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Authors
Yoon, Jean
Phibbs, Ciaran
Ong, Michael
et al.

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Acute hospitalizations and outcomes in Veterans Affairs Hospitals 2011 to 2017

Jean Yoon, PhD[a,b,c,*], Ciaran S. Phibbs, PhD[a,b,d], Michael K. Ong, MD[e,f,g], Megan E. Vanneman, PhD[h,i,j], Kenneth W. Kizer, MD[k], Adam Chow, BA[a], Andrew Redd, PhD[h,i], Hao Jiang, MS[a], Yue Zhang, PhD[h,i]

Abstract

Hospitals within the Veterans Affairs (VA) health care system exhibited growing use of observation care. It is unknown how this affected VA hospital performance since observation care is not included in acute inpatient measures. To examine changes in VA hospitalization outcomes and whether it was affected by shifting acute inpatient care to observation care. Longitudinal analysis of 986,355 acute hospitalizations and observation stays in 11 states 2011 to 2017. We estimated temporal changes in 30-day mortality, 30-day readmissions, costs, and length of stay (LOS) for all hospitalizations and 6 conditions in adjusted models. Changes in mortality and readmissions were compared including and excluding observation care. A 9% drop in acute hospitalizations was offset by a 157% increase in observation stays 2011 to 2017. A 30-day mortality decreased but readmissions did not when observation stays were included (all $P < .05$). Mean costs increased modestly; mean LOS was unchanged. There were differences by condition. VA hospital mortality decreased; there was no change in readmissions.

Abbreviations: AMI = acute myocardial infarction, CABG = coronary artery bypass surgery, DRG = diagnosis related group, GI = gastrointestinal, LOS = length of stay, VA = Veterans Affairs health care system.

Keywords: hospital, inpatient, mortality, Veterans

1. Introduction

The VA Health Care System cares for 9.5 million eligible Veterans through a national, integrated health care delivery system that includes 128 hospitals providing acute inpatient medical and surgical care. These hospitals vary by volume, availability of clinical services, and involvement in research and teaching activities. Multiple studies documented better VA hospital performance through declines in hospital mortality rates and 30-day readmissions rates between 1997 and 2010.[1–3] More recently, a prior study found that VA hospitals began to substantially increase the use of observation care 2009 to 2013.[4] Observation care was intended to provide an efficient alternative for conditions that required brief evaluation rather than conditions needing a more intensive inpatient stay. These unscheduled hospital admissions occur for patients usually admitted through the emergency department who are treated on the same general medical wards as regular hospital admissions, but care is charged as outpatient care. The reasons for the growing use of VA observation care is unclear although reasons related to improving patient flow, avoiding unsafe discharges, and reducing costs have been posited.[4]

US hospitals overall have faced greater pressures to reduce readmissions in the Medicare program since hospitals incur financial penalties for excess readmissions under Medicare's Hospital Readmission Reduction Program.[5–9] Accordingly, US hospitals saw a reduction in 30-day readmissions for conditions such heart failure, acute myocardial infarction (AMI), and pneumonia from 2002 to 2012; these trends were accompanied by reductions in hospital mortality.[10–13] The rise in observation care has been thought to be related to downward trends in readmissions. However, studies have not been able

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

This study was approved by the Stanford University, University of Utah, and Greater Los Angeles VA Institutional Review Boards.

[a] Health Economics Resource Center, VA Palo Alto Health Care System, Menlo Park, CA, [b] Center for Innovation to Implementation, VA Palo Alto Health Care System, Menlo Park, CA, [c] Department of General Internal Medicine, UCSF School of Medicine, San Francisco, CA, [d] Departments of Pediatrics and Health Policy, Stanford University School of Medicine, Stanford, CA, [e] VA Center for the Study of Healthcare Innovation, Implementation and Policy, VA Greater Los Angeles Healthcare System, Los Angeles, CA, [f] Department of Medicine, VA Greater Los Angeles Healthcare System, Los Angeles, CA, [g] Department of Medicine, David Geffen School of Medicine, University of California at Los Angeles, Los Angeles, CA, [h] Informatics, Decision-Enhancement and Analytic Sciences Center, VA Salt Lake City Health Care System, Salt Lake City, UT, [i] Department of Internal Medicine, Division of Epidemiology, University of Utah School of Medicine, Salt Lake City, UT, [j] Department of Population Health Sciences, Division of Health System Innovation and Research, University of Utah School of Medicine, Salt Lake City, UT, [k] Stanford University School of Medicine,Pulmonary and Critical Care Medicine, Stanford, CA.

** Correspondence: Jean Yoon, Health Economics Resource Center, VA Palo Alto Health Care System, 795 Willow Road (152 MPD), Menlo Park, CA 94025 (e-mail: Jean.Yoon@VA.gov).*

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to conclusively link greater use of observation care with lower readmission rates by hospitals.[5,9] VA hospitals do not face such financial penalties from readmissions although there has been greater emphasis on tracking performance measures for VA medical centers that include measures for 30-day readmission rates following an acute hospitalization. Patients admitted to observation care are not counted as readmissions for a previous hospitalization. Therefore, greater use of observation care could potentially lower readmission rates over time, affecting performance measures. If admitting practices change over time, then tracking hospital performance may be less valuable for understanding long-term trends.

Our objectives in this study were to determine changes in VA acute inpatient use and hospital outcomes 2011 to 2017 after a trend towards greater observation care began. Hospital outcomes included 30-day hospital mortality, 30-day readmissions, LOS, and costs. We measure readmissions and mortality both including and excluding observation care in order to examine its impact on VA hospital performance.

2. Methods

2.1. Study cohort and data sources

This study was conducted as part of a larger study of Veterans' hospital care in which VA and non-VA hospital records were linked in 11 states that agreed to link VA identifiers to non-VA inpatient data. We identified all acute medical/surgical hospitalizations from 56 VA hospitals in 11 states with a discharge date from January 1, 2011, through December 31, 2017. The 11 geographically diverse states (Arizona, California, Connecticut, Florida, Illinois, Louisiana, Massachusetts, Missouri, New York, Pennsylvania, South Carolina) represent the northeastern, southeastern, midwestern, and western regions of the US. Approximately 38% of enrollees in the VA system lived in these 11 states.[14] We included VA acute care hospitals that provided medical/surgical care and excluded 22 VA hospitals that only provided psychiatric, rehabilitation, or long-term care.

We focused on medical/surgical hospitalizations since there are differences in utilization practices and patterns for VA and non-VA psychiatric and other types of hospitalizations. Veterans' acute inpatient utilization and cost records were obtained from the Inpatient Encounter files and the Managerial Cost Accounting files in the VA Informatics and Computing Infrastructure. Observation stays were measured from outpatient records indicating observation care. We obtained patients' sociodemographic characteristics from the VA Observational Medical Outcomes Partnership Files and patients' and hospitals' location from the VA Planning Systems Support Group Files. Mortality was measured from the VA Vital Status File. Hospital characteristics were obtained from the Veterans Integrated Service Network Support Services Center. This study was approved by the Stanford University Administrative Panel on Human Subjects in Medical Research Institutional Review Board.

2.2. Acute hospitalizations

VA acute hospitalizations (N = 1370,134) were identified using medicine and surgery bed section codes and the diagnosis related group for the stay and assigned to the calendar year of discharge. We analyzed outcomes for index hospitalizations, defined as acute hospitalizations with no prior hospitalizations within 30 days of admission. We categorized hospitalizations using the principal diagnosis code into 12 categories: cancer, cardiovascular, endocrine/metabolic, gastrointestinal, hematologic/immunologic, infectious disease, musculoskeletal, neurologic, respiratory, sense organ, urinary, and other diagnoses.[15,16] We also identified hospitalizations for AMI, coronary artery bypass surgery (CABG), gastrointestinal (GI) hemorrhage, heart failure, pneumonia, and stroke based on a principal diagnosis code; hospital mortality for these conditions are considered quality indicators.[17]

Observation care was identified from VA outpatient encounter data with a clinic identifier for observation care (N = 229,278). Similar to inpatient care, we categorized observation care using the primary diagnosis code as all observation care and care for the 6 conditions described above. Analysis with observation care included observation stays as both index hospitalizations and readmissions.

2.3. Outcome measures

Hospital outcomes for 30-day all-cause mortality, 30-day all-cause readmissions, inpatient costs, and LOS and were measured first for acute hospitalizations. All-cause 30-day mortality was indicated if the date of death occurred within 30 days of admission. Thirty-day all-cause readmissions was measured as any VA acute medical/surgical stay within 30 days of discharge from a prior VA stay. Readmissions included both planned and unplanned events due to the challenges in distinguishing between them.[18] Costs were measured from MCA data based on the total costs of each acute stay estimated by each VA facility using bottom-up costing methods. All costs were adjusted for inflation to 2017 dollars.[19,20] LOS was calculated as the number of calendar days between admission and discharge, inclusive.

Since care provided as observation care could have been provided as acute inpatient care, mortality and readmission were then measured including both index acute hospitalizations and observation stays. Thirty-day all-cause readmissions was measured as any VA acute hospitalization or observation stay within 30 days of discharge from a prior VA hospitalization (including both acute and observation care), and mortality was indicated for death following an index acute stay or observation stay.

2.4. Patient and hospital measures

We adjusted hospital outcomes by patient and hospital characteristics documented to affect outcomes.[21–23] Patients' age, gender, race/ethnicity, marital status, and VA priority status were obtained for the year of patients' discharge. VA priority status represented Veterans' enrollment category, from highest (group 1) to lowest eligibility (group 8) in the VA based on military service-connected disability and incomes meeting the VA means test. Patients' distance to the closest VA hospital was calculated using the straight-line distance, and rurality was categorized as urban or rural.[24] We also measured patients' comorbidity for each stay using the Elixhauser–van Walraven index calculated from all recorded diagnosis codes.[25]

Hospital characteristics were measured in each year, including number of staffed beds, bed occupancy rate (number of beds occupied divided by number of staffed beds), and facility complexity based on VA's 5-tier categorization of its facilities according to the volume of patients, number of high-risk patients, availability of specialized clinical programs, and teaching and research status (ranging from category 1 as the most complex and category 5 as the least complex). We categorized hospital volume as small, medium, or large based on tertile of number of hospitalizations in each year. We also indicated whether hospitals had an operational emergency department and the VA Consumer Assessment of Health Plans patient experience measure for the percent of patients reporting they were likely to recommend their hospital to others.[26]

2.5. Analysis

The unit of analysis for all hospital outcomes was the hospital stay. Observations with missing data (age, comorbidity, hospital

occupancy, N = 228,664) were dropped. We compared the unadjusted trend from the first to last year of the study period in patient and hospital characteristics and hospital outcomes using the Cochran–Armitage nonparametric test for binary measures and Jonckheere–Terpstra nonparametric test for continuous measures.[27–30]

To estimate hospital outcomes in each year, we conducted multivariable regression analyses using generalized linear models to compare changes over time using dummy indicators for each year that captured temporal trends plus any effects of expanded access to community care (beginning November 2014).[31] After selecting patient and hospital characteristics that were related to hospital outcomes in prior studies, we then used the least absolute shrinkage and selection operator approach to finalize covariates included in the model.[32] Covariates included patient sociodemographic factors, comorbidity score, state fixed effect, hospital bed occupancy rate, and hospital complexity. We estimated mortality, readmissions, LOS, and costs for acute hospitalizations first (N = 991,456). Secondly, we estimated mortality and readmissions for both acute hospitalizations and observation stays (N = 1112,693).

All regression models adjusted standard errors for clustering by hospital; in sensitivity analyses we adjusted for clustering by unique patient-hospital combination since some patients visited more than 1 hospital during the study period. We used a generalized linear model with a binomial distribution and logit link to estimate mortality while a Gaussian distribution with a log link was used to estimate costs, and a Poisson distribution was used to estimate readmission and LOS after we examined the distribution of residuals.

For each outcome, we conducted subgroup analysis for 6 specific conditions (AMI, CABG, GI hemorrhage, heart failure, hip fracture, pneumonia, and stroke) in addition to all hospitalizations. We estimated marginal effects from our regression models for the adjusted probability of mortality and readmission and mean LOS and costs in each study year and their 95% confidence intervals. We plotted marginal effects with confidence intervals in each year. All analyses were conducted in Stata version 17.

3. Results

3.1. Trends in characteristics of VA patients and VA hospitals

In the 56 study hospitals, there was a total of 180,417 acute medical/surgical hospitalizations in 2011; this dropped by 9% to 163,785 hospitalizations in 2017 (Fig. 1). Conversely, the total number of observation stays grew by 157% from 14,346 (7% of hospitalizations) in 2011 to 36,802 (18%) in 2017. Altogether, the total number of hospitalizations was similar (194,763 and 200,587, respectively). The mean age of study patients slightly increased from 67 years (±13) in 2011 to 68 years (±13) in 2017 (Table 1). A large majority of patients were male, White, and not currently married, and these proportions were similar over time. There was a decrease in patients with service-connected disabilities (priority groups 1–4) over time. About a quarter of hospitalized patients lived in rural areas

The Elixhauser–van Walraven comorbidity index of hospitalized patients increased between 2011 to 2017 from a mean of 4.5 (±6.3) to 5.7 (±7.4), respectively. The proportion of hospitalizations by diagnostic category remained similar for the most common types of hospitalizations. Although some trends in patient characteristics over time were relatively small, all were significant at $P < .001$.

Among the study hospitals, mean bed occupancy rate declined from 70% (±15) in 2011 to 60% (±20) in 2017 ($P = .010$; Table 2). The mean number of staffed beds and facility complexity were similar across years. The mean number of hospitalizations in low-volume hospitals declined from 1332 hospitalizations (±614) to 1052 hospitalizations (±622; $P = .082$), while medium- and high-volume hospitals had similar mean numbers of hospitalizations across the study period. The percent of hospitals which operated an emergency department dropped from 85% to 74% ($P = .049$).

3.2. Hospital outcomes for all acute hospitalizations

For all medical/surgical hospitalizations, the unadjusted rate of 30-day readmissions decreased from 15.4% to 13.8% from 2011 to 2017 when observation stays were not included (Table 3). When observation stays were included, the unadjusted rate of readmissions increased from 17.0% to 18.2% from 2011 to 2017. The unadjusted 30-day mortality rate decreased slightly from 2011 to 2017 (4.3% and 4.1%, respectively) in acute hospitalizations without including observation stays, and the rate decreased by a larger amount from 4.1% to 3.5% when observation stays were included. The median unadjusted cost of hospitalizations increased slightly while the median unadjusted LOS was unchanged across the study period.

The adjusted probability of 30-day readmissions decreased significantly over time when observation stays were not

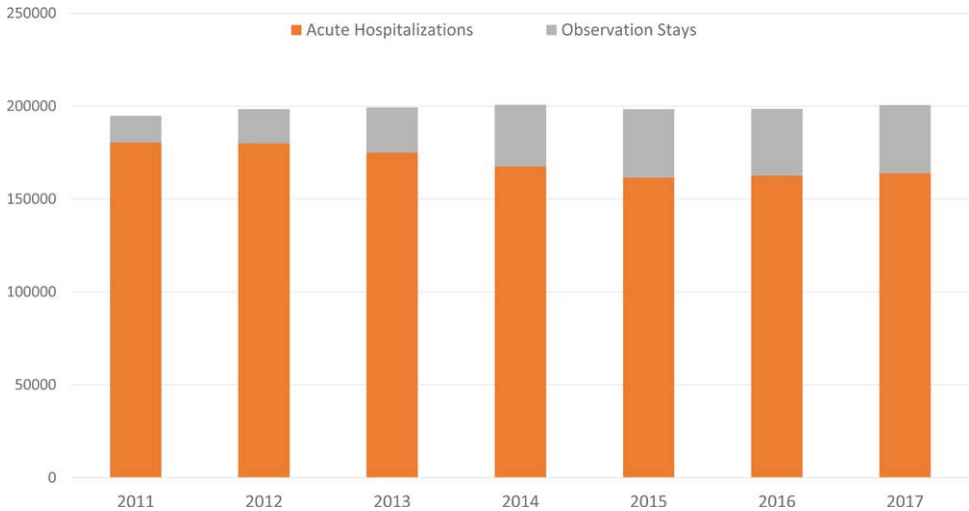

Figure 1. Total number of acute VA hospitalizations and VA observation stays in each study year, from year 2011 to 2017. VA = Veterans Affairs health care system.

Table 1

VA patient characteristics for acute hospitalizations* 2011 to 2017.

Patient characteristics	2011	2013	2015	2017	*P* value†
Hospitalizations, N	149,519	145,399	135,153	137,353	
Mean age (SD)	67 (13)	67 (13)	67 (13)	68 (13)	<.001
Male gender	96%	95%	95%	95%	.96
Mean Elixhauser score (van Walraven version)	4.5 (6.2)	4.7 (6.4)	5.1 (6.7)	5.7 (7.4)	<.001
Race/ethnicity					.19
White	69%	68%	68%	67%	
Black	20%	21%	21%	21%	
Hispanic	5%	6%	6%	6%	
Other	6%	5%	5%	5%	
Marital status					.004
Married	41%	41%	41%	42%	
Divorced/widowed/ separated	46%	45%	45%	44%	
Single never married	13%	14%	14%	14%	
VA priority status group					.014
1–2: service-connected disability 30%+	32%	30%	30%	29%	
3–4: service-connected disability 10–20%/ housebound	19%	17%	16%	15%	
5–6: below means test/5 years post discharge	39%	40%	41%	41%	
7–8: above means test	11%	13%	14%	14%	
Rural residence	28%	27%	26%	25%	.002
Diagnostic category of stay					
Cancer	6.7%	6.4%	6.4%	5.8%	<.001
Cardiovascular	26.6%	26.3%	25.4%	25.4%	<.001
Dermatologic	3.8%	3.8%	3.9%	3.8%	.18
Endocrine	4.9%	4.6%	4.6%	4.4%	<.001
Gastrointestinal	13.6%	13.9%	13.4%	13.1%	<.001
Hematologic	2.2%	2.2%	2.0%	1.9%	<.001
Infectious disease	1.6%	2.4%	3.5%	3.3%	<.001
Musculoskeletal	8.5%	8.9%	10.3%	11.1%	<.001
Neurologic	3.5%	3.5%	3.7%	3.6%	.04
Reproductive	1.3%	1.3%	1.3%	1.4%	.85
Respiratory	12.0%	11.7%	11.3%	11.9%	.02
Urinary	6.2%	6.0%	5.9%	5.8%	<.001
Other	8.1%	8.1%	7.8%	7.9%	<.001

SD = standard deviation, VA = Veterans Affairs health care system.

*Excludes patients with only observation stays.

†*P* values were obtained by comparing the trend in measures across study years using the Cochran–Armitage nonparametric test for binary measures and Jonckheere–Terpstra nonparametric test for continuous measures.

Table 2

VA hospital characteristics, 2011 to 2017.

Hospital characteristics	2011	2013	2015	2017	*P* value*
N, hospitals	54	53	53	55	
Occupancy rate, mean (SD)	70% (15)	63% (18)	61% (17)	60% (20)	.010
Bed count, mean (SD)	110 (60)	113 (63)	109 (62)	102 (61)	.338
Medical/surgical stay volume, mean (SD)					
Small volume hospitals, N = 18	1332 (614)	1339 (633)	1240 (631)	1052 (622)	.082
Medium volume hospitals, N = 18	4195 (953)	4391 (1004)	4442 (939)	4169 (1039)	.981
Large volume hospitals, N = 19/21†	7630 (1968)	8182 (2219)	8084 (2247)	7829 (2051)	.987
Complexity index					.367
Highest (%)	30	30	32	31	
High (%)	13	13	23	24	
Mid high (%)	19	23	13	15	
Medium (%)	19	13	9	9	
Low (%)	20	21	23	22	
Operated emergency department	45 (83%)	44 (83%)	40 (75%)	40 (73%)	.049

SD = standard deviation, VA = Veterans Affairs health care system.

**P* values were obtained by comparing the trend in measures across study years using the Cochran–Armitage nonparametric test for binary measures and Jonckheere–Terpstra nonparametric test for continuous measures.

† We included hospitals that reported staffed beds for medicine and surgery in our analysis which varied by year, so the number of hospitals that were considered large volume varied between 19 and 21 between study years.

included; the readmissions rate was similar over time when observation stays were included (Fig. 2A). The adjusted probability of 30-day mortality decreased at a similar rate over time when hospitalizations included and excluded observation stays although overall rates were lower when observation stays were included (Fig. 2B). Mean adjusted cost per acute hospitalization significantly increased while mean adjusted LOS was similar from 2011 to 2017 (Fig. 3A, B).

Table 3

Unadjusted outcomes of VA hospitalizations including and excluding observation care 2011 to 2017.

Outcomes	2011	2013	2015	2017
30-day readmissions excluding observation stays, N (%)	23,014 (15.4%)	20,985 (14.4%)	18,767 (13.9%)	18,928 (13.8%)
30-day readmissions including observation stays, N (%)	27,050 (17.0%)	29,098 (18.3%)	29,209 (18.5%)	29,005 (18.1%)
30-day mortality excluding observation stays, N (%)	6465 (4.3%)	5999 (4.1%)	5626 (4.2%)	5613 (4.1%)
30-day mortality including observation stays, N (%)	6473 (4.1%)	6031 (3.8%)	5667 (3.6%)	5668 (3.5%)
Median cost (IQR)*	$9533 (4766–19,489)	$9944 (4926–20,673)	$10,831 (5471–22,285)	$11,639 (5819–22,836)
Median length of stay (IQR)*	3 (2–6)	3 (2–6)	3 (2–6)	3 (2–6)

IQR = interquartile range, VA = Veterans Affairs health care system.
*Excludes observation stays.

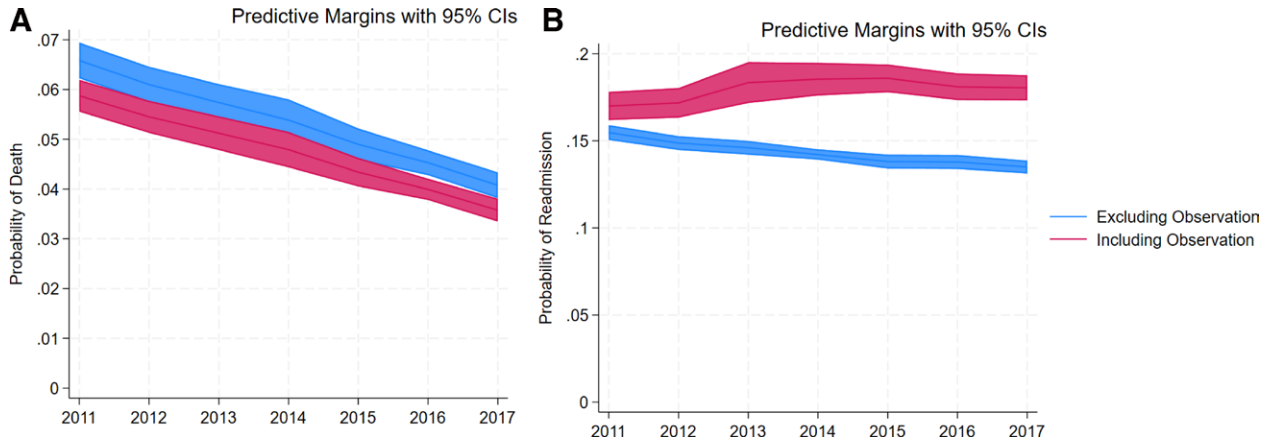

Figure 2. (A) Adjusted probability of 30-day readmission and (B) adjusted probability of 30-day mortality for acute VA hospitalizations including and excluding observation stays in each study year, from year 2011 to 2017. Note: Adjusted probabilities were estimated from marginal effects from regression models including covariates for patient and hospital factors and standard errors adjusted for clustering within hospital. VA = Veterans Affairs health care system.

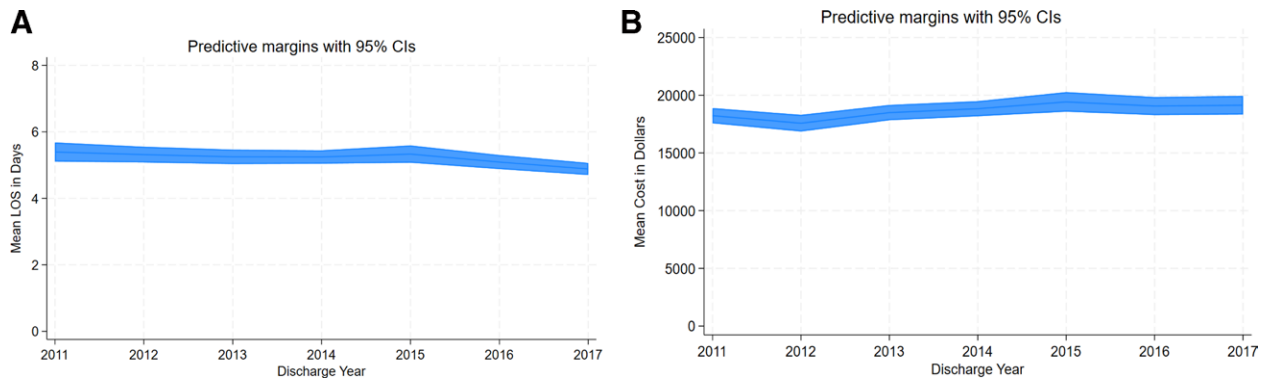

Figure 3. (A) Adjusted mean length of stay in days and (B) adjusted mean costs in dollars of acute VA hospitalizations in each study year, from year 2011 to 2017. Note: Adjusted means were estimated from marginal effects from regression models including covariates for patient and hospital factors and standard errors adjusted for clustering within hospital. VA = Veterans Affairs health care system.

3.3. Outcomes for specific conditions

Changes in outcomes over time varied for 6 specific conditions. When observation stays were not considered, there was a significantly lower rate of 30-day readmissions over time for heart failure and pneumonia, but there were no longer any differences in readmissions when observation stays were included (Fig. 4A–F). There were no significant changes over time in readmissions for AMI, CABG, GI hemorrhage, or stroke with or without observation stays.

There was lower adjusted 30-day hospital mortality for GI hemorrhage and pneumonia over time when both including and excluding observation care. There were no significant differences over time in adjusted mortality for the other conditions with or excluding observation care.

Mean adjusted costs of acute CABG and pneumonia hospitalizations decreased over the 7-year period while mean adjusted costs of acute GI hemorrhage and heart failure hospitalizations increased. Mean LOS for acute pneumonia hospitalizations decreased from 5.8 days (5.4, 6.1) in 2011 to 4.7 days (4.5, 5.0) in 2017.

4. Discussion

Over the 7-year study period, there were fewer acute medical/surgical hospitalizations and a growing number of observation stays in VA hospitals with the total number of hospitalizations similar over time. Across hospitalizations for all conditions, we found that the adjusted 30-day readmission

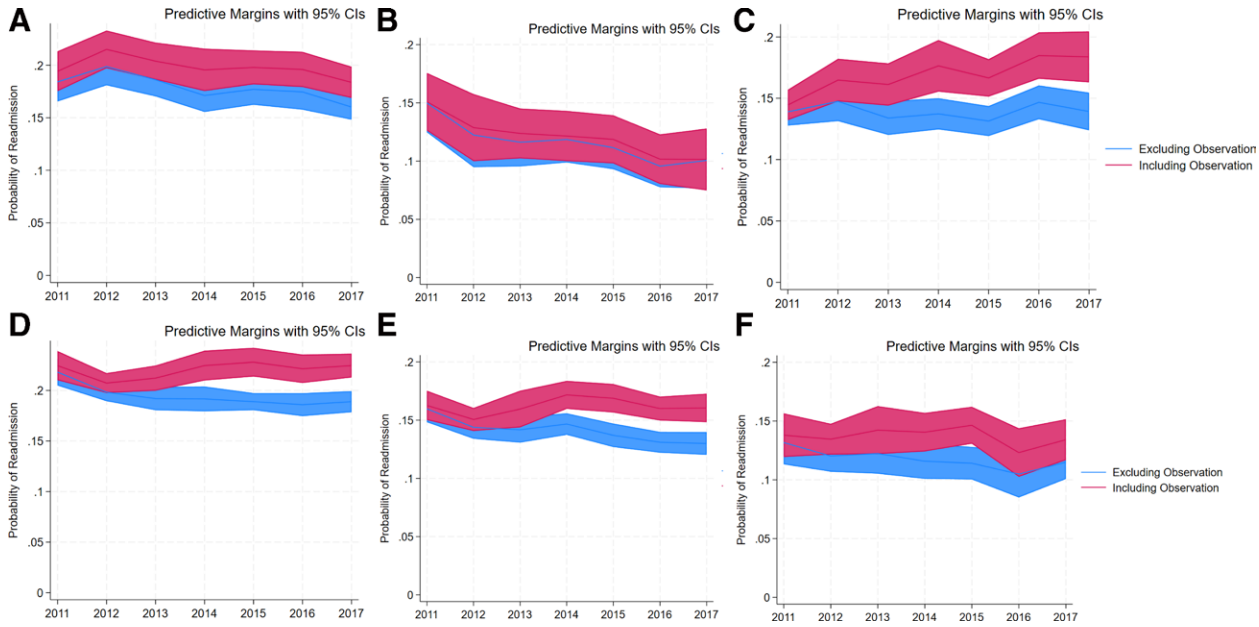

Figure 4. Adjusted probability of 30-day readmission for acute VA hospitalizations including and excluding observation stays for: (A) acute myocardial infarction, (B) coronary bypass graft, (C) gastrointestinal bleed, (D) heart failure, (E) pneumonia, (F) stroke, in each study year, from year 2011 to 2017. VA = Veterans Affairs health care system.

rate decreased over time when focusing only on acute hospitalizations, but once observation stays were included, there was no longer a significant decrease in readmissions. This pattern was also observed for hospitalizations for heart failure and pneumonia but no other study conditions. Adjusted hospital mortality decreased at a similar rate whether observation stays were included or not. Therefore, there did not appear to be adverse effects of higher mortality when admitting more patients to observation care. This is unsurprising as the lowest acuity patients were likely shifted to observation care, and these patients have minimal mortality risk. We found a similar mean LOS but higher mean costs of acute hospitalizations over time.

The reason for the shift towards observation care could not be determined with certainty from the available data. Others have noted that the delivery of observation care is similar to acute inpatient care in VA hospitals since there are no dedicated units for observation stays.[4] There may be incentives to steer less complex stays to observation care due to ongoing performance measurement (both within and outside the VA system) aimed at reducing readmission rates. The change in readmission rates that occurred once observation stays were included highlights the challenges of tracking readmission rates over time as admitting practices change.[24]

The time trend towards lower mortality that we found for all conditions combined and for GI hemorrhage and pneumonia is consistent with a long-term trend towards lower hospital mortality in the VA and in US hospitals overall.[2,11] VA-specific quality improvement efforts during the study period, including improvements in surgical care, emphasis on hospitalists to care for hospitalized patients, and new initiatives on transitions in care, all may have contributed towards reductions in hospital mortality.[33,34]

We found a modest increase in costs overall with cost increases concentrated in acute hospitalizations for heart failure and GI hemorrhage. We could not discern the reasons for the higher resource use over time, but our study follows a documented decade of lower hospitalization rates for conditions such as heart failure and more care being delivered in outpatient settings.[35,36] Therefore, VA patients hospitalized in later study years may have been sicker or had more severe cases in ways that we could not measure in this study. LOS was mostly unchanged during the study period although we found a decrease for pneumonia hospitalizations.

In addition to increased observation care, we also observed organizational changes in VA hospitals over time. Mean bed occupancy rates declined, and fewer hospitals operated an emergency department. These changes were more likely to occur in small hospitals with lower complexity. Small hospitals also had the largest declines in volume. We also found differences in patient characteristics over time. Patients were increasingly likely to be eligible for VA care without having a service-connected disability. The Great Recession and associated high unemployment rates and loss of employer-based coverage may have led to some Veterans previously not using VA care to seek out more VA care during the study period.[37] The requirement under the Affordable Care Act to have insurance coverage may have encouraged some eligible Veterans to enroll in the VA to satisfy this requirement.

4.1. Limitations

Our findings were based on a large number of hospitalizations from 47% of VA acute care hospitals in 11 geographically diverse states, but the sample may not be entirely generalizable to all VA hospitals nationally. This study was limited to care within VA hospitals since we did not have data on observation care in non-VA hospitals.

We did not have clinical-based measures of risk, so our findings may have overstated changes in patient risk during the study period. We did not distinguish between potentially avoidable readmissions and unavoidable or planned readmissions which may have led to overestimates of the observed readmission rates; however, planned readmissions only account for roughly 7% of all readmissions, so it is unlikely to affect our results.

5. Conclusion

Overall, we found a continuation in the trend towards greater use of observation care by VA hospitals as documented in an

earlier time period. Measuring VA hospital performance over time should take this shift in type of hospitalizations into account as tracking readmission measures over a period of time may result in potential misattribution of reduced readmissions to improved performance. Observation care could be incorporated into future performance measures. Hospital mortality, while lower when considering observation care, exhibited a similar decrease with or without including observation care, so admitting more patients to observation care did not appear to affect mortality. Despite the shift towards observation care, acute hospitalizations did not have changes in mean LOS, and mean costs only modestly increased between 2011 and 2017. Our study period covered the early expansion of community care purchased by the VA which was followed by the Maintaining Internal Systems and Strengthening Integrated Outside Networks Act in 2018 that further expanded eligibility for community care, so future work should address more recent changes in VA inpatient care.

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Author contributions

Conceptualization: Jean Yoon.
Data curation: Adam Chow, Hao Jiang.
Formal analysis: Jean Yoon, Ciaran S. Phibbs, Adam Chow, Andrew Redd, Hao Jiang, Yue Zhang.
Funding acquisition: Jean Yoon.
Investigation: Jean Yoon, Ciaran S. Phibbs, Michael K. Ong, Megan E. Vanneman, Kenneth W. Kizer, Yue Zhang.
Methodology: Jean Yoon, Ciaran S. Phibbs, Michael K. Ong, Megan E. Vanneman, Adam Chow, Andrew Redd, Hao Jiang, Yue Zhang.
Project administration: Jean Yoon.
Supervision: Jean Yoon.
Writing – original draft: Jean Yoon.
Writing – review & editing: Ciaran S. Phibbs, Michael K, Ong, Megan E. Vanneman, Kenneth W. Kizer, Adam Chow, Andrew Redd, Hao Jiang, Yue Zhang.

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