Outcomes after Rehospitalization at the Same Hospital or a Different Hospital Following Critical Illness

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Abstract

Rationale: Intensive care unit (ICU) patients who receive mechanical ventilation are at high risk for early rehospitalization. Given the medical complexity of these patients, a lack of continuity of care may adversely affect their outcomes during rehospitalization.

Objectives: To determine whether outcomes differ for patients who are rehospitalized at a different hospital versus the hospital of their index ICU stay.

Methods: We conducted a retrospective cohort study of mechanically ventilated ICU patients rehospitalized within 30 days in New York State hospitals between 2008 and 2013.

Measurements and Main Results: We measured frequency of rehospitalization at a different hospital, mortality, length of stay, and costs during rehospitalization. Of 26,947 mechanically ventilated ICU patients rehospitalized within 30 days of discharge, 8,443 (31.3%) were rehospitalized at a different hospital than that of the

index ICU stay. For patients at a different hospital, 13.7% died during rehospitalization versus 11.1% who died at the index hospital (adjusted rate ratio [aRR], 1.11; 95% confidence interval [CI], 1.03–1.20; $P = 0.009$). Patients who died at a different hospital had shorter length of stay (aRR, 0.80; 95% CI, 0.70–0.92; $P = 0.001$) and decreased costs (adjusted mean difference, $-\$9,632.73$; 95% CI, $-\$16,387.60$ to $-\$2,877.88$; $P = 0.005$), whereas survivors of rehospitalization at a different hospital had a modest increase in length of stay (aRR, 1.06; 95% CI, 1.01–1.11; $P = 0.009$) and increased costs of care (adjusted mean difference, $\$1,665.34$; 95% CI, $\$602.12$ – $\$2,728.56$; $P = 0.002$).

Conclusions: Almost one-third of mechanically ventilated critically ill patients were rehospitalized at a different hospital than that of the index ICU stay. This care discontinuity was associated with increased mortality.

Keywords: hospital readmissions; continuity of patient care; outcomes research; critical illness

For the past decade, decreasing unplanned rehospitalizations has been a focus of the U.S. national health care agenda (1–4). These events are viewed as potential lapses in the quality of care and are costly, with an annual estimated cost of

$\$17$ billion for Medicare (3). Although rehospitalizations for critically ill patients are not specifically tracked by the Centers for Medicare and Medicaid Services, such rehospitalizations are common; approximately 16% of survivors of

critical illness are rehospitalized within 30 days of hospital discharge (5), and rates as high as 27% have been reported for survivors of severe sepsis (6–8). Rehospitalization itself is potentially a result of lower-quality care (9, 10),

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At a Glance Commentary

Scientific Knowledge on the

Subject: Rehospitalization at a hospital that is different from that of an index stay has been associated with worse outcomes for surgical patients, but it has not been well studied in a medically complex, nonsurgical population.

What This Study Adds to the

Field: Rehospitalization at a hospital different than that of the index intensive care unit stay is associated with increased mortality during rehospitalization for survivors of critical illness who have received mechanical ventilation. Differential effects were seen for costs and length of stay, depending on whether patients died during rehospitalization. These data suggest that continuity of care may influence outcomes for critically ill patients.

but a lack of continuity of care due to rehospitalization at a different hospital may further impair the quality of care that is delivered and adversely affect patient outcomes.

Discontinuity of care has been shown to be common in both complex surgical and nonsurgical patients (11–13). Continuity of care (defined in various ways) is associated with improvements in survival as well as with decreased rates of rehospitalization, acute care use, and costs (12–20). Critically ill patients, particularly those receiving mechanical ventilation, are a group of medically complex patients at high risk for rehospitalization and thus represent an important population in which to determine whether a lack of continuity of care adversely affects outcomes of rehospitalization. Furthermore, in patients requiring prolonged mechanical ventilation, transitions of care after discharge are frequent, rendering multiple opportunities for lapses in continuity of care (21). Consequently, we undertook this study to determine whether mortality during rehospitalizations differed for patients rehospitalized at a different hospital as opposed to the index hospital where the original intensive care unit (ICU) stay occurred. We also examined

differences in length of stay during the rehospitalizations and costs associated with the care. Some of the results of this study have been published previously in the form of an abstract (22).

Methods

Patients and Data Collection

The study protocol was reviewed and approved by the institutional review board of Columbia University Medical Center (IRB-AAAJ2158, New York, NY). The need for written informed consent was waived. We used data retrieved from the New York Statewide Planning and Research Cooperative System (SPARCS) for the years 2008–2013, a comprehensive data-reporting system of patient-level data including patient characteristics, diagnoses and treatments, services, and charges for every hospital discharge in New York State. Details about this database and the creation of this cohort have been published previously (5). Briefly, the cohort consisted of all patients who were discharged alive after an index acute care hospitalization with admission to an ICU with mechanical ventilation (defined by ICU bed use billing codes) who subsequently had an unplanned rehospitalization within 30 days of hospital discharge (defined as an admission where the patient's condition does not allow time for the admission to be scheduled at least 24 h prior). For patients who were transferred to another acute hospital within the SPARCS database (defined as having visits <1 d apart), we combined these events into a single acute hospitalization and designated the hospital of discharge as the initial hospital for the purposes of analysis. We chose to limit the cohort to patients receiving mechanical ventilation because they represent a very sick subset of critically ill patients, and this restriction creates greater homogeneity of severity of illness. Use of mechanical ventilation was determined using International Classification of Diseases, Ninth Revision, procedure codes (96.70, 96.71, 96.72). Both medical and surgical patients, including cardiac surgery patients, were included in the cohort. Because we did not have data regarding deaths and rehospitalizations occurring outside New York State, patients whose primary residence was outside the state were excluded to minimize any bias due to this loss of information (23).

Patient-level covariates that were available within SPARCS included age, sex, race, insurance, patient type (nonsurgical vs. surgical), number of Elixhauser comorbidities (24), tracheostomy during the index hospitalization, use of mechanical ventilation on rehospitalization, use of dialysis and risk of mortality for both the index and second hospitalizations, length of stay of the index hospitalization, and discharge destination. Hospital-level variables were obtained from the American Hospital Association Annual Survey from 2008 to 2013 and merged with the SPARCS data; variables were matched to each hospital for each year. Selected variables included whether hospitals were in an urban location, teaching status, and hospital bed size. To account for the possibility of a volume–outcome relationship for mechanically ventilated patients (25), we used 2011 data from SPARCS to calculate the volume of mechanically ventilated patients for each hospital. (For further details on covariates, see the online supplement.)

Outcomes

The primary outcome was mortality during rehospitalization. Secondary outcomes included length of stay and costs during rehospitalization. SPARCS reports total charges (sum of accommodation and ancillary charges), accommodation charges, and ancillary charges (encompassing all charges not related to accommodations) for each hospitalization, and it contains billing codes for specific services. We converted charges to costs using cost-to-charge ratios derived from the Hospital Inpatient Cost Transparency file (available at <https://health.data.ny.gov>). In addition to accommodation, ancillary, and total costs, we also examined differences in costs related to laboratory, diagnostic radiology, and diagnostic cardiology testing because we hypothesized that differences in costs may be driven by the need to order more tests and assessments for patients not previously cared for in a given hospital. Costs were adjusted for inflation using an inflation factor based on the Consumer Price Index and are reported in 2013 U.S. dollars. Full details of methodologies regarding cost outcomes are available in the online supplement.

Statistical Analysis

We summarized demographic and clinical characteristics, including admission diagnoses, for patients who were rehospitalized at a different versus an index

hospital. Admission diagnoses were coded using Clinical Classification Software (Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality; www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp) diagnostic categories, which are based on the primary diagnosis–related grouping for the admission (26). Patients were classified as having the same admission diagnosis if their Clinical Classification Software diagnostic category was the same on rehospitalization.

We assessed the association between location of rehospitalization (different vs. index hospital) and hospital mortality using hierarchical relative risk regression, adjusting for hospital of rehospitalization as a random effect. Given that mortality during rehospitalization is relatively common, the odds ratio may overstate the magnitude of the effect (27); consequently, we used a hierarchical Poisson regression to obtain the relative risk (28, 29). Patient-level covariates and hospital-level covariates enumerated above were forced into the model for adjustment. Hospital-level covariates were included for both the index and second hospitals; patient-level covariates were centered around cluster means to facilitate interpretability of their effects (30). We also examined whether there was a significant interaction between patient type (surgical vs. nonsurgical) and location of rehospitalization, given the reported association with higher long-term mortality specifically for surgical patients rehospitalized at a different hospital (12, 13). Multicollinearity between covariates was assessed using variance inflation factor and tolerance values (31).

For secondary outcomes, we examined whether there were differences between patients rehospitalized at different versus index hospitals, and we examined whether length of stay and costs differed for patients who did or did not survive rehospitalization by including an interaction term between survival status and rehospitalization at a different hospital. (For details, see the online supplement.)

Sensitivity Analyses

To confirm the robustness of our primary outcome (mortality during rehospitalization), we performed a number of sensitivity analyses to test whether our results may reflect other differences between patients rehospitalized at a different versus the index hospital that were unaccounted for

in our primary analysis. First, we excluded patients who were rehospitalized for an admission diagnosis that may influence the choice of hospital (i.e., acute myocardial infarction, trauma, cerebrovascular accident, any type of cancer or organ transplant). Second, we repeated the analysis using a propensity-matched model, matching patients rehospitalized at a different hospital to those rehospitalized at the index hospital on the basis of having a similar likelihood of being rehospitalized at a different hospital. Third, we accounted for differences in distances traveled by repeating the analysis in a subset of patients rehospitalized at a hospital that is equidistant from their home in comparison to the index hospital (defined as having a difference of <5 min in driving time to the index hospital and driving time to the second hospital). Last, we accounted for hospital-level differences in care among index hospitals by including index hospital as a fixed effect in the model. (For further details, see the online data supplement.) Database management and statistical analysis were performed using SAS 9.4 (SAS Institute, Cary, NC) and Stata 13.1 (StataCorp LP, College Station, TX) software.

Results

Characteristics of Rehospitalized Patients

Within New York State from 2008 to 2013, 26,947 patients admitted to an ICU with mechanical ventilation survived to hospital discharge and were rehospitalized within 30 days (see Figure E1 in the online supplement). Of these patients, 8,443 (31.3%) went to a different hospital than that of the index ICU admission. Overall, primary (index) hospitalization characteristics were similar between patients rehospitalized at a different as opposed to the index hospital. However, patients rehospitalized at a different hospital had longer index hospital lengths of stay, were more likely to be surgical patients, to have received a tracheostomy during the index hospitalization, and to receive mechanical ventilation without a tracheostomy on rehospitalization; they were also more likely to go to smaller hospitals and less likely to receive care at a teaching hospital on rehospitalization (Table 1). The most common reasons for rehospitalization were similar between

patients rehospitalized at a different versus the index hospital, with sepsis being the most common diagnosis. However, patients with “complications of care” were more likely to return to the index hospital (see Table E1).

Mortality during Rehospitalization

There was a significant difference in hospital mortality for mechanically ventilated patients rehospitalized at a different versus the index hospital (13.7% vs. 11.1%; adjusted relative risk, 1.11; 95% confidence interval [CI], 1.03–1.20; $P = 0.009$) (Table 2; for full model, see Table E2). An interaction between patient type (surgical vs. nonsurgical) and rehospitalization at a different hospital was not significant ($P = 0.60$).

Length of Stay during Rehospitalization

Median length of stay for patients rehospitalized at a different versus the index hospital was not different (median, 7 d; interquartile range [IQR], 4–13; vs. 7 d; IQR, 4–14; adjusted rate ratio [aRR], 1.02; 95% CI, 0.98–1.07; $P = 0.31$). An interaction term between survival status and rehospitalization at a different hospital was significant ($P = 0.001$), indicating a differential effect of being rehospitalized at a different hospital for patients who died and those who survived rehospitalization. Length of stay was decreased for patients who died during rehospitalization (median length of stay, 8 d; IQR, 3–19; vs. 10 d; IQR, 3–21; aRR, 0.80; 95% CI, 0.70–0.92; $P = 0.001$) and increased for survivors at different hospitals (median length of stay, 7 d; IQR, 4–14; vs. 7 d; IQR, 4–12; aRR, 1.06; 95% CI, 1.01–1.11; $P = 0.009$), although the difference for survivors was not clinically meaningful (Table 2).

Costs during Rehospitalization

There was no difference in total costs for patients rehospitalized at a different versus index hospital, although costs for diagnostic radiology and cardiology testing were increased (Figure 1). Again, an interaction between survival and rehospitalization status was significant for most variables ($P < 0.001$ for total cost, accommodation and ancillary costs; $P < 0.05$ for diagnostic laboratory and radiology; $P = 0.08$ for cardiology costs). For patients who survived rehospitalization, costs were uniformly increased (adjusted mean difference in total cost, \$1,665.34; 95% CI, \$602.12–\$2,728.56;

Table 1. Characteristics of Mechanically Ventilated Intensive Care Unit Patients Rehospitalized within 30 Days of Hospital Discharge at a Different versus Index Hospital

	Index Hospital (<i>n</i> = 18,504)	Different Hospital (<i>n</i> = 8,443)
Age, yr, mean (SD)	67.1 (16.4)	66.5 (16.3)
Female sex, %	49.0	45.7
Race, %		
White	56.3	56.8
Black	19.1	17.9
Other	24.6	25.4
Rural residence, %	6.0	7.1
Insurance, %		
Medicare	57.7	56.5
Medicaid	10.7	10.8
Private	27.2	28.8
Self-pay	3.5	3.0
Other	1.0	1.0
Surgical, %	52.3	56.7
Number of Elixhauser comorbidities, %		
None	5.3	5.4
One to three	48.6	50.4
Four or more	46.1	44.2
Risk of mortality on index hospitalization*, %		
Minor	1.7	1.7
Moderate	5.9	5.8
Major	28.0	27.3
Extreme	64.4	65.2
Mechanical ventilation during index hospitalization, %		
Without tracheostomy	82.5	72.7
With tracheostomy	17.5	27.3
Dialysis during index hospitalization, %		
None	90.8	90.7
Dialysis (no ESRD on admission)	4.0	4.3
Dialysis (ESRD on admission)	5.2	5.1
Median length of index hospital stay (IQR)	18 (11–32)	23 (12–41)
Discharge destination after index stay, %		
Home	20.6	18.3
Home with health services	22.4	17.5
Skilled nursing facility	50.2	52.3
Inpatient rehabilitation facility	2.2	2.9
Hospice	0.3	0.4
Other	4.3	8.5
Rehospitalized for the same diagnosis, %	15.5	12.9
Rehospitalization requiring ICU care, %	27.8	29.5
Risk of mortality on rehospitalization*, %		
Minor	16.0	15.8
Moderate	27.1	24.4
Major	31.6	30.8
Extreme	25.4	29.0
Mechanical ventilation during rehospitalization, %		
None	78.6	72.3
Without tracheostomy	19.6	25.9
With tracheostomy	1.8	1.8
Dialysis during rehospitalization, %		
None	93.0	92.9
Dialysis (no ESRD on admission)	1.2	1.2
Dialysis (ESRD on admission)	5.8	5.9
Index hospital characteristics		
Rural location, %	3.0	2.3
Teaching hospital	76.4	79.7
Index hospital bed size		
<100	1.0	0.9
100–399	36.5	37.3
≥400	61.1	60.1

(Continued)

$P = 0.002$), whereas costs were largely decreased for patients who died during hospitalization, with the exception of those related to diagnostic radiology and cardiology testing (adjusted mean difference in total cost, $-\$9,632.73$; 95% CI, $-\$16,387.60$ to $-\$2,877.88$; $P = 0.005$) (Figure 1).

Sensitivity Analyses

To examine the robustness of our primary outcome, we performed four separate sensitivity analyses. When we adjusted for differences in distance to the index hospital versus the second hospital, differences in care at the index hospital, or excluded patients whose admission diagnoses on rehospitalization may have influenced the choice of hospital, our results were similar to those of our primary analysis (Table 3). For the propensity-matched sample ($n = 15,075$), the results were also similar (Table 3).

Discussion

Rehospitalization within 30 days of hospital discharge is a common occurrence for patients who survive a hospitalization with mechanical ventilation, and approximately one-third are rehospitalized at a hospital different from that of the index ICU stay. In this medically complex patient population with high severity of illness, we found evidence of increased mortality associated with rehospitalization at a different hospital, which was robust to multiple sensitivity analyses. Although use outcomes did not differ overall, we found differential effects for length of stay and costs for patients who did or did not survive rehospitalization.

Our study highlights differential outcomes for patients rehospitalized at a different hospital, but it also raises further questions about why patients experience care fragmentation and why care fragmentation may result in the observed findings. Moreover, care fragmentation is only one potential explanation for our results; alternatively, these differences may represent systemic differences between patients or health care systems. Although we adjusted for multiple patient- and hospital-level characteristics (including severity of illness) and performed several sensitivity analyses, it is still possible that there are unmeasured differences, with some patients being more likely to undergo particular

Table 1. (Continued)

	Index Hospital (n = 18,504)	Different Hospital (n = 8,443)
Second hospital characteristics, %		
Rural location	—	4.7
Teaching hospital	—	68.3
Second hospital bed size		
<100	—	2.7
100–399	—	42.2
≥400	—	53.0
Bed size of second hospital in comparison to index hospital		
Same	—	48.3
Smaller	—	27.7
Larger	—	20.2

Definition of abbreviations: ESRD = end-stage renal disease; ICU = intensive care unit; IQR = interquartile range.

*Determined using 3M All-Patient Refined Diagnosis-Related Group classifications (3M Health Information Systems, Salt Lake City, UT), which is based on age, comorbidities, procedures, and principal diagnosis.

patterns of health care. Thus, further elucidation of the mechanisms underlying these differential outcomes are vital to understanding the implications of our findings.

Similar estimates of rehospitalization at a different hospital have been published for patients undergoing major surgical procedures (12, 13), and our findings suggest that such care fragmentation is not unique to the surgical population. Our findings are in keeping with these studies in which researchers found increased 30- and 90-day mortality for surgical patients hospitalized at different hospitals (12, 13). We did not find

an interaction between surgical status and outcomes during rehospitalization at a different hospital, suggesting that our findings are not driven by excess mortality solely within the surgical population.

Prior studies have shown benefits related to continuity of care with improvements in survival and decreases in rehospitalization and health care resource use (12–20). These studies have primarily demonstrated the benefits of continuity of care throughout outpatient medical visits (18, 19), after hospitalization (defined as being seen by a familiar physician after

hospital discharge or providing outpatient physicians with information about the hospitalization) (14–17), and having continuity between surgical and primary care providers (20). Our study extends these findings, focusing on a very high-risk population with high mortality during rehospitalization. The mechanism underlying this potential increase in mortality is unclear, but it may be that incomplete knowledge of the patients results in delays in diagnosis and delivery of appropriate therapy. Consistent with this possibility, we found that patients rehospitalized at their index hospital were more likely to carry an admission diagnosis of “complications of surgical procedures or medical care,” which may relate to the index hospital’s ability to link the patient’s condition on rehospitalization to their prior care. Also, providers may bear a sense of responsibility or investment toward patients for whom they have previously cared and may behave differently when caring for them on rehospitalization.

A common concern associated with fragmented care is that costs will be increased secondary to the repetition of unnecessary testing. Consistent with this hypothesis, we found an increase in costs related to diagnostic laboratory, radiology, and cardiology testing for survivors of rehospitalization. However, data from the outpatient setting are mixed, with continuity of care being

Table 2. Outcomes of Rehospitalizations for Mechanically Ventilated Intensive Care Unit Patients Rehospitalized at a Different versus Index Hospital

	Unadjusted Outcomes		Adjusted Effect for Patients Rehospitalized at a Different Hospital* (95% CI)	P Value
	Index Hospital	Different Hospital		
Mortality during rehospitalization [†] , %	11.1	13.7	1.11 (1.03–1.20)	0.009
Hospital length of stay during rehospitalization [‡] , median (IQR)				
All patients	7 (4–13)	7 (4–14)	1.02 (0.98–1.07)	0.31
Survived to hospital discharge	7 (4–12)	7 (4–14)	1.06 (1.01–1.11)	0.009
Died during rehospitalization	10 (3–21)	8 (3–19)	0.80 (0.70–0.92)	0.001

Definition of abbreviations: CI = confidence interval; IQR = interquartile range.

*Patients rehospitalized at the index hospital is the reference group. This column reports the relative risk for mortality and incidence rate ratio for length of stay. All models are adjusted for age; sex; race; type of patient (surgical vs. nonsurgical); number of Elixhauser comorbidities; type of insurance; rural residence; use of tracheostomy during index hospitalization and mechanical ventilation on rehospitalization; use of dialysis during the index hospitalization and rehospitalization; length of index hospitalization; discharge destination after index hospitalization; risk of mortality on index hospitalization and rehospitalization; and hospital characteristics of index and second hospitals, including rural location, teaching hospital, hospital bed size, and percentage of admissions receiving mechanical ventilation.

[†]Results of hierarchical relative risk regression, adjusting for second hospital as a random effect.

[‡]Results of zero-truncated negative binomial regression using cluster-robust SEs to adjust for clustering by hospital of rehospitalization.

A

B

Figure 1. Estimated difference in costs for intensive care unit patients who received mechanical ventilation rehospitalized at a different versus index hospital, stratified by hospital mortality. (A) Total accommodation and ancillary costs. (B) Breakdown of ancillary costs. Estimated differences in total, accommodation, and ancillary costs (A) were generated using hierarchical linear regression models, adjusting for second hospital as a random effect. Estimates for diagnostic testing costs (B) were generated using two-part models with cluster-robust SEs to adjust for clustering by second hospital. All models are adjusted for age; sex; race; type of patient (surgical vs. nonsurgical); number of Elixhauser comorbidities; type of insurance; rural residence; use of tracheostomy and dialysis during the index hospitalization; use of mechanical ventilation and dialysis during rehospitalization; length of index hospitalization; discharge destination after index hospitalization; risk of mortality on index hospitalization and rehospitalization; and hospital characteristics of index and second hospitals, including rural location, teaching hospital and hospital bed size, and percentage of admissions receiving mechanical ventilation. Costs are reported in 2013 U.S. dollars.

associated with both over- and underuse of diagnostic procedures, depending on the specific test (32). Consequently, preventing care fragmentation may not necessarily result in decreased testing costs. We found that length of stay and costs were significantly decreased for patients who died during rehospitalization. This decrease in health care use for patients who died in different hospitals may be due to a higher severity of illness leading to faster

Table 3. Sensitivity Analyses Examining Mortality during Rehospitalization for Mechanically Ventilated Intensive Care Unit Patients Rehospitalized at a Different versus Index Hospital

Model	Point Estimate (95% CI)	P Value
Primary analysis	1.11 (1.03–1.20)	0.009
Excluding particular admission diagnoses*	1.11 (1.03–1.21)	0.01
Propensity-matched model [†]	1.12 (1.02–1.23)	0.02
Including only patients with similar travel times [‡]	1.14 (1.03–1.27)	0.02
Accounting for differences in quality of care at the index hospital [§]	1.14 (1.04–1.24)	0.004

Definition of abbreviation: CI = confidence interval.

*Results of hierarchical relative risk regression, excluding patients with an admission diagnosis on rehospitalization of acute myocardial infarction, trauma, cerebrovascular accident, and any type of cancer or organ transplant (n = 1,231). This model was adjusted for all covariates included in the primary analysis.

[†]Results of hierarchical relative risk regression in a propensity-matched sample (n = 12,852). This model was adjusted for second hospital as a random effect, as well as for hospital characteristics of the second hospital, including rural location, teaching hospital, hospital bed size, and percentage of admissions receiving mechanical ventilation.

[‡]Results of hierarchical relative risk regression in the subset of patients rehospitalized at a hospital equidistant from their home in comparison to the index hospital, defined as having a difference of less than 5 minutes of driving time to the index hospital and driving time to the second hospital (n = 21,600). This model was adjusted for all covariates included in the primary analysis.

[§]Results of hierarchical relative risk regression, adjusted for index hospital as a fixed effect. This model was adjusted for all patient-level covariates included in the primary analysis, as well as for hospital characteristics of the second hospital, including rural location, teaching hospital, hospital bed size, and percentage of admissions receiving mechanical ventilation.

deaths for those rehospitalized at different hospitals, although gross indicators of severity of illness (risk of mortality and comorbidities) were not significantly different between patients rehospitalized at a different as opposed to the index hospital. These findings may also reflect residual confounding due to unmeasured patient factors, as well as unmeasured hospital factors, because intensity of care has been shown to vary substantially between hospitals (33, 34). Alternatively, it may be that providers feel less “invested” in a patient admitted at a different hospital and may therefore be more able to move patients toward palliative care options at an earlier stage, or it may be that these hospitals have a greater focus on palliative care than the patient’s index hospital. Last, frequent hospital admission has been advocated as a trigger for a palliative care assessment (35), and rehospitalization itself may serve as an indicator of a patient’s ongoing severity of illness, prompting providers to consider other goals of care.

Our study has several limitations. Although the use of a state-level database allowed us to examine this question in a comprehensive population, there is substantial state-level variability in the

percentage of patients rehospitalized at a different hospital (13), and New York State may not be representative of all states in the United States; thus, there may be other settings in which this particular type of care fragmentation is not associated with higher mortality for critically ill patients. In particular, because New York does not have as many long-term acute care hospitals as some other states, the rates of rehospitalization for patients who have a tracheostomy may differ in other parts of the country. Furthermore, in analyses adjusting for distance traveled, our results may not be comparable to those using national data, as New York is a largely urban state. Also, because we did not have identifying information about facilities to which patients were discharged, similar to previous studies, driving times for patients discharged to facilities were calculated using the patient’s home ZIP code (as opposed to the facility’s ZIP code) as a reference point (12).

In addition to limitations related to a potential lack of generalizability resulting from using a state-level database, the need to use administrative data limits our ability to provide more granular insight into why rehospitalizations at a different hospital are occurring with such frequency and why care patterns and outcomes during

the rehospitalizations may differ. Understanding this phenomenon will likely require existing data to be enhanced by novel data sources. This may include mining of the electronic health record (via methods such as natural language processing) to include other factors that are predictive for rehospitalization at a different hospital, as well as qualitative work to understand patient decision making. Last, although it may be necessary to use administrative data to study fragmentation of care, our findings are subject to the pitfalls associated with observational data, including the possibility of misclassification, residual confounding, and the inability to further delineate underlying mechanisms. Consequently, our findings should not be viewed as confirmation of a causal relationship between rehospitalization at a different hospital and our observed outcomes.

In conclusion, rehospitalization at a different hospital than that of the index ICU stay occurred for one in three survivors of critical illness who received mechanical ventilation and was associated with increased hospital mortality. The frequency of such care fragmentation and its associated harm have implications for hospital-level quality improvement initiatives. First, a substantial portion of all patients may be rehospitalized at a different facility than their index hospitalization and may be more difficult to track. Second, reasons underlying care discontinuity and distinct patterns in length of stay and costs for patients who die in different hospitals warrant further investigation. Last, the implementation of initiatives to improve continuity of care may be premature because mechanisms underlying the association between rehospitalization at a different hospital and the observed outcomes are unclear. ■

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