions and the wide variation in admission rates across physicians, it is important to understand the extent to which higher admission rates offer clinical benefits to patients. However, a rigorous analysis must ensure that variation in admission rates is due to variation in physicians' decision-making, not to systematic differences in their patients. To accomplish this, the data used must account for key clinical factors such as time of arrival (as physicians may work different shifts with different patient populations) and the emergency severity index (ESI) (as some physicians may be more likely to be assigned lower-acuity patients). Such information is captured by electronic health record (EHR) data, but not by claims data.

In this study, we used clinically-rich nationwide Veterans Affairs (VA) EHR data to examine variation in admission rates among physicians working within the same ED. We account for several variables present in EHR data, such as chief complaint, time of arrival, location within the ED, and ESI, to construct cohorts in which patients' health status prior to ED visit is balanced across physicians. Next, we examined the extent of variation in admission rates across physicians and whether admitted patients of physicians with higher admission rates were more likely to have short inpatient stays (<24 hours), which we used as a proxy for lower clinical need for hospitalization (relative to longer inpatient stays). We then estimated the relationship between physicians' admission rates and their patients' subsequent mortality rates among all patients (regardless of disposition).

Methods

Data and Study Population

We used VA EHR data from the VA Corporate Data Warehouse (CDW), including ED visit data in EDIS (Emergency Department Integration Software), which the VA fully implemented in 2011.[12] We identified patients aged 20 and older who visited a VA ED with a chief complaint for chest pain, abdominal pain, or shortness of breath (the 3 most common chief complaints in US EDs)[13] from January 2011 through December 2019. Since physicians' admission propensities may differ by case type, we examined visits for each chief complaint separately, and limited the sample to physicians with at least 100 complaint-specific visits to ensure adequate sample sizes to estimate their admission rates with greater precision. More details can be found in **eMethods** and **eTable 1**.

Outcomes

Our first outcome was admission from the ED. As in previous studies,[7,9] we considered "observation" stays and transfers as clinically equivalent to an admission (since patients continued to receive monitoring and were not immediately discharged home). Our second outcome was, among patients admitted, whether the inpatient stay was less than 24 hours. Our third outcome was, among all patients seen by the physician (all disposition types), death within 30 days of ED visit. In sensitivity analyses, we repeated this for 7-day and 14-day mortality to examine whether disposition decisions had more immediate clinical implications, and for 90-day and 1-year mortality to examine whether disposition decisions had longer-term implications. VA mortality data include deaths captured by Medicare, Veterans Benefits Administration, and Social Security Administration. Research comparing this mortality data to the National Death Index finds this data capture 98% of all deaths.[14] Our fourth outcome was number of radiology tests and number of laboratory tests ordered by the physician in the ED. Our fifth outcome was total number of days in the hospital (ED or inpatient setting) within 30 days after ED visit.

Covariates

Our analyses included two categories of covariates. The first category was time, location, and patient-specific covariates that may influence a patient's likelihood of admission and vary across physicians, which we used as control variables in regression analyses. Time covariates were indicator variables for hour of ED presentation,[15,16] day of week,[17,18] month,[18] and year.[19] Location covariates were indicator variables for each VA ED and each room within a given ED (the latter controls for potential differences in room assignment within a given VA ED related to perceived patient acuity at triage).[20] Patient-specific covariates were age,[19] sex,[21] and ESI level.[22] The second category was covariates not used as control variables, but instead as "balance checks" to assess whether patient characteristics such as prior health status, conditional on the control variables, were similar across physicians. These included the Elixhauser comorbidity score[23] and patient race and ethnicity (self-reported; options defined by VA).[21]

Statistical Analysis

All analyses conducted were chief complaint-specific to allow for physicians' admission rates to vary by complaint. To examine variation in adjusted admission rates across physicians within the same ED, we estimated admission rates using a multivariable linear regression of our binary outcome of patient admission as a function of binary indicators for each ED interacted with binary indicators for each value of the following variables: hour, day of week, month, year, ED room, patient sex, patient age (in 5-year increments), and ESI level. The physician-level mean of the regression residuals (deviations from probability of admission predicted from variables above), when added to the overall mean rate, represent the physician's admission rate adjusted for the ED they work in, when they saw patients, the rooms they saw patients in, patient demographics, and patient severity (as measured by ESI). We used a linear model because non-linear models for binary outcomes (e.g., logistic or probit) are generally inconsistent and biased when estimating models like ours with a large number of fixed effects (see **eMethods**).[24,25]

Our analysis assumed that, conditional on the control covariates above, differences in physicians' complaint-specific admission rates were the result of differences in their propensity to admit, not differences in their patients' health.[26-32] To assess this assumption, we examined the relationship between a summary measure of a patient's health status prior to ED visit – Elixhauser comorbidity score – and physician admission rates. We performed a multivariable linear regression of the patient's score on their physician's admission rate and the control covariates above. Finding no correlation between the two would support the assumption of minimal confounding of the admission rate estimates arising from differences in patients' health status. We repeated this analysis for patient race and ethnicity.

To examine clinical implications of variation in admission rates, we performed a multivariable linear regression (among admitted patients) of the binary outcome of a short inpatient stay (< 24 hours) on the physician's admission rate, controlling for the same covariates. We repeated this analysis (among all patients seen by the physician) to examine the binary outcome of death within 30 days of ED visit.

In secondary analyses, to examine whether physicians who had higher admission rates for one complaint also had higher admission rates for other complaints, we estimated the correlation of admission rates across complaints. To examine whether physicians' admission rates reflected intensity of their care patterns more generally (e.g., if physicians with greater propensity to admit also had greater propensity to order diagnostic tests), we performed a multivariable linear regression of number of radiology tests performed during the ED visit on the physician's admission rate, controlling for the same covariates. We repeated this analysis for number of laboratory tests. Next, we explored whether physicians with lower admission rates appeared to be merely deferring admissions into the near future. In this scenario, their patients would spend no less time in the hospital in the period following their ED visit than patients who were treated by physicians with higher admission rates. In fact, patients of physicians with lower admission rates could spend even greater time in the hospital if the delay in receiving inpatient care allowed their condition to worsen. To test this hypothesis, we calculated number of days each patient spent in either the ED or inpatient setting within 30 days following their ED visit, and performed a multivariable linear regression of this outcome on the physician's admission rate, controlling for the same covariates.

All p-values were from 2-sided tests, with statistical significance at the $p<0.05$ level. Data were analyzed using R version 4.2. The VA Greater Los Angeles IRB approved the study. Informed consent was waived because data were deidentified. This study followed the STROBE reporting guideline.

Results

Our sample included 2,137,681 patient visits cared for by 2,098 physicians across 105 VA EDs. Average patient age was 63 years, and 9.8% were female (**Table 1**). 37.5% had a chief complaint of chest pain, 38.4% shortness of breath, and 30.9% abdominal pain (a visit could have more than one complaint). Average number of radiology tests per visit was 1.08, and for laboratory tests 7.9. About 41% of visits resulted in an admission, and of those admitted, 19.4% were admitted for less than 24 hours. Average 30-day mortality rate was 2.48%.

After adjustment for time of arrival, room, patient demographics, and ESI, substantial variation in admission rates remained among physicians working in the same ED. For example, for chest pain, the admission rate of physicians in the 90th percentile was 56.6%, while the 10th percentile was 32.6% (difference 24.0 percentage points) (**Figure 1**). For shortness of breath, the 90th percentile was 58.2%, while the 10th percentile was 39.1% (difference 19.1 percentage points).

We found no correlation between physicians' admission rates and Elixhauser comorbidity scores of their patients (**eFigure 1**; p-values ranged from 0.12-0.26), suggesting that admission rate estimates were not confounded by differences in patients' health status. Similarly, we found no correlation between physicians' admission rates and share of their patients who were White, non-Hispanic (**eFigure 2**; p-values ranged from 0.10-0.68).

Patients admitted by physicians with higher admission rates were more likely to experience a short inpatient stay (<24 hours). For example, among chest pain patients admitted by physicians in the 90th percentile, 31.0% were discharged within 24 hours, and for the 10th percentile 24.8% (difference: 6.2 percentage points; 95% CI for the difference: 5.7 to 6.6) (**Figure 2**). However, we did not find a negative relationship between physicians' admission rates and their patients' 30-day mortality rate (**Figure 3**). Results were substantively unchanged for 7-day (**eFigure 3, Panel A**), 14-day (**eFigure 3, Panel B**), 90-day (**eFigure 3, Panel C**), and 1-year mortality (**eFigure 3, Panel D**).

In secondary analyses, we found that physicians' admission rates were highly correlated across chief complaints. For example, the correlation between physicians' admission rates for patients presenting with chest pain and those presenting with shortness of breath was 0.73 (**eFigure 4**).

Physicians with higher admission rates ordered a higher number of radiology tests per visit and a higher number of laboratory tests per visit. For example, for chest pain, the number of radiology tests per patient visit for physicians in the 90th percentile was 1.20, and for the 10th percentile

1.04 (difference: 0.16 tests; 95% CI for the difference: 0.15 to 0.18) (**Figure 4, Panel A**). This difference of 0.16 tests is 14.7% of the mean number of radiology tests for chest pain (1.12 radiology tests). Similarly, the number of laboratory tests in the 90th percentile was 8.9 and for the 10th percentile 7.8 (difference: 1.1 tests; 95% CI for the difference: 0.9 to 1.2) (**Figure 4, Panel B**; difference 13.0% relative to the mean). Results were similar for shortness of breath and for abdominal pain.

Patients of physicians with lower admission rates spent less time in the hospital within 30 days after their ED visit. For example, among patients presenting with chest pain, the average number of days spent in either the ED or inpatient setting was 1.96 for patients of physicians in the 90th percentile, and 1.54 for patients of physicians in the 10th percentile (difference 0.42; 95% CI for the difference: 0.40 to 0.44) (**eFigure 5**). Results were similar for shortness of breath and for abdominal pain.

Regression results can be found in **eTable 2**. Patterns were similar when examining the 80th percentile of physicians versus the 20th percentile (**eTable 3** and **eTable 4**). In sensitivity analyses, our results were unchanged when including Elixhauser score or race and ethnicity as controls (**eTable 5**). They were also unchanged when classifying observation stays as discharges rather than as admissions (**eTable 6**). Results were largely unchanged when reducing the minimum sample size per physician to 50 complaint-specific patient visits from 100 (**eTable 7** and **eTable 8**). When instead estimating a hierarchical mixed effect model with physicians nested within ED site, the resulting physician random effects were highly correlated with our estimates and had similar standard deviations (**eTable 9**). The total share of variation in admissions explained by the physician ranged from 9.3% for chest pain to 3.0% for abdominal pain. For context, this is similar or greater in magnitude than the share explained by ESI (e.g., 4.4% for chest pain, 3.9% for abdominal pain) and greater in magnitude than the share explained by age (e.g., 5.8% for chest pain, 2.4% for abdominal pain), both of which are known to be highly predictive of admission.[19,22]

Discussion

Using a nationwide sample of over 2,000 physicians caring for over 2 million patient visits across 105 VA EDs, we found substantial variation in admission rates across physicians within the same ED, which differed by as much as 24 percentage points between the 90th and 10th percentile. We were able to demonstrate that there was no relationship between physician admission rates and the prior health status of the patients they treated, suggesting that variation in physician admission rates and in subsequent patient outcomes is attributable to variation in physician decision-making rather than to systematic differences in their patients' underlying health. Moreover, we found that while being treated by physicians with higher admission propensities made patients far more likely to be admitted to the hospital, this did not appear to provide them with any additional short-term protection from severe patient outcomes, as they were no less likely to die in the weeks and months that followed their ED visit. Nor did this appear to promote earlier detection of conditions that otherwise would have resulted in their deaths, as they remained no less likely to die for at least a year after their ED visit. Finally, we found that patients treated by physicians with a lower admission propensity spent fewer days in the ED or inpatient setting within 30 days after the ED visit, suggesting that physicians with lower admission propensities were not simply deferring their patients' admissions.

Although within the same ED, physicians cared for patients of similar prior health status, they varied significantly in the disposition decisions they made. While additional admissions by physicians with high admission propensities were not associated with lower patient mortality, we acknowledge we may not be capturing other potential benefits from admission, such as reassurance for the patient or lower morbidity. Such possible benefits, which are important, would need to be weighed against the possible strain on the hospital and on care providers, potential exposure to healthcare-associated infections, disruption to the patient's life, and substantial monetary costs that can be caused by hospitalization.

Each physician's admission rate was consistent across chief complaints, suggesting that the observed variation across physicians was not being driven by any single case type, but was instead reflective of something more fundamental to physicians' decision-making. The positive correlation between physicians' admission rates and their use of diagnostic tests is consistent with higher admission rates being part of a more intensive practice pattern. This is not consistent with an alternative hypothesis that physicians with lower admission rates might compensate by utilizing more diagnostic testing within the ED. This relationship may instead be capturing physicians who are better able to discern between more and less acute diagnoses and who, as a result, conduct less testing and admit patients less frequently. This explanation is consistent with our findings that patients treated by physicians with lower admission rates have similar mortality rates despite receiving less intensive treatment and, when admitted, are less likely to experience a short inpatient stay.

Another possible explanation for the range in admission propensities across physicians is variation in their tolerance of uncertainty.[33,34] Some have hypothesized that one possible response by ED physicians to uncertainty is to order more tests and to admit patients more frequently.[34] A third possible explanation is variation in physicians' thresholds to test and to admit.[34-39] That is, two physicians may have the same assessment of risk of a particular diagnosis or outcome, but one physician may have a lower threshold than the other to test or admit. Finally, the ability to have their patients follow-up in the outpatient setting may be a particularly important consideration for some physicians, which may make discharging to home challenging if outpatient care is not immediately available. Our results are not able to distinguish among these and other possibilities.

Our study contributes to an increasingly rich literature on variation in physician behavior.[6,7,9-11,40-43] Some of these studies examine clinical outcomes,[6,11,40,41] and some examine variation in ED physician admission rates.[6,7,9-11] Yet to our knowledge, ours is the first nationwide study to examine variation in admission rates across physicians working in the same ED using clinically-rich EHR data that, by accounting for important clinical factors, allows for estimation of relationships with less potential for confounding; this enables more rigorous evaluation of the clinical implications of this variation.

Our study has several limitations. First, our study is observational, so we cannot rule out the possibility of unobserved clinical confounders not captured in EHR data. However, since many unobserved potential confounders are likely correlated with patients' prior health status, that physicians' admission rates were uncorrelated with prior health status suggests a more limited scope for such confounding. Second, our measure of prior health status—the Elixhauser comorbidity score—although associated with healthcare outcomes such as readmission and in-hospital mortality, is not a measure of patient acuity. While we do control for ESI, a measure of patient acuity, it is partly based on judgment of the person triaging, leaving scope for both underestimation and overestimation of patient acuity.[44] Third, our findings could also be driven by variation in physician characteristics that we were unable to control for, such as medical training, which does not exist in our data. Prior research, however, finds medical training explains very little of the variation in physician care patterns.[42,45] Fourth, our results are specific to the VA—with its higher percentage of male patients, its comprehensive EHR that ensures most patients present to providers with a detailed medical history, and its staffing of EDs with more non-EM-trained physicians[46]—and may not generalize to non-VA settings. Fifth, our results do not speak to the question of whether interventions or policies that intend to reduce the admission rates of physicians with high admission rates would be safe. Finally, while there is large variation across physicians within an ED in admission rates, physicians explain only 3% to 9% of the total variation in admission, so a number of other factors also play an important role in admissions.

In conclusion, we found substantial variation in admission rates across physicians working in the same ED, that patients of physicians with high admission rates were more likely to have a short inpatient stay (if admitted), were no less likely to die after their visit, and spent more time in the hospital in the 30 days following their visit. Future research that explores how such variation arises and the extent to which it is amenable to safe intervention may prove beneficial to patients, providers, and health care systems.

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Conflicts of Interest: None disclosed

Disclaimer: The views expressed here are those of the authors and do not necessarily represent the views of the U.S. Department of Veterans Affairs or the U.S. government.

Data Sharing Statement: VA data involve protected health information and cannot be shared.

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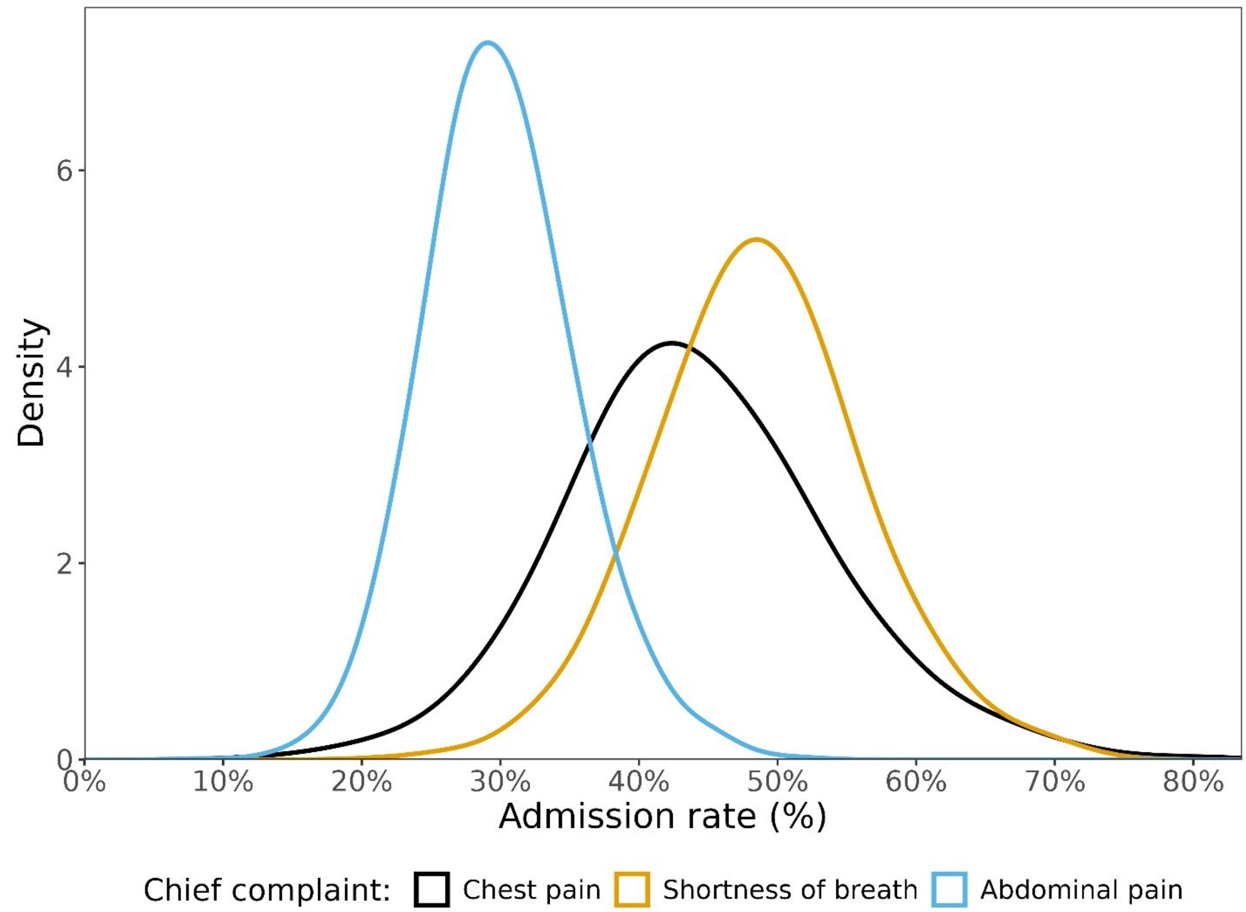
Table 1: Sample Characteristics

	All (n=2,137,681)	Chest pain (n=799,155)	Shortness of breath	Abdominal pain

			(n=819,432)	(n=659,207)
Mean age (years)	62.7	61.9	67.0	58.5
Female (%)	9.8	9.6	6.7	13.6
Race and ethnicity (%)				
American Indian or Alaska	0.8	0.8	0.7	0.9
Asian	1.3	1.3	1.1	1.4
Black	25.2	27.4	23.7	25.1
Hispanic	5.8	6.1	4.4	7.2
White	61.7	58.8	65.3	60.4
Other race and ethnicity	5.2	5.5	4.9	5.1
Chief complaint				
Chest pain (%)	37.5	100	13.9	2.6
Shortness of breath (%)	38.4	14.1	100	1.9
Abdominal pain (%)	30.9	2.2	1.6	100
Mean Emergency Severity Index	2.76	2.56	2.75	2.99
Mean Elixhauser comorbidity score	5.5	5.3	6.4	4.7
Mean number of radiology tests	1.08	1.12	1.11	1.04
Mean number of laboratory tests	7.9	8.3	7.8	7.8
Admitted (%)	41.2	44.2	48.7	30.1
Short inpatient stay among those admitted (%)	19.4	28.1	13.5	16.3
30-day mortality (%)	2.48	1.30	4.25	1.70

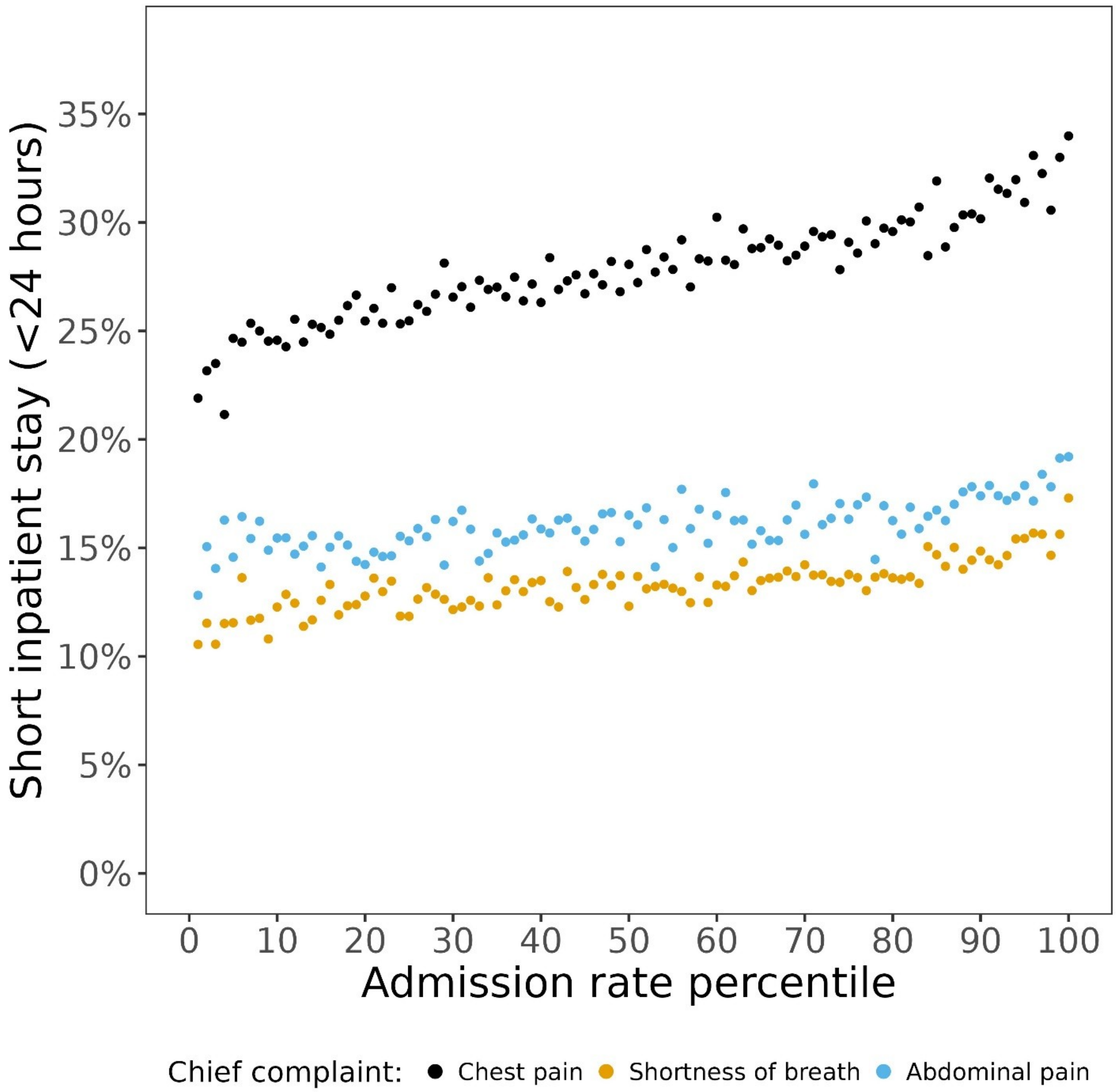
Note: Authors' calculation using Veterans Affairs data from 2011 through 2019. Other race and ethnicity refers to observations for which race and ethnicity were missing, for patients who declined to answer, or unknown by patient. Short inpatient stay is hospitalization less than 24 hours among those admitted. Rates range from 0-100.

Figure 1: Variation in Adjusted Admission Rates across Physicians Working in the Same Emergency Department



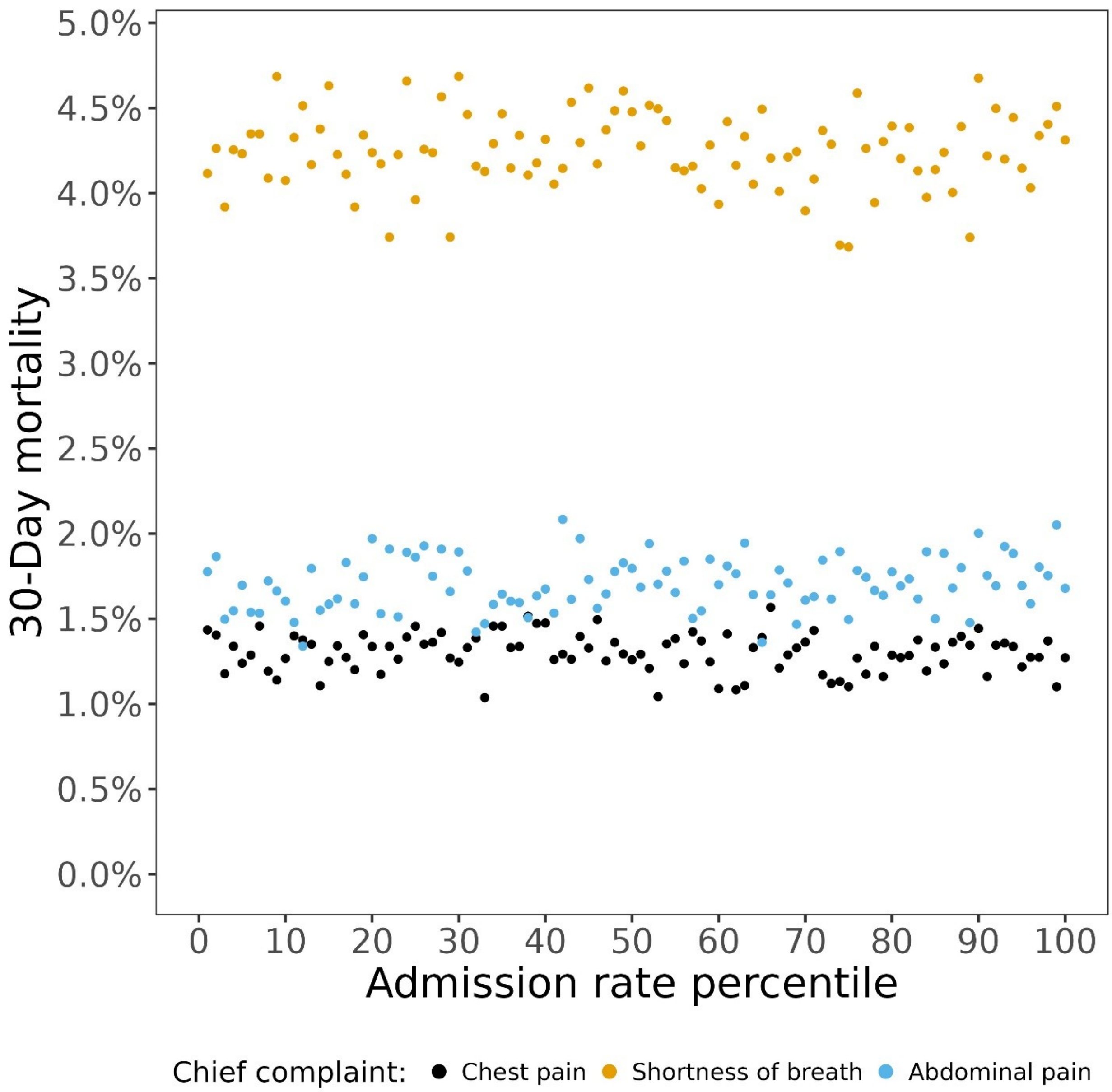
Note: Authors' calculation using Veterans Affairs data from 2011 through 2019. The figure is a density plot of physician-specific admission rates by chief complaint, adjusted for emergency department, hour, day of week, month, year, emergency department room, patient sex, patient age (in 5-year increments), and emergency severity index.

Figure 2: The Relationship between Physician Adjusted Admission Rates and Probability of their Admitted Patients Having a Short Hospitalization (<24 Hours)



Note: Authors' calculation using Veterans Affairs data from 2011 through 2019. Dots in the figure represent the mean probability of a short inpatient stay (<24 hours) among admitted patients for each percentile of physician admission rate, by chief complaint. Both the probability of a short inpatient stay and the admission rate are adjusted for emergency department, hour, day of week, month, year, emergency department room, patient sex, patient age (in 5-year increments), and emergency severity index. For chest pain, the correlation between short inpatient stay and physician admission rate is 0.06 (p<0.001), for shortness of breath 0.03 (p<0.001), and for abdominal pain 0.03 (p<0.001).

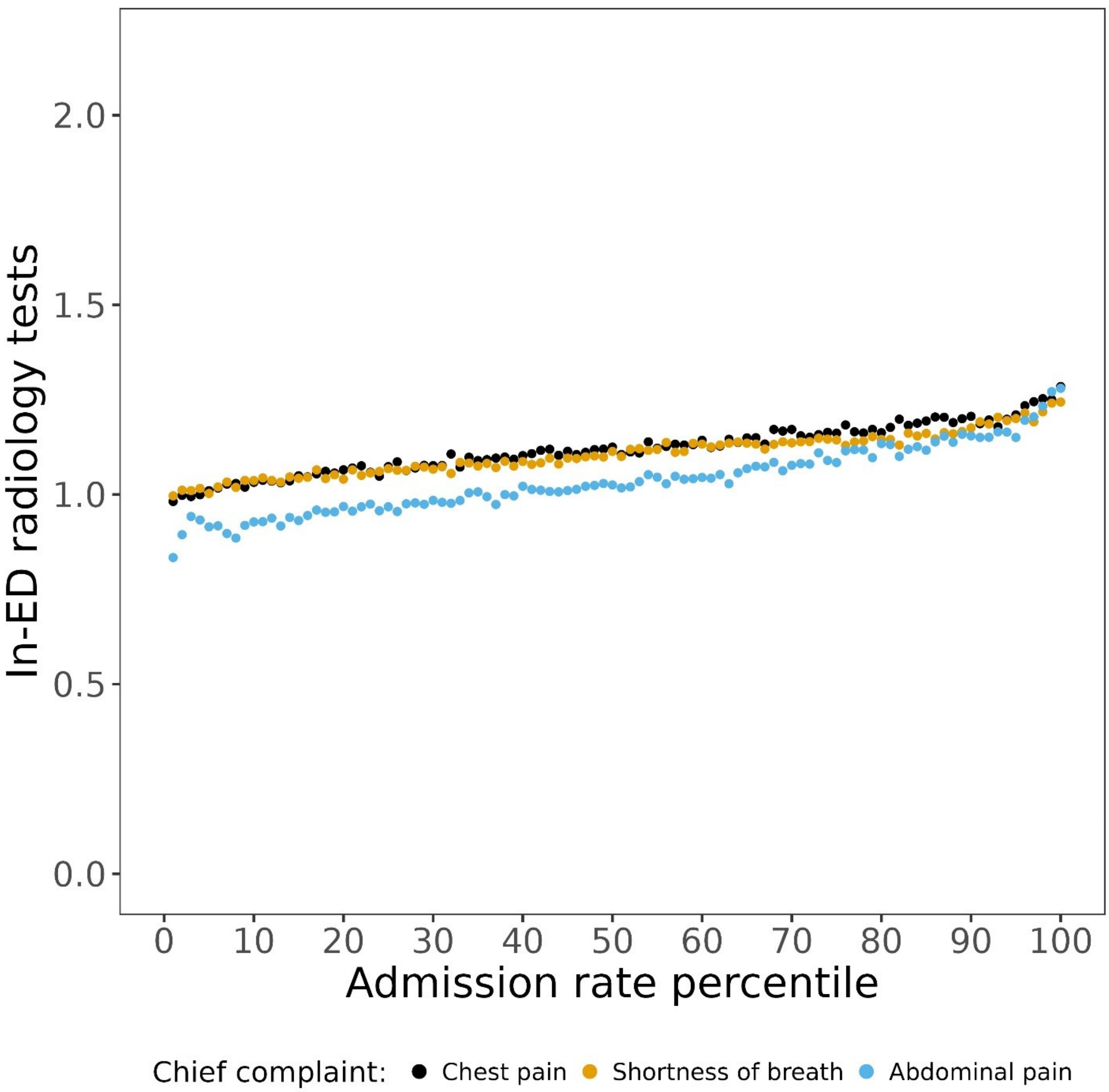
Figure 3: The Relationship between Physician Adjusted Admission Rates and the 30-Day Mortality Rate of their Patients



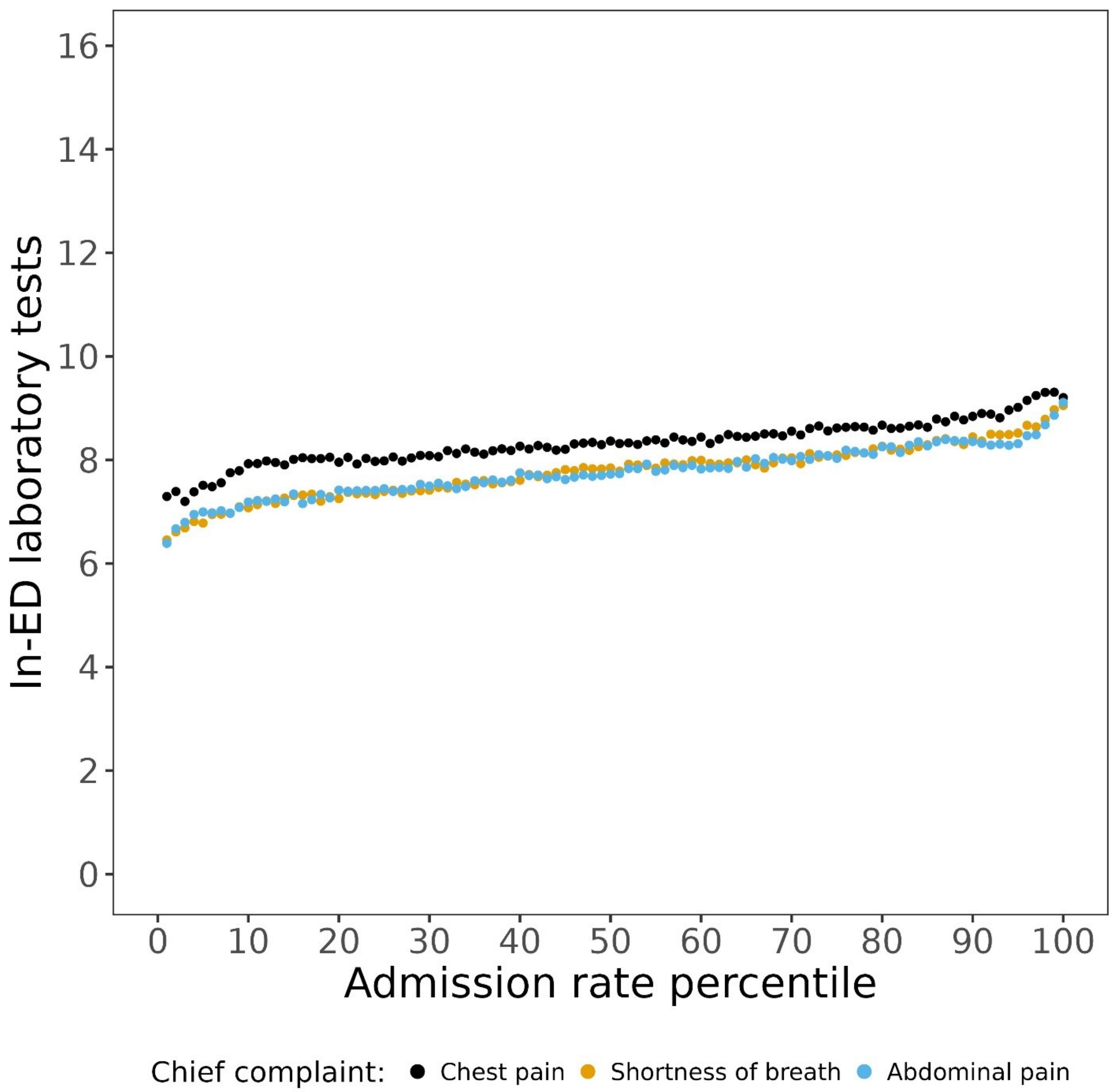
Note: Authors' calculation using Veterans Affairs data from 2011 through 2019. Dots in the figure represent the mean 30-day mortality rate for each percentile of physician admission rate, by chief complaint. Both the 30-day mortality rate and the admission rate are adjusted for emergency department, hour, day of week, month, year, emergency department room, patient sex, patient age (in 5-year increments), and emergency severity index. For chest pain, the correlation between 30-day mortality and physician admission rate is -0.001 (p=0.20), for shortness of breath -0.000009 (p=0.99), and for abdominal pain 0.002 (p=0.04).

Figure 4: The Relationship between Physician Adjusted Admission Rates and their Use of Testing in the Emergency Department

Panel A: Radiology Tests



Panel B: Laboratory Tests



Note: Authors' calculation using Veterans Affairs data from 2011 through 2019. Dots in the figure represent the mean number of radiology tests (Panel A) or laboratory tests (Panel B) for each percentile of physician admission rate, by chief complaint. Both the number of tests and the admission rate are adjusted for emergency department, hour, day of week, month, year, emergency department room, patient sex, patient age (in 5-year increments), and emergency severity index. For chest pain, the correlation between in-ED radiology tests and physician admission rate is 0.09 ($p<0.001$), for shortness of breath 0.08 ($p<0.001$), and for abdominal pain 0.10 ($p<0.001$). For chest pain, the correlation coefficient between in-ED laboratory tests and physician admission rate is 0.11 ($p<0.001$), for shortness of breath 0.12 ($p<0.001$), and for abdominal pain 0.12 ($p<0.001$).