

Unplanned Transfers to a Medical Intensive Care Unit: Causes and Relationship to Preventable Errors in Care

Srinivas R. Bapojé, MD, MPH¹
 Jennifer L. Gaudiani, MD¹
 Vignesh Narayanan, MD¹
 Richard K. Albert, MD²

¹Department of Internal Medicine, Division of Hospital Medicine, Denver Health Medical Center, University of Colorado School of Medicine, Denver, Colorado.

²Department of Internal Medicine, Denver Health Medical Center, University of Colorado School of Medicine, Denver, Colorado.

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BACKGROUND: Unplanned intensive care unit (ICU) transfers may result from errors in care but the frequency of their occurrence, and whether these transfers might be prevented, has not been investigated.

OBJECTIVE: To determine why unplanned transfers occur, what fraction results from errors in care, whether they are preceded by changes in clinical status and if so, whether earlier or different responses might prevent the transfers.

DESIGN: Retrospective study.

SETTING: University-affiliated hospital.

PATIENTS: All patients 18 to 89 years with unplanned transfers to the medical ICU from June 1, 2005 to May 30, 2006.

INTERVENTION: None.

MEASUREMENTS: Demographics, admission and transfer diagnoses, clinical triggers preceding the transfer, mortality, judgment by three reviewers about cause of transfer and whether it could have been prevented.

RESULTS: A total of 152 patients had unplanned transfers. The most common reasons were worsening of the problem for which the patient was admitted (48%) and development of a new problem (39%). Errors in care accounted for 29 transfers (19%), 15 of which were due to incorrect triage at the time of admission, and 14 due to iatrogenic errors. Of the 14 iatrogenic errors, the investigators determined that eight transfers might have been prevented by an earlier intervention. Agreement among the three reviewers was moderate to almost perfect (κ 0.55-0.90).

CONCLUSIONS: Although 19% of unplanned transfers to medical ICUs are associated with errors in care, almost 80% of these seem to be preventable. Most of the preventable errors resulted from inappropriate admission triage. *Journal of Hospital Medicine* 2011;6:68-72. © 2011 Society of Hospital Medicine.

KEYWORDS: emergency department triage, medical errors, rapid response teams, unplanned ICU admissions.

Two national surveys indicate that 14% to 28% of patients admitted to intensive care units (ICU's) are unplanned transfers (i.e., moving a patient to the ICU from other areas in the hospital providing lower intensity care due to an unanticipated change in the patient's clinical status), and that the most common reason for unplanned transfers is respiratory insufficiency/failure.^{1,2} Patients suffering adverse events during a hospitalization are more likely to have an unplanned ICU transfer and patients requiring unplanned transfers have a higher mortality.³⁻⁵ Accordingly, the Joint Commission has identified improved recognition and response to changes in a patient's condition as a national patient safety goal,⁶ and Rapid Response Teams (RRTs) have been advocated to deal with these changes,⁷ although recent studies question the effectiveness of RRTs.⁸⁻¹¹

We sought to classify the causes of unplanned, in-hospital transfers to a medical ICU (MICU) with the idea of identifying common problems in care that might be addressed by process improvement activities. We also sought to determine the fraction of patients requiring an unplanned MICU transfer that had evidence of clinical deterioration prior to

the time of transfer and whether, in retrospect, different or earlier interventions might have prevented the transfer. Our hypotheses were that (1) most unplanned MICU transfers occurred as a result of errors in care, (2) most were preceded by clinical deterioration within 12 hours prior to the transfer, and (3) most were preventable.

Methods

We conducted a retrospective cohort study of patients transferring to the MICU from non-ICU Medicine units at Denver Health, a university-affiliated, public safety net hospital. All adult patients between 18 to 89 years of age, who were admitted to the Medicine service between June, 2005 and May, 2006 were included in the study. Exclusion criteria included patients who (1) transferred from outside hospitals, (2) transferred from non-Medicine units within Denver Health, (3) were admitted directly to the MICU from the emergency department (ED), (4) were prisoners, (5) were readmitted to the MICU during the same hospitalization, (6) were known to be pregnant, or (7) were planned MICU transfers following invasive procedures (eg, elective cardiac

TABLE 1. Taxonomy of Unplanned MICU Transfers

1. Errors in triage from the Emergency Department
 - A. Diagnostic errors (conditions that were overlooked at the time of admission but explained the chief complaint).
 - B. Inadequate assessment (new diagnosis established after more extensive evaluation that could have been performed at the time of admission).
 - C. Overlooked severity (patients meeting MICU admission criteria at the time of admission from the ED).
2. Worsening of condition for which the patient was admitted
 - A. Errors with assessment or treatment (evaluation or treatment that was not thought to be standard of care for the admitting diagnosis).
 1. Delayed (could reasonably have been instituted earlier)
 2. Incorrect (not thought to represent standard of care)
 3. Inadequate (correct, but insufficient for the admitting diagnosis)
 - B. Spontaneous worsening (worsening of the problem for which the patients were admitted to the point of requiring MICU transfer for which no specific cause could be identified)
3. Development of a new problem
 - A. Iatrogenic (thought to be caused by a diagnostic or therapeutic intervention)
 - B. Spontaneous (no specific cause could be identified)
4. Critical laboratory values (laboratory values needing frequent monitoring of patient and/or blood draws)

Abbreviations: ED, emergency department; MICU, medical intensive care unit.

catheterization, defibrillator placement, ablations). Patients readmitted to the MICU were excluded because of the difficulty distinguishing between premature transfer from the MICU or potential problems in care that might have occurred prior to the time of transfer from those occurring during follow-up care on the Medicine floor services.

Computerized medical records of eligible patients were searched for demographic information and for admitting and transfer diagnoses (with the latter being categorized using a taxonomy we developed for classifying unplanned transfers, Table 1). Three independent observers (all of whom were board certified in Internal Medicine and had been practicing as Hospitalists at our institution for a minimum of three years) retrospectively reviewed each patient's hospital record to determine the cause of the unplanned transfer using this taxonomy. All three also made a judgment as to whether deterioration was evident at any time within the 12 hours preceding the unplanned transfer on the basis of clinical criteria used as our hospital's rapid response triggers (Table 2). When clinical triggers were found, each of the reviewers independently judged whether the unplanned transfer might have been prevented had different or earlier interventions been instituted. Each reviewer was blinded to the results of the other two.

All analyses were done using SAS® Enterprise Guide® 4.1, SAS Institute, Cary, NC. Data are presented as mean (standard deviation [SD]). Interobserver agreement was measured by calculating a κ statistic. κ values were interpreted by using the guidelines suggested by Landis and colleagues.¹² A chi-square test was used to seek associations between baseline characteristics, reasons for MICU transfer and mortality. $P < 0.05$ was considered to be statistically significant. The Colorado Multiple Institutional Review Board approved the research protocol.

TABLE 2. Rapid Response Clinical Triggers

- A. Respiratory
 - Respiratory rate <8 or >28 /minute
 - Acute change in oxygen saturation to $<90\%$ despite oxygen administration
 - Threatened airway
- B. Cardiovascular
 - Acute change in systolic blood pressure to <90 mmHg
 - Acute, sustained increase in diastolic blood pressure to >110 mmHg
 - Acute change in heart rate to <50 or >120 beats/minute
 - New onset chest pain or chest pain different than on admission assessment
 - Acutely cold and pulseless extremity.
- C. Neurological
 - Confusion, agitation or delirium
 - Unexplained lethargy/difficult to arouse
 - Difficulty speaking or swallowing
 - Acute change in pupillary response
 - New seizure
- D. Other
 - Temperature >39.0 Celsius
 - Uncontrolled pain (if different than admission pain assessment)
 - Acute change in urine output <50 mL/4 hours
 - Acute bleeding (bleeding with a change in vitals, urine output or mental status)

TABLE 3. Patient Demographics and Admitting Diagnoses (n = 152)

Age (years) mean (SD)	52 ± 14
Gender (male:female)	
Number	95:57
%	63:37
Race, n (%)	
White, non-Hispanic	54 (35)
White, Hispanic	59 (39)
Black	30 (20)
Other	9 (6)
Primary language, n (%)	
English	131 (86)
Spanish	17 (11)
Other	4 (3)
Length of stay prior to transfer (hours) (median, IQR)	46, 89
Admitting diagnosis, n (%)	
Acute decompensated heart failure (systolic/diastolic)	18 (12)
Community acquired pneumonia	13 (9)
Suspected acute coronary syndrome	9 (6)
Delirium	8 (5)
Acute kidney injury	8 (5)
Abdominal pain	8 (5)
Respiratory failure	6 (4)

Abbreviations: IQR, interquartile range; Agree, SD, standard deviation.

Results

Over the period of the study the Medicine floor services had 4468 admissions of which 152 met the inclusion criteria for having an unplanned MICU transfer (Table 3). The most common admitting diagnoses were heart failure (12%) and community acquired pneumonia (9%). The most common diagnoses to which the unplanned MICU transfers were attributed were respiratory failure (27%) and sepsis (9%) (Table 4). Seven cardiopulmonary arrests were successfully

resuscitated and transferred to the MICU. Throughout the period of the study, no patients were admitted to non-MICU units because the MICU was at full capacity. Additionally the investigators did not find any inordinate delays in transfer to the ICU while waiting for a bed.

A total of 51 patients (34%) were transferred within the first 24 hours of admission. The most common diagnoses resulting in transfer in this group were respiratory failure, hypertensive emergency, hypotension, gastrointestinal bleed, and acute coronary syndrome. The remaining 101 patients (66%) were transferred from two to 15 days following admission for a variety of problems but respiratory failure was most common (34 patients, 22%).

Worsening of the problem for which the patients were initially admitted accounted for the unplanned transfers of 73 patients (48%) (Table 5). Development of a new problem unrelated to the admitting diagnosis accounted for the transfer in 59 patients (39%). Five patients were transferred to the ICU for a critical laboratory value that required a

closer monitoring of the patient or needed more frequent lab draws that could not be achieved on the floor.

Errors in care were thought to be present in 29 patients (19% of the unplanned transfers). For 15 of these (52%) the error involved incorrect triage from the ED as 14 of the 15 patients met MICU admission criteria at the time they were triaged to non-MICU units (Table 6). The remaining patient had a dissecting aortic aneurysm that was not considered while he was being evaluated for acute chest pain. All these patients were transferred to the ICU within 24 hours of their admission and the reviewers agreed that all could have been

TABLE 4. Diagnoses Leading to Unplanned MICU Transfers, n (%)

Respiratory failure (cardiogenic/non-cardiogenic)	41 (27)
Sepsis	14 (9)
Hypotension	13 (9)
Gastrointestinal bleeding	12 (8)
Tachyarrhythmia	9 (6)
Cardiac arrest	7 (5)
Hypertensive emergency	7 (5)
Acute coronary syndrome	7 (5)

Abbreviation: MICU, medical intensive care unit.

TABLE 5. Causes of Unplanned MICU Transfers (n = 152)

Causes	n (%)
1. Errors in triage from the emergency department:	15 (10)
A. Diagnostic errors:	1 (0.7)
B. Inadequate assessment:	0 (0)
C. Overlooked severity:	14 (9)
2. Worsening of condition for which the patient was admitted:	73 (48)
A. Problems with assessment or treatment:	5 (3)
1. Delayed	1 (0.7)
2. Incorrect	1 (0.7)
3. Inadequate	3 (2)
B. Spontaneous worsening	68 (45)
3. Development of a new problem	59 (39)
A. Iatrogenic	9 (6)
B. Spontaneous	50 (33)
4. Critical laboratory values	5 (3)

Abbreviation: MICU, medical intensive care unit.

TABLE 6. Denver Health MICU Admission Criteria

Hemodynamic instability requiring vasopressor agents, continued aggressive fluid resuscitation, or central venous/pulmonary artery catheter monitoring or balloon pump
Acute respiratory failure with ongoing or impending need for ventilatory support (either invasively or non-invasively).
Gastrointestinal bleeding meeting ICU admission criteria (>2 clinical risk factors and Rockall score >3 per Gastrointestinal Bleeding Protocol)
Cardiac chest pains associated with two of the three criteria
Ongoing ischemic chest pain
Enzyme elevation
ST segment depression <0.5 mm in 2 consecutive leads or transient ST-segment elevation
Chest pain requiring IV nitroglycerin infusion.
Complex cardiac arrhythmia requiring close monitoring and/or intravenous infusion therapy
Temporary pacemaker.
Hypertensive crisis with end-organ dysfunction or aortic dissection requiring intravenous treatment.
Massive hemoptysis (>500 cc/24 hours)
Acute neurological dysfunction requiring one of
ICP monitoring,
Acute respiratory failure with impending need for ventilatory support
Hourly neurological checks.
Status epilepticus
Post-operative patients requiring hemodynamic monitoring/ventilator support of extensive nursing care.
Severe metabolic disorder or intoxication requiring frequent monitoring and/or intravenous infusion therapy that cannot be administered on a floor.
Multiple trauma, including severe head and spine trauma
Other indication (please specify)

Abbreviations: ICP, intracranial pressure; ICU, intensive care unit; IV, intravenous; MICU, medical intensive care unit.

prevented if existing diagnostic and admission algorithms were followed.

Of the remaining 14 patients thought to have errors in care, nine were classified as the development of a new, iatrogenic problem (ie, opiate or benzodiazepine overdose occurring during treatment for pain and/or anxiety in 3, volume overload in 2, insulin-induced hypoglycemia, antibiotic associated reaction, β -blocker overdose and acute renal failure from over-diuresis in one each) and five occurred because the patient's admitting problem worsened because treatment was thought to be either delayed, incorrect, or inadequate (Table 5). The reviewers all agreed that the unplanned transfers could have been prevented in eight of the 14 patients who developed iatrogenic problems if existing algorithms were followed or if an earlier or different intervention had occurred. The reviewers did not agree about whether the unplanned transfer could have been prevented in one patient who developed an iatrogenic problem and in all five patients whose underlying condition worsened. Accordingly, in sum, the reviewers felt that 23 of the 152 unplanned transfers (15%) could have been prevented.

In addition to trying to determine how many of the unplanned MICU transfers could have been prevented, we also investigated the utility of rapid response triggers in alerting the physicians and nurses of impending deteriorations in status and whether earlier recognition of this deterioration might have prevented the transfers. Of the 152 unplanned transfers, 106 (70%) had one or more rapid response triggers within the preceding 12 hours. All three reviewers agreed and concluded that in 94 (89%) of these, the unplanned transfer could not have been prevented, even with different or earlier interventions. For five patients (5% of the 106) all reviewers agreed and concluded that earlier intervention might have averted the subsequent transfer. For the other seven patients (6%), no consensus was reached. If we assume that, for all of these latter seven, earlier or different intervention might have averted the unplanned transfer, a maximum of 12 unplanned transfers (11% of the 106) might have been prevented by having a system of care that employed regularly assessing rapid response triggers and acting on them when recognized.

The interobserver reliability for the three reviewers was moderate to almost perfect with $\kappa = 0.60$, 95% confidence interval (CI) (0.31, 0.88); $\kappa = 0.90$, 95% CI (0.71, 1); $\kappa = 0.55$, 95% CI (0.26, 0.84).

A total of 27 (18%) of the patients with unplanned transfers died in the MICU. During this same time period 91 of 1511 patients (6%) admitted directly from the ED to the MICU died ($P < 0.05$). Mortality was lower for patients transferred within 24 hours of admission compared to those transferred > 24 hours after admission (4% vs. 22% mortality, respectively, $P < 0.05$; 95% CI, 0.09-0.89). We found no difference in mortality as a function of time of admission or time of transfer implying that differences in staffing, or the availability of various services, did not contribute to the unplanned transfers.

Discussion

The important findings of this study were that (1) 19% of unplanned, in-hospital transfers from Medicine floor services to the MICU seemed to result from apparent errors in care, (2) 15% of the unplanned transfers were potentially preventable, (3) the majority of the errors in care involved inappropriate triage of patients from the ED to the non-MICU units, (4) 106 (70%) of the patients requiring unplanned transfers developed rapid response criteria within 12 hours prior to the transfer, but on review of these (5) the transfer was thought to be preventable in only a maximum of 12 (11%).

We designed our study in part to find specific errors that commonly resulted in unplanned MICU transfers with the idea that, if these could be identified, they might be corrected, thereby improving care. Contrary to our hypothesis we found that only 29 (19%) of the unplanned transfers seemed to result from errors in care. Of these, however, half were attributable to overlooking that patients met our own institution's MICU admission criteria at the time they were triaged to non-MICU units. This result is consistent with Walter et al.¹³ finding that while 88% of MICUs in academic health centers had written MICU admission criteria, only 25% used these criteria on a regular basis. Hospital mortality is likely lower for patients meeting MICU admission criteria when they are appropriately and expeditiously triaged.¹⁴⁻¹⁸ Accordingly, developing mechanisms by which patients are routinely screened for meeting MICU admission criteria could and should reduce this source of error and improve patient outcomes.

Nine of the remaining 14 errors in care resulted from what the chart reviewers concluded was overly aggressive treatment; either excess fluid resuscitation or excess treatment of pain or anxiety. It is not clear that these represent *correctable* errors in care, however, as hypotensive patients require fluid resuscitation, and patients with pain or anxiety should receive analgesics or anxiolytics and it is not reasonable to expect that these interventions will be appropriately titrated in every instance. Nonetheless, our reviewers all agreed that, in eight of these patients, different interventions could have prevented the unplanned transfer.

Since 41 (27%) of the unplanned transfers were for respiratory failure, we reviewed each of these patients' records seeking evidence suggesting that the problem might have resulted from excessive use of fluids, narcotics, or anxiolytics. By retrospective analysis only six such cases could be identified. Most were due to worsening of the problem for which the patient was admitted.

Consistent with our hypothesis the majority of patients requiring unplanned MICU transfers (106/152, 70%) developed rapid response clinical triggers within the 12 hours preceding transfer, as has been previously demonstrated by Hillman et al.⁷ and others.^{8-10,19} Our reviewers tried to determine whether earlier or different interventions might have prevented the deterioration and the resulting unplanned transfer. Interestingly, in the large majority (94/106, 89%) they concluded that nothing different could have been done and that the transfer could not have been

avoided. While this observation contrasts with our hypothesis, it is consistent with two studies questioning the utility of RRTs in preventing unplanned ICU transfers.^{9,10} In addition some patients may ultimately need an ICU transfer despite receiving appropriate interventions as it is impossible to prevent an ICU transfer in every patient. Conversely, just because a patient meets a rapid response criteria does not mean that the patient needs a higher level of care or an ICU transfer as some can be safely managed on the floor.

Our study has a number of potential limitations. The data came from a single teaching hospital and we only assessed patients admitted to General Internal Medicine units and transferred to a MICU. Accordingly, our results might not generalize to other hospitals (teaching or nonteaching), to other services or to other types of ICUs. We found, however, that (1) unplanned transfers accounted for 10% of the total admissions to our MICU, a similar fraction as reported by Angus et al.¹ in 2006; (2) respiratory failure/insufficiency and sepsis were the most common diagnoses leading to unplanned transfers as previously reported by Groeger et al.² and Hillman et al.⁵; (3) mortality was increased in patients requiring unplanned transfer, as noted by Escarce and Kelley³ and Hillman et al.⁵; and (4) patients who were transferred to the MICU within 24 hours of admission had better outcomes than those who were transferred later, as reported by Goldhill et al.⁴ Accordingly, our patient population seems quite similar to others in the literature.

Since we did not use objective criteria to assign patients to each of the categories itemized in Table 5 we could have misclassified patients with respect to the cause for their unplanned MICU transfer. Despite this shortcoming, however, the κ scores among our independent reviewers were moderate to almost perfect suggesting misclassification did not occur commonly.

Our retrospective study design may have underestimated the utility of RRTs as we had no way of knowing the outcomes of patients who met rapid response criteria and had interventions that prevented unplanned MICU transfers.

In summary, approximately 15% of unplanned MICU transfers seem to be preventable and approximately one-fifth seem to result from errors in care, the majority of which are errors in triage from the ED. While the large majority of unplanned transfers were preceded by clinical deterioration within the preceding 12 hours, manifested by the presence of rapid response triggers, the large majority of these do not seem to be preventable. From these findings we suggest that unplanned transfers could be reduced by more closely screening patients for the presence of defined MICU admission criteria at the time of admission from the ED, by recognizing that fluid resuscitation and control of pain and/or anxiety can have adverse effects and by monitoring patients receiving these interventions more closely.

Address for correspondence and reprint requests:

Srinivas R. Bapojé, Division of Hospital Medicine, Denver Health Medical Center, 660 Bannock Street, MC 4000, Denver, CO 80204; Telephone: 303-436-7421; Fax: 303-436-7249;

E-mail: srinivas.bapojé@dhha.org Received 28 January 2010; revision received 7 April 2010; accepted 17 May 2010.

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