Annals of Internal Medicine ORIGINAL RESEARCH

Preventability of Early Versus Late Hospital Readmissions in a National Cohort of General Medicine Patients

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Background: Many experts believe that hospitals with more frequent readmissions provide lower-quality care, but little is known about how the preventability of readmissions might change over the postdischarge time frame.

Objective: To determine whether readmissions within 7 days of discharge differ from those between 8 and 30 days after discharge with respect to preventability.

Design: Prospective cohort study.

Setting: 10 academic medical centers in the United States.

Patients: 822 adults readmitted to a general medicine service.

Measurements: For each readmission, 2 site-specific physician adjudicators used a structured survey instrument to determine whether it was preventable and measured other characteristics.

Results: Overall, 36.2% of early readmissions versus 23.0% of late readmissions were preventable (median risk difference, 13.0 percentage points [interquartile range, 5.5 to 26.4 percentage points]). Hospitals were identified as better locations for preventing early readmissions (47.2% vs. 25.5%; median risk difference, 22.8 percentage points [interquartile range, 17.9 to 31.8 percentage points]), whereas outpatient clinics (15.2% vs. 6.6%; median risk difference, 10.0 percentage points [interquartile range, 4.6 to 12.2 percentage points]) and home (19.4% vs. 14.0%; median risk difference, 5.6 percentage points [interquartile range, −6.1 to 17.1 percentage points]) were better for preventing late readmissions.

Limitation: Physician adjudicators were not blinded to readmission timing, community hospitals were not included in the study, and readmissions to nonstudy hospitals were not included in the results.

Conclusion: Early readmissions were more likely to be preventable and amenable to hospital-based interventions. Late readmissions were less likely to be preventable and were more amenable to ambulatory and home-based interventions.

Primary Funding Source: Association of American Medical Colleges.

Ann Intern Med. doi:10.7326/M17-1724 **Annals.org**
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This article was published at Annals.org 1 May 2018.

Each year, hospital readmissions affect 18.2% of Medicare beneficiaries (1) and cost Medicare between $15 billion and $17 billion (2). Effective 1 October 2012, section 3025 of the Patient Protection and Affordable Care Act established the Hospital Readmissions Reduction Program, which authorized the Centers for Medicare & Medicaid Services to impose financial penalties on hospitals for excessive readmissions within 30 days of discharge (3).

The Affordable Care Act specified 30 days because lawmakers sought to identify a window during which a readmission was probably attributable to the quality of care during the index hospitalization and thus was preventable. However, this choice has little scientific basis (2, 4–7) and does not correlate with quality indicators (8, 9) or inpatient mortality rates (10–12), and readmissions during this window are influenced by the ambulatory care environment, chronic illness burden, and social determinants of health (13–23). Furthermore, 1 recent single-center study found that readmissions within 7 days of discharge were more closely associated with factors influenced by the index hospitalization than those 8 to 30 days after discharge (13). Moreover, whether preventability varies during the 30 days is uncertain (24). One way to determine the ideal period would be to use a measure that identifies preventable readmissions that are directly influenced by hospital factors (such as physician decision making, processes of inpatient care, and transitional care planning) while striking a balance between validity and simplicity (2). The search for this ideal has led experts to propose windows of 3, 7, or 14 days rather than 30 days (4–7, 13), but no direct evidence was given for these shorter periods.

The aim of this study was to compare patients readmitted within 7 days of hospital discharge with those readmitted 8 to 30 days after discharge using measures of preventability. We hypothesized that early readmissions are more preventable than late readmissions and that early readmissions are more likely caused by factors directly related to the index hospitalization.

Methods

Setting and Cohort

The Hospital Medicine Reengineering Network (HOMERuN) comprises 12 academic medical centers in the United States (25). Our study is limited to the 10 centers whose databases include readmission timing (Appendix Table 1, available at Annals.org). Eligible patients were aged 18 years or older, spoke English as their primary language, and had been discharged from

Table 1. Physician-Adjudicated Readmission Preventability, by Readmission Timing

Variable	Early Readmissions (*n* = 301 [36.6%]), %*	Late Readmissions (*n* = 521 [63.4%]), %†	Median Risk Difference Across Sites (IQR), *percentage points*
Preventability‡	36.2	23.0	13.0 (5.5 to 26.4)
Alternate definition of preventability§	22.6	12.5	12.4 (1.6 to 21.6)
Odds ratio of preventability (95% CI)‖	2.0 (1.5 to 2.8)	Reference	–
Ideal location for an intervention to prevent readmission¶			
Hospital	47.2	25.5	22.8 (17.9 to 31.8)
Home	14.0	19.4	−5.6 (−17.1 to 6.1)
Outpatient clinic	6.6	15.2	−10.0 (−12.2 to −4.6)
Emergency department	3.7	4.0	−2.0 (−3.1 to 1.5)
Other	14.6	18.4	−6.6 (−11.8 to 1.5)

IQR = interquartile range.
* 0–7 d after discharge.
† 8–30 d after discharge.
‡ Defined as a preventability score ≥4 on a 6-point ordinal scale in which 1 indicates no evidence for preventability, 2 indicates slight evidence of preventability, 3 indicates a <50% chance of preventability but a close call, 4 indicates a >50% chance of preventability but a close call, 5 indicates strong evidence for preventability, and 6 indicates virtually certain evidence for preventability; this is the standard approach.
§ Defined as a preventability score ≥5 on the scale described in the previous footnote, presented as a sensitivity analysis.
‖ Using logistic regression to model the odds of a preventable readmission for early vs. late readmissions, adjusted for hospital site, patient age, and all process of care variables listed in **Table 2**.
¶ Determined by adjudicators after review of each admission and readmission pair.

a general medicine service and readmitted unexpectedly within 30 days between 1 April 2012 and 31 March 2013. We used a random-digit generator to select up to 5 patients per week at each site. If a patient declined an interview, was too sick to participate, or was unavailable, we tried to enroll the next randomly selected patient.

Institutional review boards at the University of California, San Francisco (the data coordinating center), and all participating sites approved this study.

Data Collection

Trained research assistants performed structured review of medical records to collect demographic data, information on comorbid conditions and medications, and measures of transitions in care. We developed survey instruments to identify factors that might contribute to readmission, and research assistants administered these surveys to each patient's primary care physician, the attending physician for the index hospitalization, and the attending physician for the readmission. Research assistants used similar survey instruments to interview readmitted patients (22, 25).

The primary outcome was preventability, which we defined as a rating of at least 4 of 6 on an ordinal scale (Table 1, third footnote) (26–30). Each site had 3 to 10 adjudicators; for each readmission, 2 adjudicators used a standard approach (26–28) to review all available data and jointly determine the preventability rating, with a decision by the lead physician when needed (22, 25). These physicians also identified the location where an intervention to prevent the readmission would have been most effective and factors that contributed to the readmission. The factors were based on the Ideal Transition in Care framework (29) and included monitoring or managing symptoms after discharge, social and community supports, self-management instruction, continuity of care, end-of-life care and advance care planning, diagnostic and therapeutic problems, decision making about the readmission, and medication problems and adverse events. We defined early readmission as 0 to 7 days after discharge and late readmission as 8 to 30 days after discharge.

Statistical Analysis

We describe the preventability of early and late readmissions using the median of risk differences and interquartile ranges across study sites. We used logistic regression to model preventability of the readmission based on early versus late timing, with hospital site as a fixed variable to adjust for site-specific differences in patient characteristics, hospital care processes, the adjudication process, and other unknown variables. We also included patient age and variables describing each patient's transitions in care as covariates. To identify the optimal cut point for separating early versus late readmissions, we visually inspected a graph of the adjusted probability of preventability by postdischarge day. We report the frequencies of each potential causative factor during the early and late periods, along with the median risk difference and interquartile range across sites. We managed and analyzed the data using SAS, version 9.2 (SAS Institute).

Role of the Funding Source

The funding sources 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.

RESULTS

We identified 890 eligible patients but subsequently excluded 54 who had missing age values and 14 who had data entry errors for date of discharge, date of readmission, or both. Of the remaining 822 patients, 301 (36.6%) were readmitted 0 to 7 days after discharge and 521 (63.4%) were readmitted 8 to 30 days after discharge. Patients who were readmitted early and late had similar baseline characteristics, co-

morbid conditions, social factors, and process-of-care variables (Table 2). However, more results of diagnostic studies were pending at hospital discharge for early readmissions (27.6%) than for late readmissions (20.0%) (Table 2). In addition, patient characteristics and processes of care differed by study site (Appendix Table 2, available at Annals.org).

Overall, 229 readmissions (27.9%) were preventable. Preventability differed with timing: 36.2% of early readmissions versus 23.0% of late readmissions were preventable. It also varied between early and late readmissions across study sites (Figure 1 and Appendix Table 2), although preventability was rated as higher for early readmissions for 9 of 10 sites. The median risk difference across sites was 13.0 percentage points (interquartile range, 5.5 to 26.4 percentage points) (Table 1). In adjusted analyses, early readmissions were significantly more likely to be preventable (odds ratio, 2.0 [95% CI, 1.5 to 2.8]) (Table 1). A sensitivity analysis using a more stringent cutoff for preventability produced similar results (Table 1). Preventability clearly decreased after day 7 (Figure 2).

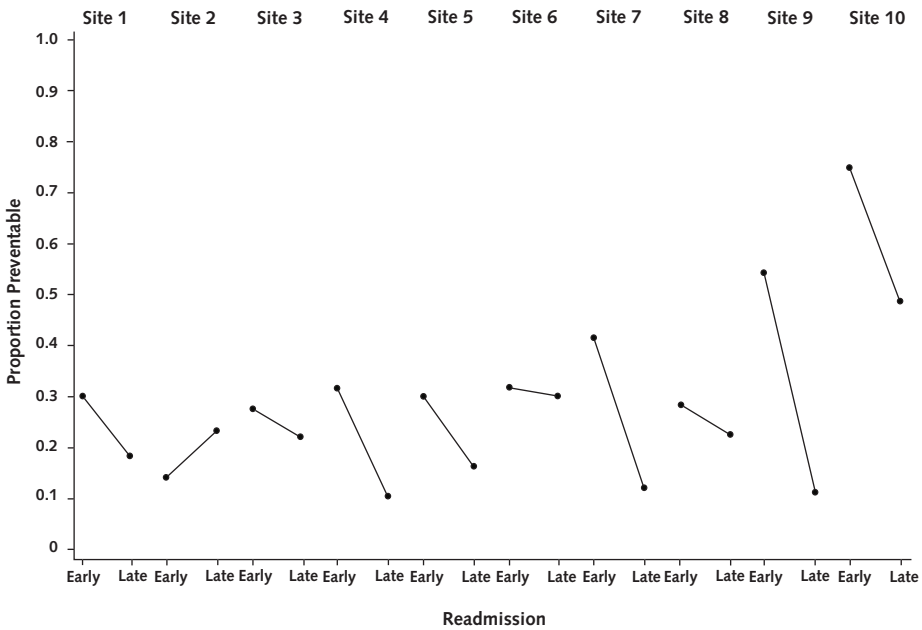
Hospitals were more likely to be identified as the ideal location for an intervention to prevent early read-

Table 2. Initial Hospitalization and Patient Characteristics, by Readmission Timing*

Characteristic	Early Readmissions (*n* = 301 [36.6%])†	Late Readmissions (*n* = 521 [63.4%])‡
Mean age (SD), *y*	54.7 (17.3)	55.5 (18.3)
Mean index length of stay (SD), *d*	5.8 (7.7)	5.5 (4.9)
Preadmission disposition, %§		
Homeless	6.3	5.8
Home without services	68.8	69.9
Home with services	11.6	12.7
Home hospice	0.7	0.2
Home, services unspecified	5.0	3.8
Rehabilitation facility	5.0	3.1
Chronic care facility	1.0	2.9
Other	1.0	1.5
Married or living as married, %	36.5	33.2
Status of inpatient work-up, %		
Studies pending at discharge‖	27.6	20.0
Diagnostic work-up as outpatient¶	34.9	31.9
Terminal illness, %		
Stage III or IV congestive heart failure	7.0	5.4
Hemorrhagic or ischemic stroke, degenerative central nervous system disorder	7.3	6.1
Cancer	2.0	3.3
Severe chronic obstructive pulmonary disease**	16.9	17.5
Stable stage IV chronic renal failure††	5.7	6.1
Stage III or IV congestive heart failure	15.0	12.9
Treatment indicating chronic illness, %		
Dialysis	7.6	6.0
Chemotherapy	1.0	1.0
Anticoagulation	14.3	14.8
Opioids	49.2	51.6
Insulin	17.3	17.9
Lasix (Sanofi-Aventis)	17.3	18.2
English as a primary language, %	90.4	93.5
Patient understood how to execute care plan, %	92.0	91.5
Difficulty with transportation access, %	20.3	21.6
Income vulnerability, %		
Homeless	4.7	4.2
Difficulty meeting basic needs	11.4	10.8
Social supports lacking	16.7	15.6
Substance use disorder	9.0	6.6
Process-of-care variables, %		
Primary physician contacted at admission	63.8	59.5
Follow-up call to patient	13.6	14.8
Discharge summary within 24 h	78.1	75.8
Postdischarge appointment made	66.8	61.0
Medication reconciliation	86.7	84.3
Primary physician contacted at discharge	48.5	41.3

* Percentages may not sum to 100 due to rounding. Fewer than 3% were missing data for all variables (mean index length of stay, 0.5%; patient understood how to execute care plan, 0.7%; difficulty with transportation access, 2.8%; difficulty meeting basic needs, 0.7%; social supports lacking, 0.5%; and substance use disorder, 0.9%).
† 0–7 d after discharge.
‡ 8–30 d after discharge.
§ At the time of the readmission.
‖ Discharge documentation noted that test results were pending at the time of discharge.
¶ Discharge documentation included directions that additional diagnostic work-up was to be completed as an outpatient.
** Oxygen-dependent or with an FEV_1 <1 L.
†† Estimated glomerular filtration rate <30 mL/min/1.73 m^2 or receiving hemodialysis.

Figure 1. Proportion of early and late readmissions that were preventable at each of the 10 hospital sites.



missions (47.2% vs. 25.5%; median risk difference, 22.8 percentage points), whereas outpatient clinics (6.6% vs. 15.2%; median risk difference, −10.0 percentage points) and home (14.0% vs. 19.4%; median risk difference, −5.6 percentage points) were more likely to be identified as the ideal location to prevent late readmissions (Table 1). The ideal location for an intervention varied by study site (Appendix Table 3, available at Annals.org). However, the hospital was more frequently identified as the ideal location for early versus late readmissions at 9 of 10 sites, and home and the outpatient clinic were more frequently identified as the ideal location in late versus early readmissions at 7 and 9 (respectively) of 10 sites.

Problems with physician decision making related to diagnosis and management were more frequently identified as causal factors for early rather than late readmissions (28.9% vs. 11.5%; median risk difference, 14.1 percentage points) (Table 3). The differences by specific problem were 10.6% versus 4.0% for missed diagnoses (median risk difference, 6.7 percentage points), 14.3% versus 7.1% for inadequate treatment of active medical conditions during the index admission (median risk difference, 4.6 percentage points), and 16.3% versus 3.7% for premature discharge (median risk difference, 13.6 percentage points).

Issues with monitoring and managing symptoms after discharge (33.2 vs. 25.3%; median risk difference, 11.8 percentage points) and with end-of-life care and advance care planning (13.8 vs. 8.0%; median risk difference, 3.9 percentage points) were more frequently identified as causal factors for late versus early readmissions. The differences by specific problem were 10.0% versus 5.0% for inappropriately long wait times for postdischarge appointments (median risk difference, 2.9 percentage points) and 10.9% versus 5.7% for patient inability to keep postdischarge follow-up visits (median risk difference, 5.3 percentage points). Desire for hospitalization and full treatment measures by patients nearing the end of life was more frequently identified as a cause of late versus early readmissions (8.6 vs. 5.3%; median risk difference, 3.6 percentage points) (Table 3). An analysis of causation that included only preventable readmissions produced similar results except that issues with end-of-life care or advance care planning no longer differed significantly, and medication problems or adverse drug events were more likely to be identified as causal factors for late versus early readmissions (36.7 vs. 27.5%; median risk difference, 2.9 percentage points) (Appendix Table 4, available at Annals.org).

DISCUSSION

In this cohort of general medicine patients readmitted to 10 academic medical centers, we found a significant difference in rates of preventability between early and late periods within the 30 days after hospital discharge. Early readmissions were associated with double the odds of preventability compared with late readmissions, and adjusted preventability rates clearly decreased after postdischarge day 7. Physician adjudicators were more likely to consider the hospital to be the optimal site to implement interventions for preventing early readmissions (days 0 to 7) and the outpatient clinic and home environments for preventing late readmissions (days 8 to 30). Lastly, we found that premature discharge and problems with physician decision mak-

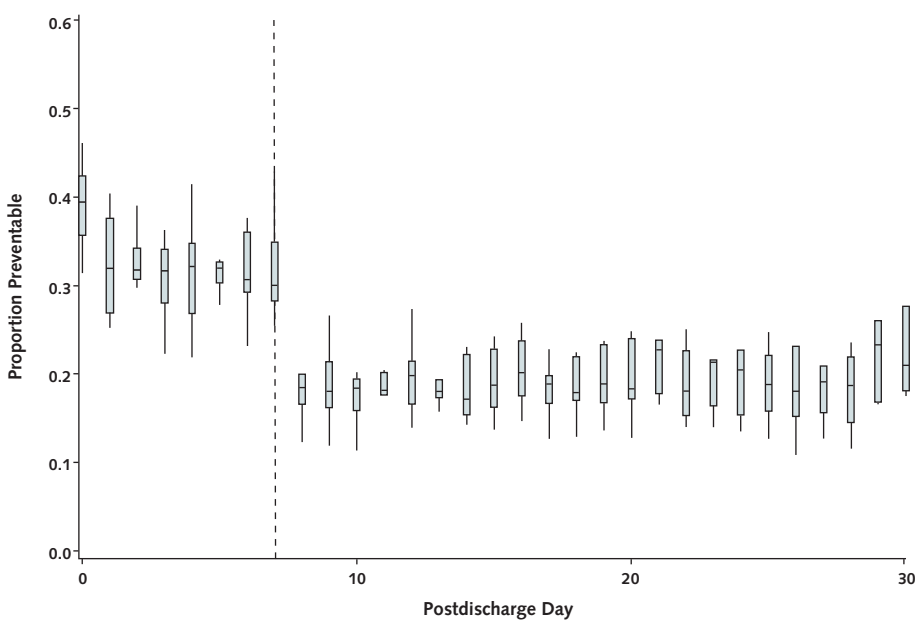
ing related to diagnosis and management during the index hospitalization were significantly more likely to be identified as causes of readmissions in the early period. Problems with postdischarge follow-up and monitoring as well as end-of-life issues were more likely to be identified as causes of readmissions in the late period. Taken together, these findings suggest that readmissions in the week after discharge are more preventable and more likely to be caused by factors over which the hospital has direct control than those later in the 30-day window.

These findings suggest that hospitals are more likely to successfully prevent readmissions within the first week after discharge, after which interventions targeted to the ambulatory care environment may be more effective. This is consistent with our prior work, which showed that factors related to the index hospitalization, such as acute illness burden and discharge timing, were more closely associated with early rather than late readmissions (13). Our single-center follow-up study using blinded physician review showed that mean preventability scores were significantly higher in the early period than in the late period (31). In the current study, we addressed our hypothesis directly with a geographically diverse, multicenter sample, improving on external validity. Our findings also support prior work by others who showed that interhospital variability in readmissions is highest during postdischarge days 0 to 7, which suggests this as a more ideal time frame to capture hospital-attributable readmissions (7).

Our assessment of causality provides further insight into potential targets to prevent readmissions in these 2 time frames. Compared with late readmissions, early readmissions were more likely to be caused by problems with physician decision making related to diagnosis and treatment during the index admission. Specifically, adjudicators cited missed diagnoses and inadequate treatment of the admitting condition as reasons for early readmissions significantly more frequently than for late readmissions. They also cited premature discharge as more likely to cause early readmissions. This may be because more patients in the early cohort had incomplete diagnostic work-ups on the day of discharge. Although physician cognitive error may affect premature discharge, hospitalists face many significant factors in the health care system that could influence decisions about discharge timing, including external pressure to decrease length of stay and shift nonurgent evaluation and treatment to the outpatient setting. This points to a potential source of bias regarding optimal discharge timing that may harm patients and should be explored further.

The analysis of causality also found that inadequate monitoring and management of symptoms after discharge were significantly more prevalent for late readmissions. Specifically, we found that long wait times and inability to keep postdischarge follow-up appointments with primary care providers were more often cited as causing late rather than early readmissions. These findings also support our hypothesis that late readmissions are driven by factors outside the hospital and in the ambulatory care environment, where postdischarge monitoring and follow-up care could be bet-

Figure 2. Pooled, adjusted proportion of readmissions ascertained as being preventable using a standard algorithm and physician adjudication at all 10 hospital sites, by day.



The bottom and top edges of the boxes represent the pooled 25th and 75th percentiles (interquartile range), the center horizontal line is drawn at the 50th percentile (median), the vertical lines represent the most extreme observations, and the dotted line indicates postdischarge day 7.

Table 3. Adjudicators' Assessment of Factors Contributing to Readmission, by Readmission Timing*

Factor	Early Readmissions (*n* = 301 [36.6%]), %†	Late Readmissions (*n* = 521 [63.4%]), %‡	Median Risk Difference Across Sites (IQR), *percentage points*
Monitoring and managing symptoms after discharge	25.3	33.2	−11.8 (−17.1 to 2.3)
Inappropriate choice of discharge location	9.3	5.6	−0.1 (−2.0 to 8.9)
Inappropriately long time between discharge and first follow-up with outpatient providers	5.0	10.0	−2.9 (−4.9 to −0.7)
Patient was not able to keep postdischarge appointments	5.7	10.9	−5.3 (−9.3 to −1.4)
Discharge without needed procedure	3.0	2.5	0.5 (−1.8 to 3.2)
Lack of disease monitoring	11.6	12.7	−1.8 (−4.9 to 5.5)
Social and community supports	24.6	22.1	0.9 (−4.5 to 7.3)
Patient required additional or different home services from those included in discharge plans	12.3	9.8	3.0 (−1.1 to 6.4)
Patient was not able to access services at home	4.0	4.0	1.6 (−3.4 to 2.5)
Patient required additional help from others that was not available or sufficient	12.3	13.6	−2.3 (−6.3 to 2.0)
Patient required community programs not included in discharge plans	5.3	4.2	2.1 (−1.5 to 2.5)
Inpatient assessment of physical needs was incomplete	4.0	3.5	1.3 (−2.1 to 3.9)
Self-management instruction	49.8	45.9	6.4 (−8.1 to 12.1)
Patient lacked awareness of whom to contact and when to go to the ED	7.3	9.6	−0.6 (−6.1 to 1.8)
Patient lacked awareness of postdischarge plans	2.7	5.6	−4.7 (−7.9 to −0.9)
Patient or family had difficulty managing symptoms at home	39.2	33.4	6.6 (−6.4 to 14.3)
Patient or family had difficulty managing other self-care activities at home	18.9	17.3	3.5 (0.7 to 5.1)
Continuity of care	16.9	18.8	−0.2 (−9.6 to 11.3)
Team did not ensure that the patient had a primary care physician	1.7	2.5	−1.8 (−3.6 to 2.5)
Follow-up appointments were not scheduled before discharge	10.0	10.4	1.5 (−3.9 to 6.5)
Follow-up appointments were not sufficiently soon after discharge	5.6	8.8	−2.2 (−5.5 to 2.1)
Team did not relay important information to outpatient providers	5.7	4.6	1.6 (−2.1 to 8.7)
Patient was unable to be reached for postdischarge care coordination	1.7	1.2	2.0 (−4.2 to 3.2)
Test results ordered by the initial team were not followed up appropriately	0.3	0.6	−1.5 (−1.8 to 0)
End-of-life/advance care planning	8.0	13.8	−3.9 (−10.7 to −1.0)
Patient nearing end of life but still wanted hospitalization and full treatment measures	5.3	8.6	−3.6 (−6.1 to −0.4)
Patient receiving palliative or hospice care but unable to manage symptoms	0	0.6	−1.8 (−2.0 to −1.7)
Patient had end-stage illness but palliative care was not consulted	3.0	5.4	−3.6 (−4.1 to 2.5)
Patient had end-stage illness but discussion about goals of care was not documented	3.0	5.2	−4.0 (−5.1 to 0.1)
Diagnostic or therapeutic problems	28.9	11.5	14.1 (9.8 to 26.5)
Missed diagnosis during the index admission	10.6	4.0	6.7 (1.1 to 8.9)
Inadequate treatment of medical conditions during the index admission	14.3	7.1	4.6 (1.0 to 15.7)
Inadequate treatment of pain during the index admission	4.0	2.3	1.8 (−2.0 to 5.0)
Patient discharged too soon from the index hospitalization	16.3	3.7	13.6 (2.6 to 23.0)
Decision making concerning readmission	7.6	5.6	2.9 (−2.6 to 7.9)
Patient inappropriately sent from subacute facility to ED	0.7	0.6	−1.8 (−1.8 to 2.6)
Patient inappropriately told to come to ED from home	1.0	1.3	−1.4 (−1.8 to 1.0)
ED inappropriately decided to admit patient	7.0	4.4	2.9 (−2.0 to 7.9)
Medication problem or adverse drug event	18.6	21.7	0 (−10.4 to 2.2)
Errors in taking the preadmission medication history during index admission	1.3	0.6	3.3 (0.8 to 4.8)
Errors in discharge orders	2.3	2.1	−1.1 (−1.8 to 5.0)
Drug–drug or drug–disease interaction	2.7	5.0	−2.7 (−5.5 to 0.2)
Patient/caregiver misunderstanding of discharge medication regimen	5.3	4.8	2.4 (−0.7 to 3.0)
Patient/caregiver inability to manage medications at home/inadequate drug-level monitoring	9.3	11.9	−2.9 (−5.2 to 2.0)
Inadequate monitoring for adverse effects or nonadherence	6.6	6.7	−0.4 (−2.4 to 1.1)
Inadequate steps to ensure patient could afford medications	1.7	2.7	−1.8 (−2.0 to −0.9)

ED = emergency department; IQR = interquartile range.
* The top row of each category represents the frequency with which ≥1 factor from this category was selected by physician adjudicators.
† 0–7 d after discharge.
‡ 8–30 d after discharge.

ter tracked and managed. This is a potential area for intervention in ambulatory care clinics.

Finally, we found that issues related to end-of-life care and advance care planning were more likely to be cited as causes of late readmissions. Specifically, we found that terminal illness in patients who preferred to pursue aggressive medical care rather than palliative care was significantly more likely to be considered a

contributing factor for late rather than early readmissions. These findings also support our conceptual model and prior work (13) in that a terminally ill patient who desires aggressive care is likely to be readmitted as a function of disease progression rather than processes that are sensitive to care from hospitals or outpatient clinics, leading to inevitable rather than preventable readmissions.

The most important limitation of our study is that physician adjudicators were not blinded to readmission timing, because this was not a prespecified analysis. Adjudicators were not explicitly instructed to note timing as an aim of the original study, but the knowledge could have biased their assessment of preventability or informed their choice of the most effective location for an intervention to prevent the readmission. Although bias may have been present, the current study is consistent with findings from our prior single-center study, where physician adjudicators were blinded to readmission timing (31). In addition, all of our sites were academic medical centers, where patients often live far away and usual transitions in care can be challenging. These out-of-network patients were not included in the cohort unless they were readmitted to 1 of the sites in our data set. This may limit the generalizability of our findings, which should be validated in community hospitals and hospitals with full access to readmission data.

Adjudicators can disagree considerably in preventability determinations, which may have contributed to the heterogeneity in our outcomes across sites (32). Accordingly, differences in preventability by site can reflect either true differences or differences in calibration of the adjudicators in their probability of assigning preventability. We attempted to mitigate this factor by training adjudicators in depth, using a dual-physician review process to allow some degree of internal calibration, and providing descriptive analyses stratified by hospital site. Although we observed substantial site-level variability in the magnitude of differences in preventability and ideal location for an intervention between early and late readmissions, the direction of the relationship was consistent across most sites. Nonetheless, we cannot rule out confounding from differences in care processes or preventability determinations.

Our findings have several further implications. An ideal accountability metric should reflect a care process or system over which the organization or person that is penalized has direct control. As such, the time frame used for this metric is critical, specifically given concerns that the 30-day readmission rate has introduced disparities in penalties, with the highest burden affecting hospitals that care for the most socially disadvantaged patients (33). The time frame used must balance simplicity with validity (2). Recommending direct clinician review of the medical record to assess preventability is not feasible. However, until hospital discharge is viewed as a population management task requiring successful integration between hospital and primary care teams—and where penalties are equally shared by both environments—a more evidence-based time frame could strike this balance.

We believe that a 7-day cutoff would avoid inappropriate penalization while continuing to incentivize hospitals to develop processes of care that reduce readmissions. This idea is supported by our finding that the hospital was identified as the ideal location for an intervention to reduce early readmissions nearly half of the time, compared with about a quarter for late readmissions. Taken together, we believe that our findings provide strong evidence for a 7-day readmission rate as a superior accountability measure for the hospital setting.

However, although changing the time frame may address the problem of potentially undeserved financial penalties, a simple cutoff is unlikely to be the answer to providing our patients with high-quality, safe transitions in care at discharge. This effort will require a multifaceted integration between hospitals and primary care offices and better quality measurement. In addition to best practices for discharge planning, our results suggest that hospitalists should focus on interventions to reduce cognitive errors that affect diagnosis and treatment planning. The extent to which incentives imposed by hospital systems to increase throughput result in premature discharge and readmission should be further examined. Outpatient systems should prioritize development of multidisciplinary care management systems for postdischarge monitoring and expanded access to the primary care team for timely follow-up appointments. Finally, we believe that the quality metric used to measure and promote success in this realm must change. Shared accountability over the 30 days, possibly with weighted penalties by readmission timing, would engage outpatient practices in readmission reduction efforts and reduce unfair financial penalties on hospitals, which have negative downstream effects on the patients they serve.

In summary, in a cohort derived from 10 academic medical centers, we found that readmissions within the first 7 days after hospital discharge were more likely to be preventable than those within a late period of 8 to 30 days. Early readmissions were more likely to be amenable to interventions within the hospital and to be caused by factors for which the hospital is directly accountable, such as problems with physician decision making and premature discharge. Late readmissions were more likely to be amenable to interventions outside the hospital and to be caused by factors over which the hospital has less direct control, such as appropriate monitoring and managing of symptoms after discharge by the primary care team and end-of-life preferences. We believe it is time to change the model for patient outcomes after hospital discharge to one that recognizes shared accountability for readmissions along the entire spectrum of care. If this cannot be achieved in the short term, our findings suggest that a 7-day readmission window will more accurately capture preventable hospital readmissions.

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Disclaimer: The content is solely the responsibility of the authors and does not necessarily represent the official views of any of the funding agencies. Dr. Graham had full access to all of the study data and takes responsibility for its integrity and the accuracy of the data analysis.

Financial Support: By an unrestricted research grant from the Association of American Medical Colleges. This work was done with support from Harvard Catalyst, The Harvard Clinical and Translational Science Center, through award UL1 TR001102 from the National Institutes of Health and financial contributions from Harvard University and its affiliated academic health care centers. Dr. Graham is funded by the Eleanor and Miles Shore 50th Anniversary Fellowship Program for Scholars in Medicine at Beth Israel Deaconess Medical Center and Harvard Medical School. Dr. Herzig is funded by grant K23AG042459 from the National Institute on Aging. Dr. Marcantonio was supported in part by grants R01AG030618 and K24AG035075 from the National Institute on Aging. Dr. Vasilevskis was supported by National Institute on Aging award K23AG040157, the Veterans Affairs Clinical Research Center of Excellence, and the Geriatric Research Education and Clinical Center.

Disclosures: Dr. Schnipper reports grants from Mallinckrodt Pharmaceuticals outside the submitted work. Dr. Flanders has given expert testimony and reports grants from Blue Cross Blue Shield of Michigan and the Agency for Healthcare Research and Quality and personal fees from Wiley Publishing outside the submitted work. Dr. Kim reports grants from the Association of American Medical Colleges during the conduct of the study and personal fees from ZS Pharma and Actavis Pharma outside the submitted work. Dr. Kripalani reports personal fees from Verustat and SAI Interactive and equity from Bioscape Digital outside the submitted work. Dr. Lindenauer receives support from the Center for Outcomes Research & Evaluation at Yale New Haven Health System, under contract from the Centers for Medicare & Medicaid Services, to develop hospital outcome measures for pneumonia and chronic obstructive pulmonary disease. Dr. Williams reports consultancy for Telligen Technical Expert Panel and Medical College of Wisconsin; grants from the Patient-Centered Outcomes Research Institute, Agency for Healthcare Research and Quality, Centers for Medicare & Medicaid Services, and National Center for Advancing Translational Sciences; payment for lectures from Northwestern University and the Society of Hospital Medicine; royalties from Elsevier; and payment for development of educational presentations from Vizient outside the submitted work. Dr. Davis reports payments for service on the American Heart Association's editorial board outside the submitted work. Dr. Herzig reports grants from the National Institute on Aging during the conduct of the study. Authors not named here have disclosed no conflicts of interest. Disclosures can also be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M17-1724.

Reproducible Research Statement: *Study protocol:* Available from Dr. Herzig (e-mail, sherzig@bidmc.harvard.edu). *Statistical code and data set:* Available from Dr. Graham (e-mail, kgraham@bidmc.harvard.edu).

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Appendix Table 1. Participating Academic Medical Centers

Beth Israel Deaconess Medical Center
Brigham and Women's Hospital
Christiana Medical Center
Northwestern University Medical Center
San Francisco General Hospital
University of California at San Francisco Medical Center
University of Chicago Medical Center
University of Michigan Medical Center
University of Washington Medical Center
Vanderbilt University Medical Center

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Appendix Table 2. Admission Characteristics, by Site

Characteristic	Study Site							
	1 (*n* = 96)		2 (*n* = 600)		3 (*n* = 97)		4 (*n* = 68)	
	E	L	E	L	E	L	E	L
Preventability, %	22.9		20.0		23.7		16.2	
Preventability, %	30.0	17.9	14.3	23.1	27.6	22.1	31.6	10.2
Mean age (SD), *y*	51.9 (16.5)	54.1 (18)	52.6 (19.2)	56.6 (18.9)	49.0 (19.5)	53.3 (22.0)	59.5 (16.1)	61.2 (18.3)
Mean index length of stay (SD), *d*	3.6 (1.9)	5.1 (4.0)	4.0 (3.4)	5.9 (4.9)	9.1 (12.7)	5.7 (4.6)	5.5 (4.8)	5.5 (2.9)
Disposition, %								
Homeless	2.5	5.4	0	0	0	1.5	5.3	0
Home without services	82.5	62.5	61.9	53.9	79.3	88.2	57.9	69.4
Home with services	15.0	25.0	19.1	20.5	10.3	10.3	21.1	12.2
Home hospice	0	0	0	0	0	0	0	2.0
Home, services unspecified	0	0	9.5	15.4	0	0	0	0
Rehabilitation facility	0	3.6	0	5.1	6.9	0	5.3	2.0
Chronic care facility	0	3.6	0	5.1	0	0	10.5	8.2
Other	0	0	4.8	0	3.5	0	0	4.1
Married or living as married, %	40.0	37.5	38.1	38.5	24.1	27.9	42.1	36.7
Status of inpatient work-up, %								
Studies pending at discharge*	37.5	32.1	42.9	43.6	3.5	4.4	5.3	6.1
Diagnostic work-up as outpatient†	42.5	48.2	47.6	56.4	13.8	25.0	5.3	24.5
Terminal illness, %								
Stage III or IV congestive heart failure	2.5	1.8	0	0	27.6	19.1	0	0
Hemorrhagic or ischemic stroke, degenerative central nervous system disorder	5.0	7.1	0	0	17.3	19.1	10.6	6.2
Cancer	12.5	21.4	19.1	12.8	13.8	14.7	21.1	18.4
Severe chronic obstructive pulmonary disease‡	5.0	3.6	14.3	7.7	10.3	13.2	15.8	8.2
Stable stage IV chronic renal failure§	7.5	12.5	4.8	5.1	31.0	17.7	10.5	6.1
Treatment indicating chronic illness, %								
Dialysis	7.5	5.4	0	0	0	7.4	10.5	4.1
Chemotherapy	0	0	0	0	0	0	0	2.0
Anticoagulation	10.0	25.0	23.8	10.3	24.1	14.1	10.5	14.3
Opioids	45.0	42.9	47.6	41.0	58.6	54.4	47.4	57.1
Insulin	17.5	23.2	4.8	23.1	31.0	19.1	42.1	22.5
Lasix (Sanofic-Aventis)	10.0	19.6	28.6	15.4	20.7	14.7	10.5	30.6
English as a primary language, %	100.0	100.0	95.2	82.1	96.6	100.0	94.7	100.0
Patient understood how to execute care plan, %	90.0	96.4	95.2	92.3	100.0	92.7	84.2	85.4
Difficulty with transportation access, %	25.0	23.2	9.5	23.1	24.1	25.0	13.3	16.3
Income vulnerability, %								
Homeless	2.5	1.8	0	0	0	1.5	5.3	0
Difficulty meeting basic needs	10.0	14.3	14.3	18.0	6.9	7.4	10.5	4.4
Social supports lacking	20.0	16.1	9.5	18.0	24.1	10.3	16.7	22.9
Substance use disorder	7.5	1.8	4.8	12.8	13.8	4.4	5.3	2.1
Process-of-care variables, %								
Primary physician contacted at admission	97.5	96.4	42.9	53.9	20.7	30.9	26.3	20.4
Follow-up call to patient	12.5	8.9	4.8	7.7	6.9	0	0	0
Discharge summary within 24 h	80.0	85.7	95.2	94.9	13.8	29.4	68.4	67.4
Postdischarge appointment made	87.5	78.6	81.0	69.2	69.0	76.5	10.5	14.3
Medication reconciliation	77.7	75.0	95.2	100.0	96.6	98.5	100.0	98.0
Primary physician contacted at discharge	37.5	25.0	33.3	33.3	10.3	7.4	15.8	18.4

E = early admission; L = late admission.
* Discharge documentation noted that test results were pending at time of discharge.
† Discharge documentation included directions that additional diagnostic work-up was to be completed as an outpatient.
‡ Oxygen-dependent or with an FEV_1 <1 L.
§ Estimated glomerular filtration rate <30 mL/min/1.73 m^2 or currently receiving hemodialysis.

Appendix Table 2–Continued

Study Site												
5 (*n* = 86)		6 (*n* = 98)		7 (*n* = 29)		8 (*n* = 98)		9 (*n* = 90)		10 (*n* = 100)	
E	L	E	L	E	L	E	L	E	L	E	L
20.9		30.6		24.1		25.5		27.8		56.0	
30.0	16.1	31.6	30.0	41.7	11.8	28.6	22.5	54.3	10.9	75.0	48.6
59.4 (17.2)	61.2 (19.2)	61.6 (17.7)	57.6 (18.5)	52.2 (11.8)	57.6 (15.3)	50.4 (15.3)	49.7 (15.8)	57.5 (15,6)	54.3 (12.7)	53.9 (18.4)	52.5 (17.8)
7.4 (13.8)	6.6 (7.1)	4.9 (5.9)	6.8 (6.0)	5.6 (7.5)	5.2 (3.9)	6.4 (7.0)	5.3 (4.1)	6.4 (5.9)	3.5 (3.1)	5.4 (5.4)	5.2 (5.4)
3.3	0	2.6	5.0	25.0	29.4	8.2	4.1	22.9	25.5	0	2.8
70.0	80.4	55.3	61.7	66.7	52.9	67.4	83.7	57.1	54.6	85.7	72.2
6.7	5.4	10.5	6.7	8.3	17.7	8.2	4.1	14.3	12.7	7.1	16.7
0	0	0	0	0	0	4.1	0	0	0	0	0
13.3	0	21.1	16.7	0	0	0	0	0	3.6	3.6	2.8
6.7	5.4	7.9	5.0	0	0	10.2	6.1	5.7	1.8	0	1.4
0	5.4	2.6	1.7	0	0	0	2.0	0	1.8	0	1.4
0	3.6	0	3.3	0	0	0	0	0	0	3.6	2.8
60.0	53.6	26.3	16.7	8.3	0	38.8	38.8	20.0	18.2	57.1	43.1
6.7	3.6	21.1	25.0	25.0	58.8	50.0	26.5	31.4	9.1	32.1	25.0
16.7	7.1	42.1	16.7	50.0	58.8	34.7	46.9	40.0	30.9	53.6	33.3
3.3	5.4	10.5	11.7	0	0	6.1	0	11.4	5.5	0	1.4
10.0	10.8	13.2	15.0	0	0	6.1	6.1	2.9	0	17.9	13.9
13.3	21.4	18.4	15.0	16.7	5.9	24.5	34.7	8.6	9.1	21.4	15.3
0	3.6	5.3	3.3	0	11.8	4.1	6.1	2.9	5.5	3.6	2.8
13.3	14.3	26.3	16.7	0	5.9	14.3	14.3	20.0	20.0	7.1	8.3
6.7	7.1	18.4	13.3	0	5.9	8.2	0	14.3	12.7	0	1.4
0	1.8	0	3.3	8.3	0	0	2.0	0	0	7.1	0
23.3	21.4	23.7	26.7	16.7	11.8	2.0	2.0	8.6	7.3	10.7	9.7
36.7	46.4	39.5	50.0	41.7	41.2	69.4	59.2	31.4	41.8	64.3	68.1
13.3	14.3	7.9	10.0	8.3	11.8	16.3	22.5	20.0	9.1	14.3	20.8
13.3	19.6	15.8	21.7	16.7	11.8	18.4	12.2	17.1	12.7	25.0	19.4
96.7	100.0	39.5	55.0	91.7	100.0	100.0	100.0	97.1	100.0	100.0	100.0
93.3	89.3	92.1	91.7	91.7	100.0	93.8	91.7	88.2	90.6	89.3	90.3
10.0	17.9	23.7	23.3	54.6	35.3	25.0	18.8	14.3	16.7	14.8	23.5
0	0	2.6	3.3	16.7	17.7	4.1	2.0	20.0	21.8	0	2.8
3.3	5.4	7.9	10.0	16.7	35.3	17.0	4.2	14.3	20.0	14.3	8.3
6.7	10.7	13.2	18.3	25.0	35.3	12.5	2.1	31.4	29.1	10.7	9.7
0	0	7.9	5.1	16.7	29.4	4.2	2.1	26.5	25.5	7.1	1.4
53.3	64.3	76.3	71.7	41.7	41.2	100.0	95.9	54.3	61.8	53.6	51.4
6.7	7.1	2.6	1.7	0	0	34.7	46.9	34.3	61.8	3.6	9.7
76.7	80.4	100.0	91.7	50.0	76.5	79.6	63.3	94.3	94.6	96.4	84.7
90.0	76.8	42.1	41.7	91.7	82.4	71.4	71.4	65.7	63.6	53.6	50.0
100.0	100.0	92.1	96.7	100.0	100.0	100.0	100.0	91.4	94.6	17.9	15.3
93.3	92.9	47.4	40.0	0	17.7	87.8	87.8	65.7	60.0	21.4	26.4

Appendix Table 3. Ideal Location to Prevent Readmission, by Hospital Site*

Location	Study Site																			
	1 (*n* = 96)		2 (*n* = 60)		3 (*n* = 97)		4 (*n* = 68)		5 (*n* = 86)		6 (*n* = 98)		7 (*n* = 29)		8 (*n* = 98)		9 (*n* = 90)		10 (*n* = 100)	
	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L	E	L
Hospital	42.5	10.1	61.9	33.3	31.0	11.8	52.6	34.7	30.0	32.1	26.3	16.7	75.0	17.7	55.1	32.7	60.0	27.3	60.7	37.5
Home	17.5	5.4	9.5	15.4	31.0	29.4	10.5	4.1	0	5.4	7.9	25.0	0	35.3	26.5	40.4	14.3	29.1	3.6	27.8
Outpatient clinic	15.0	19.6	9.5	5.1	0	10.3	0	18.4	6.7	19.6	5.3	15.0	8.3	11.8	6.1	18.4	2.9	14.6	10.7	15.3
ED	7.5	10.7	0	2.6	6.9	2.9	0	2.0	3.3	1.8	5.3	8.3	0	5.9	2.0	4.1	2.9	3.6	3.6	0
Other	0	10.7	4.8	20.5	54.4	45.6	5.3	10.2	3.3	1.8	55.3	33.3	0	11.8	8.2	16.3	8.6	7.3	17.9	15.3

E = early admission; ED = emergency department; L = late admission.
* Values are percentages.

Appendix Table 4. Adjudicators' Assessment of Factors Contributing to Preventable Readmissions, by Readmission Timing*

Factor	Early Preventable Readmissions (*n* = 109 [13.2%]), %†	Late Preventable Readmissions (*n* = 120 [14.6%]), %‡	Median Risk Difference Across Sites (IQR), *percentage points*
Monitoring and managing symptoms after discharge	33.9	66.7	−30.7 (−46.7 to −18.8)
Inappropriate choice of discharge location	15.6	10.8	2.9 (−11.1 to 8.3)
Inappropriately long time between discharge and first follow-up with outpatient providers	7.3	18.3	−6.7 (−22.2 to 11.1)
Patient was not able to keep postdischarge appointments	9.2	24.2	−21.9 (−22.2 to 0)
Discharge without needed procedure	3.7	6.7	−9.8 (−16.7 to 16.7)
Lack of disease monitoring	12.8	25.0	−11.0 (−16.7 to −3.8)
Social and community supports	29.4	28.3	3.6 (−11.1 to 11.7)
Patient required additional or different home services from those included in discharge plans	16.5	19.2	−1.2 (−11.1 to 6.7)
Patient was not able to access services at home	3.7	5.8	6.8 (−1.3 to 16.7)
Patient required additional help from others that was not available or sufficient	14.7	16.7	−12.4 (−20.8 to 11.7)
Patient required community programs not included in discharge plans	5.5	7.5	−4.4 (−9.8 to 6.2)
Inpatient assessment of physical needs was incomplete	7.3	8.3	0.3 (−11.4 to 9.8)
Self-management instruction	53.2	65.0	−9.4 (−22.2 to 0)
Patient lacked awareness of whom to contact, when to go to the ED	12.8	20.8	−9.4 (−15.8 to 2.6)
Patient lacked awareness of postdischarge plans	4.6	14.2	−11.1 (−15.2 to 2.8)
Patient or family had difficulty managing symptoms at home	37.6	45.0	−7.3 (−13.9 to 13.3)
Patient or family had difficulty managing other self-care activities at home	25.7	21.7	−0.9 (−3.9 to 3.8)
Continuity of care	22.0	35.0	−6.7 (−29.2 to 11.1)
Team did not ensure that the patient had a primary care physician	0.9	5.0	−10.0 (−20.0 to −6.7)
Follow-up appointments were not scheduled before discharge	13.8	18.3	−1.8 (−11.1 to 5.6)
Follow-up appointments were not sufficiently soon after discharge	8.3	19.2	5.6 (−2.7 to 20.0)
Team did not relay important information to outpatient providers	11.9	12.5	5.6 (−20.0 to 11.4)
Patient unable to be reached for postdischarge care coordination	0.9	2.5	−0.1 (−8.6 to 8.3)
Test results ordered by initial team were not followed up appropriately	0	1.7	−9.5 (−10.0 to −9.1)
End-of-life/advance care planning	9.2	13.3	−3.3 (−20.0 to 7.1)
Patient nearing end of life but still wanted hospitalization and full treatment measures	3.7	2.5	6.2 (−5.7 to 8.3)
Patient receiving palliative or hospice care but unable to manage symptoms	0	0	
Patient had end-stage illness but palliative care was not consulted	5.5	7.5	−6.1 (−13.3 to 5.7)
Patient had end-stage illness but discussion about goals of care was not documented	4.6	10.0	−13.3 (−22.2 to 5.3)
Diagnostic or therapeutic problems	46.8	25.0	22.1 (3.5 to 31.7)
Missed diagnosis during the index admission	17.4	8.3	15.2 (1.3 to 16.7)
Inadequate treatment of medical conditions during the index admission	26.6	16.7	11.7 (0 to 18.3)
Inadequate treatment of pain during the index admission	5.5	4.2	−1.0 (−11.1 to 8.3)
Patient discharged too soon from the index hospitalization	31.2	10.8	22.1 (5.8 to 33.8)
Decision making concerning readmission	13.8	12.5	2.6 (−10.1 to 12.6)
Patient inappropriately sent from subacute facility to ED	1.8	0	6.5 (4.8 to 8.3)
Patient inappropriately told to come to ED from home	1.8	3.3	−2.9 (−9.1 to −1.7)
ED inappropriately decided to admit patient	11.9	12.5	0 (−10.1 to 6.9)
Medication problem or adverse drug event	27.5	36.7	−2.9 (−9.1 to −1.7)
Errors in taking the preadmission medication history during index admission	2.8	0	0 (−10.1 to 6.9)
Errors in discharge orders	3.7	5.0	−8.5 (−12.3 to −3.8)
Drug–drug or drug–disease interaction	3.7	10.0	−10.0 (−22.2 to −5.6)
Patient/caregiver misunderstanding of discharge medication regimen	11.0	8.3	5.7 (−2.8 to 14.3)
Patient/caregiver inability to manage medications at home/inadequate drug-level monitoring	12.8	16.7	−10.0 (−22.2 to −5.6)
Inadequate monitoring for adverse effects or nonadherence	11.9	15.0	−8.3 (−11.1 to 0)
Inadequate steps to ensure patient could afford medications	2.8	7.5	−13.9 (−20.0 to −9.1)

ED = emergency department; IQR = interquartile range.
* The top row of each category represents the frequency with which ≥1 factor from this category was selected by physician adjudicators.
† 0–7 d after discharge.
‡ 8–30 d after discharge.