Title

The Impact of Resident Holdover Admissions on Length of Hospital Stay and Risk of Transfer to an Intensive Care Unit

Journal

Journal of Patient Safety, 17(8)

ISSN

1549-8417

Authors

Ashana, Deepshikha Charan
Chan, Vincent K
Vangala, Sitaram
et al.

Publication Date

2021-12-01

DOI

10.1097/pts.0000000000000662

Peer reviewed

HHS Public Access

Author manuscript

J Patient Saf. Author manuscript; available in PMC 2023 May 16.

Published in final edited form as:

J Patient Saf. 2021 December 01; 17(8): e1855–e1859. doi:10.1097/PTS.0000000000000662.

The Impact of Resident Holdover Admissions on Length of Hospital Stay and Risk of Transfer to an Intensive Care Unit

Deepshikha Charan Ashana, MD, MBA[*], **Vincent K. Chan, MD**[†], **Sitaram Vangala, MS**[‡], **Douglas S. Bell, MD, PhD**[‡]

[*]Division of Pulmonary, Allergy and Critical Care, Department of Medicine, Perelman School of Medicine, Philadelphia, Pennsylvania

[†]Division of Pediatrics, University of California, Los Angeles, Los Angeles, California.

[‡]Division of General Internal Medicine, University of California, Los Angeles, Los Angeles, California.

Abstract

Objective: Implementation of residency duty hour standards has led to adoption of different staffing models, such as the “holdover” model, whereby nighttime teams admit patients and transfer their care to daytime teams who provide ongoing care. In contrast, nonholdover teams at our institution are responsible for both admitting patients and providing ongoing care. We sought to determine whether patients admitted by holdover teams experience worse outcomes than those admitted by nonholdover teams.

Methods: This is a retrospective cohort study of patients admitted to the internal medicine hospital service at a quaternary care hospital from July 2013 to June 2015. Primary outcomes included hospital length of stay (LOS) and transfer to an intensive care unit within 72 hours of admission. Secondary outcomes were any transfer to an intensive care unit, in-hospital mortality, discharge to home (versus discharge to postacute care facility), and readmission to the health system within 30 days of discharge.

Results: We analyzed 5518 encounters, 64% of which were admitted by a holdover team. Outcomes were similar between study groups, except the LOS, which was 5.5 hours longer for holdover encounters in unadjusted analyses (5.18 versus 4.95 days, $P = 0.04$) but not significantly different in adjusted analyses. The mean discharge time was 4:00 P.M. for both groups, whereas the mean admission times were 12:00 A.M. and 4:00 P.M. for holdover and nonholdover encounters, respectively.

Conclusions: Holdover encounters at our institution were not associated with worse patient safety outcomes. A small increase in LOS may have been attributable to holdover patients having earlier admission and identical discharge times.

Correspondence: Deepshikha Charan Ashana, MD, MBA, University of Pennsylvania, 300 Blockley Hall, 423 Guardian Dr, Philadelphia, PA 19104, (deepshikha.ashana@uphs.upenn.edu).

The authors disclose no conflict of interest.

A poster containing preliminary data was presented at the Society of General Internal Medicine National Meeting, Hollywood, FL, May 14, 2016.

Keywords

patient outcomes; residency; duty hours

In 2011, the Accreditation Council for Graduate Medical Education Task Force enacted a limit on continuous duty periods for residents.[1] Many internal medicine residency programs adapted to this standard by implementing different staffing models, such as the “holdover” model, whereby residents admit patients at night and transfer their care to daytime teams who assume responsibility for their ongoing care, as well as admitting patients who present during the day.[2,3]

Although the holdover model allows compliance with the Accreditation Council for Graduate Medical Education guidelines, there are potential harms associated with this approach. At many hospitals, most patients are admitted by holdover teams and exposed to the discontinuity of care inherent in this model.[4] Handoffs are known to be a vulnerable process.[5–9] One study found that key clinical information was missing in nearly 40% of handoff reports, and omissions of data were perpetuated in future handoffs.[10] Furthermore, several studies have demonstrated that residents spend 30% less time evaluating a holdover patient compared with a newly admitted patient, including key activities, such as reviewing the chart, performing a history and physical exam, and formulating a plan of care.[2,11]

Despite this growing literature, the impact of holdover admissions on patient outcomes is not yet known. Thus, we conducted a retrospective cohort study to determine whether patients admitted by holdover teams experience worse outcomes than those admitted by nonholdover teams who provide longitudinal care. Because of discontinuity of care, we hypothesized that patients admitted by holdover teams would have a longer hospital length of stay (LOS) and higher rate of transfer to the intensive care unit (ICU) within 72 hours of admission. We limited the time frame because we hypothesized that effects stemming from initial discontinuity of care are likely to have a diminishing impact as a patient’s hospital course progresses.

METHODS

This study was approved by the University of California, Los Angeles (UCLA) institutional review board.

Setting

We studied admissions to the Ronald Reagan UCLA Medical Center (RRUMC), a 520-bed quaternary care academic hospital. The general internal medical hospital service comprised five teams, each with one attending physician, one senior resident (postgraduate year 2 or 3), and two interns. On call days, teams assumed care of holdover patients who had been admitted the preceding night by a night admitting team, in addition to admitting new patients who presented during daytime hours. Handoffs were unstructured and performed in person or via e-mail at the discretion of the night team. The night admitting team, including two senior residents and one intern, was responsible for new admissions from 7:00 P.M. until 7:00 A.M. the following day. In addition, when all daytime teams had reached their

admission cap, a senior resident was available for overflow admissions during a “swing shift” from noon until 9:00 P.M. daily. Patients admitted during this shift were transferred to the night admitting resident, then to the daytime resident the next morning. At night, attending physicians were available to answer calls from home, except in the case of an emergency when a hospitalist physician was available for in-person consultation in the emergency department.

Patients

We included patients admitted to the RRUMC general internal medicine hospital service between July 1, 2013, and June 6, 2015. We used the Epic electronic health record clarity data repository to identify patients older than 17 years for whom inpatient wards admission orders were written by a UCLA internal medicine or internal medicine-pediatrics resident. We limited our study sample to patients admitted from the emergency department or ambulatory settings (clinic or home), excluding patients admitted from other hospitals or other services within RRUMC, as patients who have had prior inpatient treatment may be managed differently in the initial part of their hospitalization. Patients who were not full code were also excluded, because they may be less likely to be transferred to the ICU.

Based on the final duty schedule, we created a database with the name of every night admitting resident, night admitting intern, and swing shift resident for each day of the study period. If the admission order for an encounter was placed by these house staff, the encounter was classified as a holdover encounter. Holdover encounters completed by the swing shift resident were further classified as swing holdover encounters, whereas holdover encounters completed by the night admitting resident or intern were classified as nonswing holdover encounters. Swing holdover encounters were flagged separately because they required two handoffs. All encounters not meeting these criteria were labeled as nonholdover encounters.

Measurements

Primary outcomes included LOS and transfer to ICU within 72 hours of admission. Length of stay was calculated as the time between arrival at the hospital and placement of the discharge order. Secondary outcomes included any transfer to ICU during the hospitalization, death during the hospitalization, discharge to home (versus discharge to postacute care facility), and readmission to any UCLA hospital within 30 days of discharge.

Continuous variables were summarized by means, standard deviations, and quartiles, and categorical variables were summarized by frequencies and percentages. Admission and discharge time of day were summarized by circular means. Encounter-level comparisons were made between holdover and nonholdover admissions using Wilcoxon rank-sum tests for continuous variables, and χ^2 or Fisher exact test, as appropriate, for categorical variables. Analyses of clinical outcomes accounting for repeated encounters per patient were performed using generalized linear mixed effects models with random patient effects and fixed encounter type (i.e., holdover versus nonholdover encounter) effects. Binary outcomes were evaluated using mixed effects logistic regression models, whereas natural log-transformed LOS was evaluated using a linear mixed effects model. Adjusted analysis

of LOS was performed, controlling for age, sex, and the Elixhauser comorbidity index. Subgroup analyses of holdover encounters were performed comparing swing holdover encounters with nonswing holdover encounters. *P* values of less than 0.05 were considered statistically significant. All analyses were performed using SAS v. 9.4 (SAS Institute Inc, Cary, NC).

RESULTS

During the study period, 5518 encounters met criteria for inclusion in our study, corresponding with 4106 unique patients. Only 36% were nonholdover encounters, whereas the remaining 64% were holdover encounters. Holdover encounters were largely admitted by the night admitting team (85%); however, a small portion (15%) were admitted by the swing resident.

Patients in the holdover group were slightly younger (mean age = 57 versus 59 y) than those in the nonholdover group, whereas the proportion of female patients was similar (49 versus 47%). Hypertension, renal failure, and fluid and electrolyte disorders were the most common Elixhauser comorbidities. Encounter-level analyses demonstrated a significantly longer LOS for holdover patients, as well as a difference in discharge status indicating a higher propensity for holdover patients to be transferred to a postacute care facility upon discharge (Table 1).

However, after adjusting for multiple encounters per patient, LOS was the only outcome that differed significantly between the study groups, with a geometric mean LOS of 4.95 days for nonholdover patients and 5.18 days for holdover patients ($P = 0.04$) (Fig. 1). This corresponds to an additional 5.5 inpatient hours for holdover encounters. The circular mean admission times were 12:00 A.M. and 4:00 P.M. for holdover and nonholdover encounters, respectively, whereas the circular mean discharge time was 4:00 P.M. for both groups.

Rates of 72-hour ICU transfer (odds ratio [OR] = 1.19, confidence interval [CI] = 0.59–2.41), any ICU transfer (OR = 1.29, CI = 0.78–2.14), hospital mortality (OR = 1.49, CI = 0.49–4.58), 30-day hospital readmission (OR = 0.97, CI = 0.83–1.12), and home discharge (OR = 2.64, CI = 0.64–10.8) were not statistically different when comparing nonholdover and holdover encounters (Table 2).

Adjusted analysis of the difference in LOS between holdover and nonholdover patient encounters, controlling for patient age, sex, and Elixhauser comorbidity index, was performed. The adjusted estimates of geometric mean LOS were similar to the unadjusted estimates; however, the difference between groups was no longer significant (5.07 days for nonholdover patients versus 5.19 days for holdover patients, $P = 0.22$). When comparing swing holdover encounters with nonswing holdover encounters, there was no difference in the primary outcomes, LOS or 72-hour ICU transfer.

DISCUSSION

In this single-center study comparing holdover and nonholdover hospital encounters, we found that the likelihood of transfer to the CU, death in the hospital, discharge to home,

and readmission to the same health system within 30 days of discharge did not differ significantly between the study groups. These results are consistent with several studies that have failed to identify an increase in patient mortality or readmissions after institution of the 2011 duty hour reforms.[12–15] This suggests that the tradeoff between discontinuity of care and resident fatigue inherent in contemporary staffing models is likely be a balanced one, with each exerting no effect or opposite but similar effects on safety outcomes.

We also found that holdover patients had a slightly longer LOS compared with nonholdover patients. This trend persisted after adjustment for patient demographic and clinical characteristics; however, the difference was no longer significant. To better understand this result, we examined the mean admission and discharge times for the two groups and discovered that holdover patients were admitted several hours earlier than nonholdover patients but discharged at the same time of day. There are several possible explanations for this finding. First, certain patient care activities are likely to be feasible only during daytime hours. For example, the primary attending, key consultants, and discharge coordinators may promptly contribute to the care of nonholdover patients admitted during the day, whereas several hours may elapse before they evaluate holdover patients. Holdover patients may experience several hours of “dead time” during the initial hours of their admission, as a definitive plan of care is not established until the following morning. Second, additional tasks are likely to be necessary in the care of these patients that are not required for nonholdover patients. Namely, nighttime residents must complete a handoff of the newly admitted patient to the daytime residents, and daytime residents may duplicate time spent on history gathering and physical exam as they are responsible for coordinating care for the remainder of the hospital stay although they were not present for the initial presentation or recounting of the patient’s history—both crucial elements of the diagnostic and treatment process.

Taken together, these results suggest that the holdover model does not harm patients. Indeed, residents are now trained in a postduty hour reforms era where handoffs are common and expected. Therefore, it is possible that they have adapted to their environment and become proficient at caring for patients in a safe manner within the constraints of a shift-work model. It is also possible that there may be benefits to having multiple teams of residents evaluate a patient as errors or missed diagnoses may be more readily identified during a second assessment. However, although small increases in LOS may not be meaningful for individual patients, such changes, in aggregate, may have an impact on bed capacity, patient throughput, and hospital financial performance. If this result is replicated in future studies, additional work should be undertaken to determine whether LOS can be safely reduced for holdover patients, for example, through focused implementation of discharge-before-noon programs that are already underway at many hospitals.[16–18]

This study has several limitations. First, the results of a single-center study may not be generalizable to other hospitals or residency programs. Second, our study may not have been powered to detect a difference in outcomes that occurred at a low frequency, such as ICU transfer within 72 hours, ICU transfer during the hospitalization, and hospital mortality. Continued research with larger populations is critical to answering the questions posed here, as they have far-reaching consequences for resident education and patient care. We look

forward to the patient outcomes results of iCompare, the multicenter randomized trial that prospectively evaluated a variety of resident staffing models.[19] Third, patients admitted at night may be meaningfully different from patients admitted during the day in ways that we were not able to measure. Fourth, there are a multitude of additional outcome measures, such as infection rates, medication errors, and patient experience scores, that could not be measured in our database but should be included in future studies to provide a more granular understanding of the impact of this staffing model. Finally, our study may not have been powered to detect differences in outcomes after adjustment for demographic factors and comorbidities.

CONCLUSIONS

We found that holdover encounters were associated with similar patient safety outcomes and slightly longer lengths of stay in some analyses, perhaps because of an inability to initiate care during the night that contributes toward the critical path to discharge.

ACKNOWLEDGMENT

The authors thank Robert Follett, lead data analyst at the University of California, Los Angeles Clinical and Translational Science Institute, for his assistance in abstracting patient data from the Epic data repository.

This study was supported in part by the National Center for Advancing Translational Science (NCATS, Grant Number UL1TR001881).

REFERENCES

1. Nasca TJ, Day SH, Amis ES. The new recommendations on duty hours from the ACGME task force. N Engl J Med. 2010;363:e3. [PubMed: 20573917]
2. Bump GM, Zimmer SM, McNeil MA, et al. Hold-over admissions: are they educational for residents? J Gen Intern Med. 2014;29:463–467. [PubMed: 24163152]
3. Horwitz LI, Krumholz HM, Green ML, et al. Transfers of patient care between house staff on internal medicine wards: a national survey. Arch Intern Med. 2006;166:1173–1177. [PubMed: 16772243]
4. Cohee BM, Hartzell JD, Shimeall WT. Achieving balance on the inpatient internal medicine wards: a performance improvement project to restructure resident work hours at a tertiary care center. Acad Med. 2014;89:740–744. [PubMed: 24667506]
5. Denson JL, McCarty M, Fang Y, et al. Increased mortality rates during resident handoff periods and the effect of ACGME duty hour regulations. Am J Med. 2015;128:994–1000. [PubMed: 25863148]
6. Kuhn EN, Davis MC, Agee BS, et al. Effect of resident handoffs on length of hospital and intensive care unit stay in a neurosurgical population: a cohort study. J Neurosurg. 2016;125:222–228. [PubMed: 26684784]
7. Petersen LA, Brennan TA, O'Neil AC, et al. Does housestaff discontinuity of care increase the risk for preventable adverse events? Ann Intern Med. 1994;121:866–872. [PubMed: 7978700]
8. Singh H, Thomas EJ, Petersen LA, et al. Medical errors involving trainees: a study of closed malpractice claims from 5 insurers. Arch Intern Med. 2007;167:2030–2036. [PubMed: 17954795]
9. Starmer AJ, Sectish TC, Simon DW, et al. Rates of medical errors and preventable adverse events among hospitalized children following implementation of a resident handoff bundle. JAMA. 2013;310:2262–2270. [PubMed: 24302089]
10. Horwitz LI, Moin T, Krumholz HM, et al. What are covering doctors told about their patients? Analysis of sign-out among internal medicine house staff. Qual Saf Health Care. 2009;18:248–255. [PubMed: 19651926]

11. Desai SV, Feldman L, Brown L, et al. Effect of the 2011 vs 2003 duty hour regulation-compliant models on sleep duration, trainee education, and continuity of patient care among internal medicine house staff: a randomized trial. JAMA Intern Med. 2013;173:649–655. [PubMed: 23529771]
12. Patel MS, Volpp KG, Small DS, et al. Association of the 2011 ACGME resident duty hour reforms with mortality and readmissions among hospitalized Medicare patients. JAMA. 2014;312:2364–2373. [PubMed: 25490327]
13. Rajaram R, Chung JW, Jones AT, et al. Association of the 2011 ACGME resident duty hour reform with general surgery patient outcomes and with resident examination performance. JAMA. 2014;312:2374–2384. [PubMed: 25490328]
14. Bolster L, Rourke L. The effect of restricting residents' duty hours on patient safety, resident well-being, and resident education: an updated systematic review. J Grad Med Educ. 2015;7:349–363. [PubMed: 26457139]
15. Parshuram CS, Amaral AC, Ferguson ND, et al. Patient safety, resident well-being and continuity of care with different resident duty schedules in the intensive care unit: a randomized trial. CMAJ. 2015;187:321–329. [PubMed: 25667258]
16. Kane M, Weinacker A, Arthofer R, et al. A multidisciplinary initiative to increase inpatient discharges before noon. J Nurs Adm. 2016;46:630–635. [PubMed: 27851703]
17. Wertheimer B, Jacobs RE, Bailey M, et al. Discharge before noon: an achievable hospital goal. J Hosp Med. 2014;9:210–214. [PubMed: 24446232]
18. El-Eid GR, Kaddoum R, Tamim H, et al. Improving hospital discharge time: a successful implementation of Six Sigma methodology. Medicine (Baltimore). 2015;94:e633. [PubMed: 25816029]
19. Desai SV, Asch DA, Bellini LM, et al. Education outcomes in a duty-hour flexibility trial in internal medicine. N Engl J Med. 2018;378:1494–1508. [PubMed: 29557719]

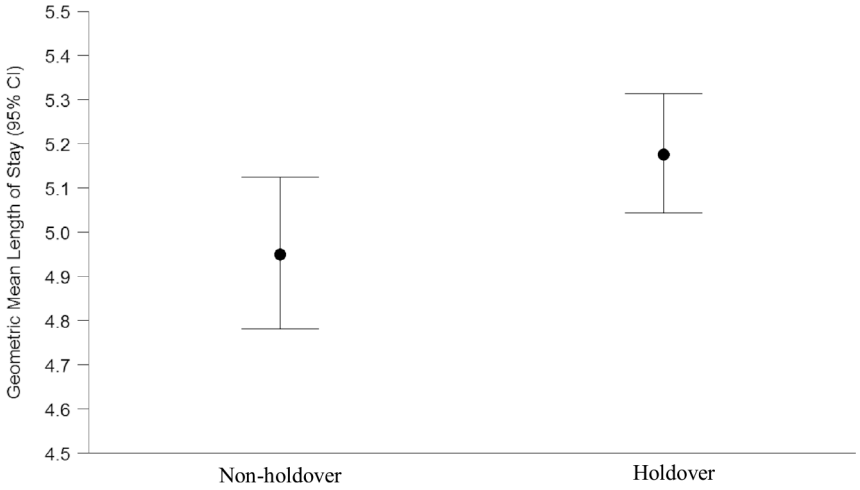

FIGURE 1.
Geometric mean LOS, accounting for multiple patient admissions.

TABLE 1.

Patient Encounter Characteristics

	Nonholdover (n = 1964)	Holdover (n = 3554)	*P*
Patient characteristics			
Age, y			<0.001
Mean (SD)	59(19)	57 (19)	
Median (Q1-Q3)	61 (46–73)	59 (44–71)	
Min-max	18–98	18–99	
Female, n (%)	921 (47)	1740(49)	0.14
Elixhauser comorbidity condition			
Congestive heart failure, n (%)	241 (12)	439 (12)	0.93
Valvular disease, n (%)	103 (5)	160 (5)	0.22
Pulmonary circulation disease, n (%)	144 (7)	257 (7)	0.89
Peripheral vascular disease, n (%)	78 (4)	164 (5)	0.26
Hypertension, n (%)	742 (38)	1254(35)	0.07
Paralysis, n (%)	41 (2)	93 (3)	0.22
Other neurological disorders, n (%)	173 (9)	300 (8)	0.64
Chronic pulmonary disease, n (%)	199 (10)	314 (9)	0.11
Diabetes w/o chronic complications, n (%)	219(11)	423 (12)	0.41
Diabetes w/ chronic complications, n (%)	189 (10)	300 (8)	0.14
Hypothyroidism, n (%)	171 (9)	315 (9)	0.84
Renal failure, n (%)	550 (28)	813 (23)	<0.001
Liver disease, n (%)	182 (9)	390 (11)	0.05
Peptic ulcer disease x bleeding, n (%)	1(<1)	1(<1)	1
Acquired immune deficiency syndrome, n (%)	17(1)	24(1)	0.43
Lymphoma, n (%)	38 (2)	69 (2)	0.99
Metastatic cancer, n (%)	126 (6)	245 (7)	0.50
Solid tumor w/o metastasis, n (%)	89 (5)	191 (5)	0.17
Rheumatoid arthritis/collagen vas, n (%)	95 (5)	194 (5)	0.32
Coagulopathy, n (%)	182 (9)	409 (12)	0.01

	Nonholdover (n = 1964)	Holdover (n = 3554)	*P*
Obesity, n (%)	54(3)	127 (4)	0.10
Weight loss, n (%)	116(6)	239 (7)	0.24
Fluid and electrolyte disorders, n (%)	568 (29)	1082(30)	0.24
Chronic blood loss anemia, n (%)	17(1)	38(1)	0.47
Deficiency anemias, n (%)	396 (20)	678 (19)	0.33
Alcohol abuse, n (%)	48 (2)	110(3)	0.17
Drug abuse, n (%)	50 (3)	109 (3)	0.27
Psychoses, n (%)	79 (4)	184 (5)	0.05
Depression, n (%)	118(6)	228 (6)	0.55
Admission characteristics			
Continuous cardiac monitoring, n (%) *	1228 (65)	2208 (63)	0.20
ICU transfer within 72 h, n (%)	64(3)	127 (4)	0.54
Length of stay, d			0.04
Mean (SD)	6.2 (10.3)	6.4 (8.9)	
Median (Q1-Q3)	3.7 (1.9–6.7)	3.7 (1.9–7.1)	
Min-max	0.1–174.5	0.1–115.2	
30-Day readmission, n (%)	449 (23)	801 (23)	0.78
Any ICU transfer, n (%)	143 (7)	262 (7)	0.90
Discharged status, n (%)			0.04
Home or hospice	1689 (86)	2964 (83)	
Expired	38 (2)	78 (2)	
Postacute care facility	237 (12)	512(14)	

* 71 missing values for nonholdover admissions and 55 missing values for holdover admissions.

TABLE 2.

Effect of Nonholdover Versus Holdover Encounter, Accounting for Multiple Patient Encounters

	Nonholdover Versus Holdover	*P*
72-Hour ICU transfer, OR (95% CI)	1.19(0.59–2.41)	0.63
Any ICU transfer, OR (95% CI)	1.29(0.78–2.14)	0.32
Hospital mortality, OR (95% CI)	1.49(0.49–4.58)	0.49
30-Day readmission, OR (95% CI)	0.97(0.83–1.12)	0.66
Home discharge, OR (95% CI)	2.64(0.64–10.8)	0.18

J Patient Saf. Author manuscript; available in PMC 2023 May 16.