Incidence and Etiology of Potentially Preventable ICU Readmissions*

Mohammed J. Al-Jaghbeer, MD[1]; Seema S. Tekwani, MD[2]; Scott R. Gunn, MD[3]; Jeremy M. Kahn, MD, MS[3,4]

Objectives: The rate of unplanned ICU readmissions is often considered a measure of hospital performance. However, the degree to which these readmissions are preventable and the causes of preventable readmissions are unknown, creating uncertainty about the feasibility and value of reducing ICU readmission rates. To inform this issue, we sought to determine the frequency and underlying causes of potentially preventable ICU readmissions.

Design: Retrospective cohort study.

Setting: Urban, academic medical center in the mid-Atlantic United States.

Patients: Adult patients discharged alive from their first ICU admission with an unplanned readmission within 48 hours of discharge.

Measurements and Main Results: Each patient's medical chart was reviewed by two independent investigators who rated each readmission's preventability according to standardized scale and assessed the etiology of both preventable and nonpreventable readmissions. We assessed concordance between raters using the κ statistic and resolved disagreements through iterative discussion. Of 136 readmissions in the final analysis, 16 (11.8%; 95% CI, 6.9–18.4) were considered preventable and 120 (88.2%; 95% CI, 81.5–93.1) were considered nonpreventable. Of nonpreventable readmissions, 67 were due to a new clinical problem and 53 were due to an existing clinical problem. Among preventable readmissions, six were attributable to system errors, six were attributable to management errors, two were attributable to procedural events, one was attributable to a diagnostic error, and one was attributable to a medication error. Compared to nonpreventable readmissions, preventable readmissions tended to have shorter index ICU lengths of stay (2 vs 3 d; $p = 0.05$) and a shorter duration of time on the ward prior to readmission (16.6 vs 23.6 hr; $p = 0.05$).

Conclusions: The majority of early ICU readmissions are nonpreventable, raising important concerns about ICU readmission rates as a measure of hospital performance. (*Crit Care Med* 2016; 44:1704–1709)

Key Words: critical care; intensive care; medical errors; patient readmission; patient safety

Many patients discharged alive from the ICU will ultimately be readmitted to intensive care during the same hospitalization (1). These readmissions can occur in up to 14% of all ICU discharges and are associated with an increased risk of mortality and morbidity, as well as increases in overall length of stay and costs (2–4). As a consequence, many experts advocate that ICU readmission rates be used as a hospital performance measure, and that hospitals take active steps to reduce ICU readmissions in an attempt to improve outcomes and lower costs (5–8).

Despite these calls, there are several conceptual concerns with ICU readmission rates as a measure of hospital performance (9). First, the proportion of ICU readmissions that are preventable is unknown. If ICU readmissions occur because of unpredictable clinical deterioration rather than addressable quality gaps, then there is little that hospitals can do to prevent them and thus it is unfair to hold hospitals accountable. Second, to the degree that ICU readmissions are preventable, few data exist describing what types of quality gaps lead to the readmissions. Hypothetically, preventable ICU admissions may be due to many different factors, including premature ICU discharge or poor quality care on the patient ward. Without an understanding of what quality gaps lead to ICU readmissions, hospitals lack targets in their efforts to reduce readmission rates.

To address these knowledge gaps, we sought to better describe the epidemiology of ICU readmissions by determining the proportion that are potentially preventable, characterizing

*See also p. 1790.

[1]Division of Pulmonary, Critical Care, and Sleep Medicine, Department of Internal Medicine, University of South Carolina School of Medicine, Columbia, SC.

[2]Division of Pulmonary, Allergy, Critical Care and Sleep Medicine, Department of Medicine, Emory University, Atlanta, GA.

[3]Department of Critical Care Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA.

[4]Department of Health Policy and Management, University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA.

This work was performed at the University of Pittsburgh.

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For information regarding this article, E-mail: kahnjm@upmc.edu

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the adverse events leading to potentially preventable ICU readmission, and identifying the differences between potentially preventable and nonpreventable readmissions in a large academic medical center.

METHODS

Study Design and Patients

We performed a retrospective cohort study of unplanned ICU readmissions in University of Pittsburgh Medical Center (UPMC) Presbyterian Hospital between July 2012 and June 2013. UPMC Presbyterian is a large, urban, academic medical center with 85 ICU beds in eight ICUs located in Pittsburgh, PA. All eight ICUs are administered by experienced physicians, ICU directors, and staffed by trained intensivists as well as critical care fellows, residents, and advanced practice providers. Senior-level intensivist physicians are available around the clock to not only make discharge decisions but also serve as leaders of the hospital-wide rapid response team. At the time of the study, there were no step-down units or formal efforts to reduce ICU readmission rates. During the study period, mean ICU occupancy was 89% and mean ICU length of stay was 6 days.

We included patients who were discharged alive from the first ICU admission and were readmitted to the same or different ICU within 48 hours of their ICU discharge (10). ICU readmissions were identified from an automated report generated by the hospital's electronic health record (Cerner PowerChart, [Cerner, Kansas City, MO]). We excluded patients under 18 years old on the day of the index admission and patients with a planned ICU readmission, as determined through chart review.

Based on prior work of hospital readmissions (11, 12), we estimated that a sample of 136 patients would be necessary to estimate a 16% incidence of preventable readmissions with a 5% margin of error. To meet this sample size, from the pool of all ICU readmissions during the study period, we abstracted the data from the medical charts of random readmissions until we reached 136 eligible patients.

Data Collection and Variables

We collected data using two methods: electronic chart abstraction and manual chart review. We used electronic chart abstraction to obtain patient characteristics, including demographics, ICU admission source, the timing of the index ICU discharge, the timing of the ICU readmission, and the patient's ultimate outcome. We collected these data for all ICU admissions whether or not they were readmitted. We used manual chart review to obtain admission and readmission characteristics, including the reason for admission and readmission, and the potential preventability of the readmission. We collected these data only on readmitted patients.

Each chart was independently reviewed by two separate critical care physicians using a standardized chart abstraction tool designed to assess causality and preventability (a copy of which is provided in the **Supplemental Digital Content**, http://links.lww.com/CCM/B828). Causality was defined as the degree to which the readmission was caused by the actions or inactions of the medical team. Preventability was defined as the degree to which the readmission could have been reasonably prevented by appropriate action of the medical team (i.e., given available foresight, could the medical team have taken or avoided actions such that the readmission would not have occurred). The two physicians independently rated the causality and preventability of the readmission according to a six-point ordinal scale derived from prior work (**Table 1**) (12).

As in prior work, we defined readmissions rated in the bottom half of the scale (1–3) as noncausal and nonpreventable, and readmissions rated in the top half of the scale (4–6) as causal and preventable. For readmissions deemed nonpreventable (i.e., rated 1–3), raters indicated whether the readmission was due to an existing problem or a new problem. For readmissions deemed preventable (i.e., rated 4–6), raters indicated the primary cause of the readmission as either a medication-related event, a procedure-related event, a nosocomial infection, a diagnostic error, a management error, or a system error. In addition, the raters created a brief narrative review of the case.

The two raters were provided with standardized definitions and examples of all the assessment categories (Supplemental Digital Content, http://links.lww.com/CCM/B828). The raters were then trained by reviewing 10 charts that were not included in the final analysis. These charts were discussed with the other investigators with feedback given based on the pilot results.

Analysis

We used the weighted κ coefficient to address inter-rater agreement between reviewers (13). κ ranges from 0 to 1, with a higher score associated with greater concordance between raters. A κ of 0–0.19 is considered slight agreement, 0.20–0.39

TABLE 1. Classification Schema for Causality and Preventability

Rating	Causation	Preventability
1	No evidence for management causation	No evidence for preventability
2	Slight evidence for management causation	Slight evidence for preventability
3	Management causation < 50–50 but close call	Preventability < 50–50 but close call
4	Management causation > 50–50 but close call	Preventability > 50–50 but close call
5	Strong evidence for management causation	Strong evidence for preventability
6	Virtually certain evidence for management causation	Virtually certain evidence for preventability

is fair agreement, 0.4–0.59 is moderate agreement, 0.6–0.79 is substantial agreement, and 0.8–1.0 is extremely high agreement. After assessing concordance, disagreements between raters were resolved through iterative consensus discussion.

We summarized the incidence of preventable readmissions and the causes of readmissions using frequencies and percents. We compared clinical characteristics between preventable and nonpreventable readmissions using Fisher exact test (for categorical variables) or the Wilcoxon signed rank test (for continuous variables). We focused on four characteristics that were hypothesized to differ between preventable and nonpreventable readmission: use of mechanical ventilation during the index admission, index ICU length of stay, nighttime discharge (defined as 6 PM to 6 AM), and the length of time on the ward prior to the readmission. For the last characteristic, in addition to summary comparisons, we graphically examined differences between groups using a Kaplan-Meier curve.

All analyses were performed using Stata 12.1 (StataCorp, College Station, TX). This work was considered exempt from Human Subjects Review by the UPMC Quality Improvement Review Committee and the University of Pittsburgh Institutional Review Board.

RESULTS

In total, there were 11,483 ICU admissions during the study period (**Fig. 1**). Of these admissions, 9,534 (83.0%) were discharged alive to a hospital ward. Of these, 388 (4.1%) were readmitted to an ICU. We excluded 31 readmissions that were not the first for each patient, leaving 357 unique patients. In order to enroll 136 patients, we reviewed a total of 156 charts in random order. Among reviewed charts, we excluded three patients who were not actually readmitted, six patients who were readmitted outside the 48-hour window, and 11 patients for whom the readmission was planned. After these 20 exclusions, 136 unique patients were included in the final analysis.

Patient characteristics are shown in **Table 2**. The mean age was 62 ± 17 years, with a roughly equal distribution of male and female patients. Readmissions were most frequently from the Solid Organ Transplant ICU (22.8%), Trauma ICU (17.7%), or Medical ICU (15.4%). A significant proportion of the cohort (34.6%) required mechanical ventilation at admission. Nighttime discharge occurred in 37% of the cohort, and the median time to readmission was 22.6 hours. In-hospital mortality for the cohort was 11.8%. The admission and readmission diagnoses varied substantially, with most readmissions due to cardiovascular (34%) or pulmonary (32%) diagnoses (**Table 3**).

Weighted κ was 0.26 for causation and 0.23 for preventability, indicating fair agreement among reviewers. All disagreements were easily resolved through iterative discussion. After resolution of disagreements, 27 readmissions (19.9%) were deemed causal and 109 readmissions (80.1%) were deemed noncausal; 16 readmissions (11.8%) were deemed preventable and 120 readmissions (88.2%) were deemed nonpreventable.

Among nonpreventable readmissions, 67 (56%) were readmitted due to a new problem and 53 (44%) were readmitted due to clinical deterioration of an existing problem. Among preventable readmissions, causes included system errors (six), management errors (six), procedure event (two), diagnostic error (one), and medication error (one). Narrative descriptions of the 16 preventable readmissions as well as selected nonpreventable readmissions (three of each) are available in the Supplemental Digital Content (http://links.lww.com/CCM/B828).

Compared to nonpreventable readmissions, preventable readmissions tended to have shorter ICU lengths of stay (2 vs 3 d; $p = 0.05$) and a shorter duration of time on the ward prior to readmission (16.6 vs 23.6 hr; $p = 0.05$) (**Table 4**) and (**Fig. 2**).

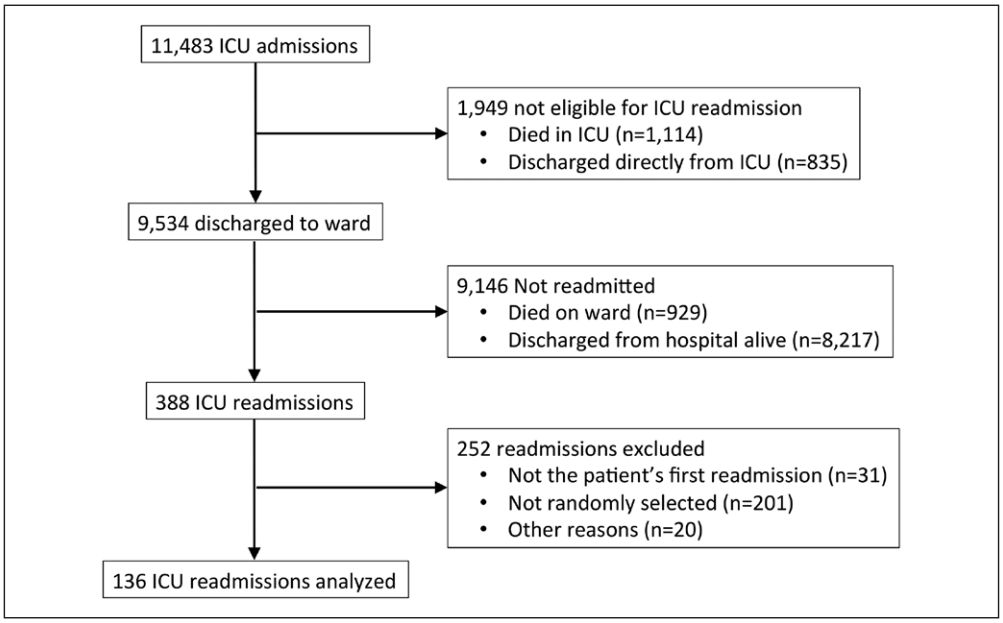

Figure 1. Patient flow, including outcomes for patients discharged from the ICU but not readmitted.

DISCUSSION

In a retrospective analysis of unscheduled ICU admissions at an academic medical center, subjective ratings suggested that the majority of ICU admissions were not potentially preventable according to the study definition. This finding highlights the tensions surrounding efforts to reduce ICU readmission rates, as well the limitations of broader efforts to benchmark hospital quality by measuring ICU readmission rates.

Our findings extend the results of previous studies focusing on readmissions to individual cardiac and surgical ICUs

TABLE 2. Demographic and Clinical Characteristics of Patients Included in the Final Chart Review

Variable	Value (*n* = 136)
Age, yr, mean ± SD	62 ± 17
Female sex, *n* (%)	69 (50.1)
Race, *n* (%)	
White	109 (80.1)
Black	8 (5.9)
Other	2 (1.5)
Unknown	17 (12.5)
ICU type, *n* (%)	
Coronary care	6 (4.4)
Cardiothoracic surgery	16 (11.8)
Medical	21 (15.4)
Neurovascular	12 (8.8)
Neurotrauma	15 (11)
Surgical	11 (8.1)
Trauma	24 (17.7)
Transplant	31 (22.8)
Admission source for index admission, *n* (%)	
Emergency department	55 (40.4)
Ward	37 (27.2)
Clinic	22 (16.2)
Operating room/procedure unit	22 (16.2)
Mechanical ventilation at admission, *n* (%)	47 (34.6)
ICU length of stay, d, median (IQR)	3 (2–7)
Nighttime discharge, *n* (%)	51 (37.5)
Length of time on ward prior to readmission, hr, median (IQR)	22.6 (12.7–35.3)
In-hospital mortality, *n* (%)	16 (11.8)

IQR = interquartile range.

(14, 15). In a 1997 study of cardiac ICU patients, the investigators found that 15 of 44 coronary care unit readmissions (34.1%) might have been prevented with more appropriate pharmacological therapy, although the historical nature of the data limit application to the present day (14). In a 2003 study of surgical ICU patients, the investigators found that 21 of 97 ICU readmissions (21.8%) were potentially preventable based on the quality of their care on the ward (15). We find that in the modern era and in a much broader population of ICU patients, the likely incidence of potentially preventable ICU readmissions remains low.

Our results highlight the challenges inherent in efforts to reduce ICU admission rates. Despite the existence of several

TABLE 3. Admission Diagnoses for Index ICU Admission and ICU Readmission

Diagnosis	Index ICU Admission (*n* = 136) (%)	ICU Readmission (*n* = 136) (%)
Cardiovascular	16 (12)	46 (34)
Pulmonary	13 (10)	44 (32)
Gastrointestinal	14 (10)	9 (7)
Neurological	20 (15)	19 (14)
Endocrine	0 (0)	2 (1)
Hematologic/oncologic	1 (1)	0 (0)
Infectious disease	7 (5)	2 (1)
Surgical	65 (48)	14 (10)

validated scores for assessing readmission risk (16), data indicate that incorporating those scores into discharge decision does not lead to lower readmission rates (17). Similarly, ICU outreach teams, which systematically follow recently discharged patients to provide treatment recommendations and monitor for clinical deterioration, appear to offer only minimal benefits (18). Yet, these programs do carry substantial costs. For ICU outreach teams, the costs include establishing and maintaining the programs themselves. For discharge risk prediction, there are the hidden costs of prolonged ICU length of stay, as may occur when discharge risk scores lead to delays in discharge without other clinical benefit (17).

Our results also suggest that ICU readmission rates may not be a good measure of hospital performance in the care of critically ill patients. Good performance measures must be actionable, in that they can be measurably improved through evidence-based practice (19). We find that ICU readmission rates do not necessarily meet this criteria, at least under current evidentiary standards, adding to the other literature on this topic. In one multicenter study, ICU readmission rates did not correlate with risk-adjusted ICU outcome, suggesting a lack of construct validity (20). In another study, across hospital variation in ICU readmission rates were nearly equally attributable to patients characteristics as hospital characteristics (21). Together, these data suggest that although ICU readmission rates have strong "face validity," at present they may not be valid measures of hospital performance.

At the same time, our findings do not mean that hospitals should ignore ICU readmission in their quality improvement efforts. Indeed, we found many instances in which readmissions were causally related to medical care even if they were not immediately preventable. In this context, ICU readmissions may be valuable "sentinel events" that can help hospitals identify ineffective and potentially harmful care practices, leading to improved overall quality. Furthermore, ICU admission rates vary substantially across hospitals, and hospitals with higher ICU readmission rates may see a higher number of potentially preventable readmissions, making these events better targets for quality improvement at other hospitals.

TABLE 4. Relationship Between Selected Patient Characteristics and Readmission Preventability

Variable	Nonpreventable (*n* = 120)	Preventable (*n* = 16)	*p*
Mechanical ventilation at admission, *n* (%)	42 (35.8)	4 (25)	0.57
ICU length of stay, d, median (IQR)	3 (1–6)	2 (1–3)	0.05
Nighttime discharge, *n* (%)	46 (38.3)	5 (31.2)	0.78
Length of time on ward prior to readmission, hr, median (IQR)	23.6 (12.8–36.2)	16.6 (4.0–23.4)	0.05

IQR = interquartile range.

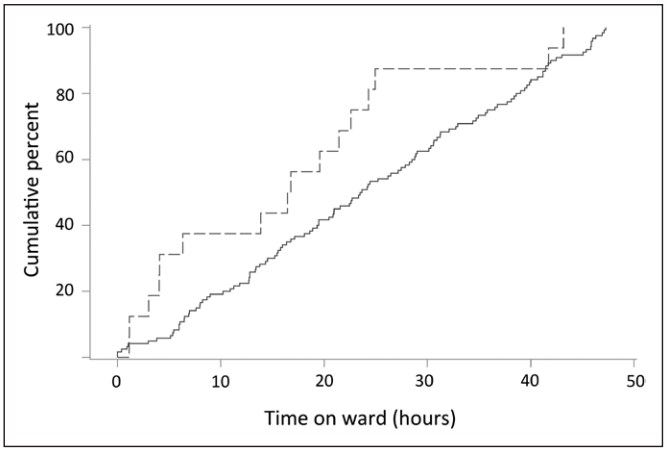

Figure 2. Timing of readmissions deemed preventable (*dotted line*) and nonpreventable (*solid line*).

More broadly, it may be wise to view ICU readmissions as a marker of system-level inefficiencies that are worthy of attention regardless of their preventability. As treatment patterns and clinical standards change, readmissions that are thought nonpreventable under current standards may become preventable. In this context, we should strive to improve our systems of hospital care in ways that minimize overall errors and maximize trajectories of recovery, potentially reducing ICU readmissions indirectly rather than directly.

Our study has several limitations. First, although our study comprises one of the largest and most diverse cohorts to date, it was limited to a single academic medical center, which at the time of the study was staffed with 24-hour intensivist physicians and had an established rapid response program. Although neither of these factors are consistently associated with clinical outcomes (22, 23), they may affect readmission rates, limiting the generalizability of our findings. Second, we performed retrospective data collection, which may not accurately capture events as they happened in real time. Nonetheless, we used a standardized data collection tool, increasing the validity of the results. Third, our assessment of the potential preventability of the readmission was based on subjective judgment, and initial concordance between the two independent raters was only fair. Furthermore, the judgment of the two primary reviewers might have been biased since the primary reviewers also worked in the study ICUs. However, we used two independent reviewers backed by a committee to adjudicate any discrepancies, supporting reliable and unbiased assessments. Fourth, we did not study deaths on the hospital ward that might have been readmissions under different circumstances. Therefore our results may provide an incomplete picture of quality gaps that occur after ICU discharge. Fifth, we did not have data on limitations on life support, which may have affected readmission rates. Sixth, we powered our study only to assess the incidence of potentially preventable admissions, and our relatively small sample size makes our other analyses potentially underpowered.

CONCLUSIONS

Despite these limitations, our study provides preliminary empirical evidence that most unplanned ICU readmissions are not likely to be preventable under current standards. Future work should attempt to replicate these findings in more health systems and better quantify the notion of potentially preventable readmissions. In the meantime, clinicians, hospital administrators, and policy makers should consider these results in the context of larger efforts to improve outcomes for acutely ill patients.

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ICU Readmissions: Good for Reflection on Performance But Not a Reflection of Quality*

Thomas Bice, MD, MSc
Division of Pulmonary and Critical Care Medicine
Department of Medicine
University of North Carolina
Chapel Hill, NC

As the population ages, the need for critical care beds continues to rise, and the emphasis on "faster and better" care for shorter length of stay (LOS) and improved quality of care creates increased stress for the intensivist (1). One potential target suggested for hospital performance is rate of readmission to the ICU (2, 3). Typical reported rates of ICU readmission range from 1.2% to 14.5% of ICU discharges, and readmissions are associated with increased mortality and LOS (4–6). This wide variation in readmission rate suggests that there may be room for standardization and improvement in the process of ICU discharge. However, a better understanding of the etiology and potentially preventable factors in ICU readmissions is needed.

In this issue of *Critical Care Medicine*, Al-Jaghbeer et al (7) describe a study of potentially preventable ICU readmissions. The study was performed at a single urban academic medical center with eight ICUs and 85 ICU beds staffed 24 hours a day by attending intensivists. No step-down units were available for ICU transfer. Using a standardized reporting form, two reviewers categorized readmissions as preventable or nonpreventable and causal or noncausal (i.e., no obvious precipitating cause). Of over 11,483 admissions, 9,534 (83%) were discharged alive from the ICU; excluding repeat readmissions, 357 unique patients (3.7%) were readmitted. Approximately, 160 charts were reviewed at random to include 136 patients in the analysis. Of these, 27 readmissions (19.9%) were deemed causal, and 16 (11.8%) were deemed potentially preventable. Nonpreventable readmissions were divided between new problems (56%) and clinical deterioration or exacerbation of an earlier problem (44%). Preventable readmissions were predominantly caused by system errors, such as failure to communicate positive culture results, and management errors, such as failing to resume home medications for hypertension or atrial fibrillation, with a small number of procedure events, diagnostic errors, and medication errors. Preventable readmissions had shorter ICU LOS and were readmitted in a shorter time frame than nonpreventable readmissions.

This retrospective analysis of readmissions to the ICU addresses an important question in a time of rapid development of hospital quality measures. It expands on previous work evaluating ICU readmissions as potential quality markers—a concept that has strong face validity. To my knowledge, this is the first study that examines whether ICU readmissions are preventable. Less than 0.2% of all ICU discharges experienced preventable readmissions. Large, system-based, interventions are unlikely to effectively target these minority of cases; these cases are likely better evaluated on a case by case basis. Identification of system issues, such as those elucidated in the supplemental index, provide opportunities to improve care and prevent future events. For example, a system to provide consistent communication or identification of home medications that have been appropriately held during the ICU stay would have potentially avoided several cases in this study—and likely in all hospitals. Hospital-wide interventions, however, could be costly and impose an excessive burden not only on providers but also on patients that may not benefit from them.

The study does have some limitations. This was conducted in an academic center with 24-hour intensivist staffing and there were no step-down units, which limit the generalizability to other types of centers. However, after reviewing the cases listed in the supplemental index, it is clear that many of these conditions or situations could occur in any hospital—for example, a patient who lacks capacity refusing medications or lack of recognition of alcohol withdrawal. Another limitation to generalizability is that the investigators found a relatively low readmission rate, and it is possible that this reflects the necessary stability of the patients at ICU discharge, given the lack of step-down units. Patients discharged to step-down units would likely be less stable than those discharged to the floor. Finally, in the analysis of the preventability and causality, there was only fair agreement between reviewers; however, consensus was ultimately reached by group adjudication, increasing the reliability of measurement.

Previous studies have suggested potential risk factors for readmission to the ICU. Several ICU discharge prediction scores have been evaluated to predict future readmissions (8). Many of these have modest predictive ability and could be implemented as a potential route for reduction of ICU readmissions. However, one study compared these scores for accuracy in predicting readmissions and found that not only was there no difference between scores but also each score had only moderate accuracy (9). In addition, another study found implementation of a discharge checklist was challenging and yielded little result (10). These results highlight the difficulty

***See also p. 1704.**

Key Words: intensive care unit readmissions; patient safety; quality

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with prediction and the problems that arise from extrapolation of results from retrospective studies.

In addition to difficulty with prediction, there are questionable benefits of an efferent arm of the ICU team. Rapid response and medical emergency teams have been implemented in many hospitals seeking to improve safety on the wards. If these teams can react to emergency situations, why not have them proactively evaluate all ICU discharges? Multiple studies have evaluated this in a before-and-after fashion, and none have found a benefit. The most recent prospective study found an ICU readmission rate of 6.7% before the intervention and 7.3% after, with no change in ICU LOS or hospital mortality (11).

So, we have difficulty predicting who will be readmitted and we cannot prevent readmission if we proactively look for it. As the authors of the current study point out, quality measures should be modifiable and actionable. So where does that leave us with ICU readmissions? Previous editorials had similar opinions about catheter-associated bloodstream infections and ventilator-associated pneumonia—"these are not preventable events." Yet we now know they are, and likely we all have systematic approaches to reducing their occurrence. Like many other findings in medicine and research, results should be taken in context. It is challenging to compare a small community ICU with six beds to an 85-bed ICU behemoth with respect to mortality, readmission, and complications.

Rather than throwing the baby out with the bathwater, how could ICU readmission rates remain a useful data point? A recent meta-analysis examined over 2 million ICU admissions from various levels of ICU in order to develop a benchmark for ICU quality measures (12). They found that approximately 4–6% of ICU discharges were readmitted (range based on fixed effects vs random effects modeling). Rather than using this data for penalizing or rewarding ICUs, we could aim to use it in evaluating performance for improvement or modification. If an ICU has a readmission rate of 8% (adjusted for various complicating factors), then the ICU may be discharging patients too early. If another ICU has an adjusted readmission rate of 2%, then they are likely keeping patients in the ICU too long.

The current study highlights the importance of practice evaluation. Knowledge about appropriate ICU readmission rates is reasonable. But before we mandate this—or any other—quality measure, we should first perform more studies like this to identify appropriate measures that are truly modifiable and preventable.

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SUPPLEMENTARY DIGITAL CONTENT

For: Al-Jahgbeer, et la. Incidence and etiology of potentially preventable intensive care unit readmissions.

Contents:

CHART ABSTRACTION TOOL

1. Readmission occurred within 48 hours of discharge (circle one): YES / NO
   If no, stop
   Otherwise continue

2. Readmission unplanned (circle one): YES / NO
   If no, explain here and stop: _____
   Otherwise continue

3. Admission and discharge dates:

Event	Date (MM/DD/YYY)	Diagnosis (code)	Diagnosis (text)
Hospital admission			
Index ICU admission			
Index ICU discharge			
ICU readmission			

4. Rating of causality and preventability of ICU readmission (check and circle one in each column):

Rating	Causation (check and circle one)	Preventability (check and circle one)	
1	☐ No evidence for management causation	☐ No evidence for preventability	If preventability = 1-3, then proceed to question #5
2	☐ Slight evidence for management causation	☐ Slight evidence for preventability	
3	☐ Management causation less than 50-50 but close call	☐ Preventability less than 50-50 but close call	
4	☐ Management causation more than 50-50 but close call	☐ Preventability more than 50-50 but close call	If preventability = 4-6, then proceed to question #6
5	☐ Strong evidence for management causation	☐ Strong evidence for preventability	
6	☐ Virtually certain evidence for management causation	☐ Virtually certain evidence for preventability	

5. For NON-PREVENTABLE ADMISSIONS ONLY (preventability rating 1-3), complete one and only one of the below options. See instructions for guidance.

Type	Present?	Explanation
Clinical deterioration, existing problem	☐	
Clinical deterioration, new problem	☐	

6. For PREVENTALBLE ADMISSIONS ONLY (preventability rating 4-6), complete one and only one of the below options. See instructions for guidance.

Type	Present?	Explanation
Medication-related events	☐	
Procedure-related events	☐	
Nosocomial infections	☐	
Diagnostic error	☐	
Management error	☐	
System error	☐	

7. For ALL READMISSIONS, based on the above responses construct a 2-3 sentence narrative of the readmission:

RATINGS GUIDE

PREVENTABLE READMISSIONS

Medication-related events

- Definition: critical illness resulting from medication administration
- Example: A patient with a pulmonary embolus is discharged from the ICU on IV heparin. A supra-therapeutic dose of warfarin is administered on the ward and the patient experiences a GI bleed necessitating ICU readmission.

Procedure-related events

- Definition: critical illness resulting from a procedure or surgery
- Example: A patient with pneumonia and sepsis is discharged from the ICU. He experiences continued fevers in the setting of small pleural effusion. A thoracentesis is performed which is complicated by an intrathoracic bleed necessitating thoracic surgery with subsequent ICU admission.

Nosocomial infections

- Definition: critical illness resulting from an infection acquired during hospital care
- Example: A patient is discharged from the ICU following a stoke. She develops a catheter-associated urinary tract infection leading to hypotension and is transferred back to the ICU for sepsis.

Diagnostic error

- Definition: critical illness as a consequence of a provider not following an appropriate diagnostic algorithm or when a provider does not appropriately act on the findings of a diagnostic test
- Example: A patient is discharged from the ICU after presenting with shortness of breath and being diagnosed with pneumonia. The patient subsequently experiences PEA arrest and is readmitted to the ICU for management following ROSC. Subsequent CT scan shows a large pulmonary embolus but no pneumonia.

Management error

- Definition: critical illness as a consequence of a provider ordering a contraindicated therapy, failing to correctly monitor the effects of therapies, or not initiating an indicated therapy
- Example: A patient with liver failure is discharged from the ICU after admission for spontaneous bacterial peritonitis and sepsis. He is discharged from the ICU without a prescription for lactulose, although he is on this medicine at home. He subsequently develops severe hepatic encephalopathy is readmitted to the ICU for management.

System error

- Definition: critical illness that occurs as a result of flaws in the health care system leading to inefficiencies or patient harm
- Example: A patient with staph bacteremia and sepsis is discharged from the ICU on vancomycin. Soon after discharge the cultures turn positive for candida. The microbiology lab calls the ICU, but the culture results are not conveyed to the ward team. The patient then develops candida-related sepsis and is readmitted to the ICU

NON-PRENVENTALBLE READMISSIONS

Clinical deterioration, existing problem

- Definition: critical illness that occurs as a result of clinical deterioration stemming from the natural history of an existing medical problem
- Example: A patient with cystic fibrosis and hemoptysis is discharged from the ICU after bronchoscopy and bronchial artery embolization. Subsequently she experiences another episode of hemoptysis and she is brought back to the ICU for urgent bronchoscopy.

Clinical deterioration, new problem

- Definition: critical illness that occurs as a result of clinical deterioration stemming from the natural history of a new medical problem
- Example: A patient is discharged from the ICU following a motor vehicle accident and closed head trauma with no CT scan abnormalities. Subsequently he experiences seizures and aspiration leading to a respiratory arrest and is brought back to the ICU for intubation and mechanical ventilation.

CASE VIGNETTES FOR POTENTIALLY PREVENTABLE READMISSIONS

Case A: A 66-year-old female with a past medical history of atrial fibrillation, pharyngeal cancer status post tracheostomy and total laryngectomy was admitted to the ICU after an esophageal dilation, bronchoscopy, and a foreign body removal. Her ICU course was complicated by transient periodic oxygen desaturations thought to be secondary to secretions causing stoma occlusion. She was transferred to the hospital ward on post-operative day 2, after which the surgical team inserted a red rubber catheter into her stoma to assist in secretion management. Later that evening she was readmitted to the ICU for persistent oxygen desaturation related to partial obstruction of the tracheal stoma by crusting about the red rubber catheter. The catheter removed by the surgical team with no further complications.
Consensus etiology: Management error

Case B: An 80-year-old male with a past medical history of systolic congestive heart failure status post pacemaker placement was admitted for encephalopathy, suspected seizures and hypotension. An electroencephalogram was negative and he was transferred from the ICU to the hospital ward in a stable condition. The next day blood cultures became positive, however initially no antibiotics were ordered. He was readmitted to the ICU later that day for septic shock, with an infected pacemaker lead as the infectious source.
Consensus etiology: System error

Case C: A 63-year-old male with a past medical history of alcohol abuse was admitted to the ICU for alcohol withdrawal, pancreatitis, and fever. After initial workup he was transferred to the hospital ward. However upon transfer he was noted to be confused and febrile. His confusion was attributed to benzodiazepines, which were tapered with subsequent worsening tachycardia, decreased mental status and increased work of breathing. He was readmitted to the ICU where his condition improved with administration of higher benzodiazepines doses.
Consensus etiology: Management error

Case D: A 50-year-old female with a past medical history of hypertension and end stage renal disease on hemodialysis was admitted to the ICU for a hypertensive emergency due to medication non-adherence. She was treated with intravenous antihypertensive and urgent hemodialysis. A psychiatry consult in the ICU deemed her incompetent to make medical decisions for herself. She was transferred to the hospital ward with improved systolic blood pressures and orders for her home oral antihypertensive regimen. On the ward she refused to take her oral anti-hypertensives and went several hours without medication. Subsequently she was readmitted to the ICU with a systolic blood pressure of 221 mmHg. In the ICU she responded to intravenous antihypertensive medications.
Consensus etiology: System error

Case E: An 80-year-old male with a past medical history of spinal surgeries for kyphosis was admitted to the ICU for post-operative care after a T5-L4 spinal fusion and removal of hardware. He was transferred to the hospital ward on post-operative day two. On the fourth post-operative day he developed right lower extremity weakness. A myelogram showed spinal

cord obstruction due to a hematoma. He underwent an urgent decompression with subsequent readmission to the ICU for monitoring of his right lower extremity.
Consensus etiology: Procedure event

Case F: A 51-year-old male with a past medical history of severe congestive heart failure and atrial fibrillation was admitted to the ICU for post-operative management after an incarcerated hernia repair. His ICU course was complicated by atrial fibrillation with rapid ventricular response. He was treated with IV medications. He was discharged to the hospital ward with an uncontrolled heart rate (140s) on oral medications. His home dose of furosemide was not restarted despite having a 5 liter positive balance over 2 days. His home digoxin was also not restarted. He was subsequently readmitted to the ICU after 4 hours on the ward for atrial fibrillation with rapid ventricular response. His condition improved after optimization of his medications.
Consensus etiology: Management error

Case G: A 57-year-old male was admitted to the ICU for post-operative management after bilateral lung transplant. His initial ICU course complicated by delirium. He was transferred to the hospital ward on 4 liters of oxygen by nasal cannula. He was subsequently readmitted to the ICU for hypoxemia and encephalopathy after he removed his oxygen and showered alone. He responded to oxygen administration.
Consensus etiology: System error

Case H: A 66-year-old male with a past medical history of colon perforation status post colectomy and diverting ileostomy was transferred from another hospital with sepsis from a complicated ileostomy takedown. He was treated with surgical resection of a leaking anastomosis, abdominal closure and placement of a new ileostomy. After initial improvement he was transferred to the hospital ward. On the second day after ICU discharge, he was noted to have copious green drainage from the surgical wound. On the following day, he was taken to surgery were a bile leak was repaired, with subsequent readmission to the ICU for post-operative care.
Consensus etiology: Procedure event

Case I: A 56-year-old female with a past-medical history of severe mental retardation and an advance directive specifying DNR/DNI status was admitted to the ICU with sepsis due to a urinary tract infection. She was managed with intravenous fluids and antibiotics and transferred to the hospital ward after stabilization. While on the ward the rapid response team was called for hypotension, and she was transferred back to the ICU. However upon readmission, her blood pressure was brought back to baseline with 1 liter fluid bolus. After discussion with the family, palliative care was consulted and patient was admitted to hospice.
Consensus etiology: system error

Case J: A 72-year-old female with a past medical history of severe aortic stenosis was admitted to the ICU after mitral valve replacement and a coronary artery bypass grafting for post-operative management. She was transferred to the hospital ward the next day. Subsequently

she was readmitted to the ICU for profound hypoglycemia and encephalopathy after accidently receiving 90 units of intravenous insulin through what was thought to be an antibiotic infusion. She responded to intravenous dextrose administration.
Consensus etiology: Medication error

Case K: A 74-year-old female with a past-medical history of chronic obstructive pulmonary disease on and severe aortic stenosis was admitted to the ICU for a hypertensive emergency complicated by respiratory distress and pulmonary edema. She responded to diuresis and non-invasive positive pressure mechanical ventilation and was transferred to the hospital ward. She was subsequently readmitted to ICU after diuretic dose was held, leading to worsening shortness of breath from pulmonary edema
Consensus etiology: Management error

Case L: A 64-year-old male was admitted to the ICU for post-operative management after a clival chordoma resection via endoscopic endonasal approach and tracheostomy. During the operation there was bleeding at the tracheostomy site that was treated with packing. He was transferred from the ICU to the hospital ward with high oxygen requirement, blood-tinged sputum and need for frequent suctioning. Prior to transfer ICU nurses verbalized concerns about the safety of transfer given ongoing secretions. The patient was readmitted to the ICU within 1 hour of transfer for respiratory distress.
Consensus etiology: System error

Case M: A 33-year-old male with a past-medical history of hypertension was admitted to the ICU after a kidney transplant. His ICU stay was complicated by intermittent hypertension treated with intravenous medications. Not all his home anti-hypertensive medications were administered. He was transferred to the hospital ward, however he was readmitted to the ICU for an elevated blood pressure. His medications were optimized and he was rapidly transferred out of the ICU.
Consensus etiology: Management error

Case N: A 74-year-old female with a past medical history of aortic valve replacement, coronary artery bypass grafting, and atrial fibrillation was admitted to the ICU after exploratory laparotomy, ileo-colectomy and an ileostomy due to a small bowel obstruction. After recovery she was transferred from the ICU to the hospital ward. Her home diuretics were held given her inability to take medications by mouth. On the next day she was readmitted to the ICU for respiratory insufficiency secondary to fluid overload. She was given intravenous diuretics with subsequent improvement and discharge.
Consensus etiology: Management error

Case O: An 86-year-old male with a past medical history of dementia was admitted to the ICU after a motor vehicle accident with multiple rib fractures. He was managed using a lidocaine patch for pain and was transferred to the hospital ward. He refused a nerve block and continued to report severe pain. Ultimately, at the request of the ward team he was readmitted

to the ICU for closer monitoring. However, his clinical status remained stable and he did not require any additional management.
Consensus etiology: System error

Case P: A 52-year-old male with a past-medical history of intravenous drug abuse was admitted for encephalopathy and seizures. He was started on a symptom-targeted protocol for alcohol withdrawal. The protocol was discontinued prior to transfer from ICU to the hospital ward despite psychiatry recommendations and presence of ongoing symptoms. He was readmitted to the ICU for altered mental status, tachycardia and tachypnea. Further workup revealed that he also had a past medical history of benzodiazepine abuse and his symptoms were attributed benzodiazepine withdrawal.
Consensus etiology: Diagnostic error

CASE VIGNETS FOR POTENTIALLY CAUSAL BUT NOT POTENTIALLY PREVENTABLE READMISSIONS (SELECTED)

Case Q: A 54-year-old female was admitted for rhabdomyolysis and mental status changes after a fall. She was observed overnight in the ICU and then transferred to the hospital ward the next day. On the ward she was given a psychiatric evaluation and was treated with an alcohol withdraw protocol. One day later the rapid response team was called for altered mental status. She treated with flumazenil with good response twice, and the alcohol withdrawal protocol was discontinued under suspicion of benzodiazepine overdose. Later, another rapid response team was called for altered mental status for which there was no clinical response to flumazenil. She progressed to acute respiratory failure requiring intubation and was transferred to ICU. Subsequently she was found to have sepsis and bacteremia.
Consensus etiology: Potentially causal, not potentially preventable

Case R: A 72-year-old male with a past medical history of mechanical mitral valve replacement was admitted to ICU after elective head and neck dissection for squamous cell cancer. His home dose of warfarin was held perioperatively. He was discharged to the ward after an uneventful ICU course and begun on low molecular weight heparin for mechanical valve prophylaxis. He subsequently experienced a severe surgical bleed with a supraclavicular fossa hematoma and was readmitted to the ICU for further observation.
Consensus etiology: Potentially causal, not potentially preventable

Case S: A 61-year-old male with a past medical history of atrial fibrillation was admitted to the ICU for postoperative monitoring following a mitral valve replacement, tricuspid valve replacement, and maze procedure. He was subsequently transferred to the hospital ward with atrioventricular pacing. On the ward he experienced a ventricular fibrillation cardiac arrest. Electrophysiology evaluation showed under-sensing of the native QRS complex by the pacer and delivery of a ventricular spike during the T wave, which induced the ventricular fibrillation.
Consensus etiology: Potentially causal, not potentially preventable

CASE VIGNETS FOR READMISSIONS THAT ARE NEITHER POTENTIALLY CAUSAL NOR POTENTIALLY PREVENTABLE (SELECTED)

Case T: A 33-year-old male was admitted to the ICU after an endoscopic endonasal neuroblastoma resection. His initial stay in the ICU was complicated by prolonged respiratory failure. Following extubation he was transferred to the hospital ward. After transfer the rapid response team was called for respiratory distress, tachycardia and hypertension. He clinically improved without specific therapy but was transferred back to the ICU for observation given that that he was thought to have a difficult airway given his post-surgical status. Ultimately his respiratory distress was thought to be due to anxiety.
Consensus etiology: Not potentially causal, not potentially preventable

Case U: A 65-year-old male with a past medical history of esophageal adenocarcinoma was admitted to the ICU after a minimally invasive esophagectomy. He received a beta-blocker for perioperative cardioprotection. His initial ICU stay was uneventful and he was transferred to the medical ward. On the ward he developed a new-onset atrial fibrillation with a rapid ventricular response and was readmitted to the ICU for rate control. His electrolytes were normal and he was maintained on beta-blocker.
Consensus etiology: Not potentially causal, not potentially preventable

Case V: A 56-year-old male with a past medical history of end-stage liver disease, hepato-cellular carcinoma, and recurrent lymphoma who was admitted to the ICU for consideration of trans-jugular intrahepatic porto-systemic shunt (TIPS) for a large hepatic hydrothorax. He was deemed inappropriate for TIPS. A chest tube was inserted and diuresis was begun. He was discharged to the ward comfortable and ambulatory on room air. He subsequently developed respiratory distress and was readmitted to the ICU. Radiographic evaluation revealed no pulmonary embolus and his respiratory distress was thought secondary to his chest tube, although he was begun on empiric antibiotics.
Consensus etiology: Not potentially causal, not potentially preventable