Failure Events in Transition of Care for Surgical Patients

Thomas S Helling, MD, FACS, Larry C Martin, MD, FACS, Magdeline Martin, MSN, RN, Marc E Mitchell, MD, FACS

BACKGROUND: Unexpected clinical deterioration (failure events) in surgical patients on standard nursing units (WARDs) could have a significant impact on eventual survival. We sought to investigate failure events requiring intensive care (surgical ICU [SICU]) transfer of surgical patients on WARDs in a single-center academic setting.

STUDY DESIGN: Surgical patients admitted to WARDs over a 12-month period, who developed failure events, were retrospectively reviewed. Time to deterioration since WARD arrival, clinical factors, notification chain, and outcomes were identified. A physician review panel determined the preventability of failure events.

RESULTS: Ninety-eight patients experienced 111 failure events requiring SICU transfer. Most patients (85%) were emergency admissions. Of 111 events, 90% had been previously discharged from an SICU or a postanesthesia care unit (PACU). Recognition of failure was by nursing (54%) and on routine physician rounds (34%). Rapid response or code blue alone was less common (12%). A second physician notification was needed in 29%, with delays due to failure to identify severity of illness. Most commonly, respiratory events prompted notification (77 of 111, 69%). Overall mortality was 26 of 98 (27%). Median time to failure was 2 days and was associated with early transfer from the SICU or PACU. Rapid response or code blue activation was associated with higher mortality than physician notification.

CONCLUSIONS: Patients most at risk for WARD failures were those with acute surgical emergencies or recently discharged from the SICU or PACU. Respiratory complications were the most common cause of WARD failure events. Many early failures may have been due to premature transfer from the SICU or PACU. Failure events on WARDs can have lethal consequences. Awareness, monitoring, and communication are important components of preventative measures. (J Am Coll Surg 2014;218:723–733. © 2014 by the American College of Surgeons)

Mortality in surgical patients has declined over the past decades. This has largely been due not so much to a decrease in complications but rather to improvements in “failure to rescue” or effective recognition and treatment of complications.1 However, failures in processes of care still occur and can have an impact on patient mortality, length of stay, and cost of care.2 A recent systematic review demonstrated that adverse events, defined as unintended injuries or complications caused by health care (mis)management, perhaps as a consequence of process failures, occurred in 14.4% of surgical patients, and more than one-third of these events were preventable.3 Some of these process failures had to do with recording and interpreting vital signs and communicating patient information between shifts of health care workers (so-called hand-offs) during periods of transition of care.4 In fact, some have determined that more than 60% of in-hospital cardiac arrests, as the extreme result of process failure, were preventable and that virtually all received inadequate previous care.5 Although intensive care units are capable of close monitoring and immediate intervention, hospital wards may have variable staffing and resources available to handle unanticipated clinical deterioration that could lead to adverse events. And they are often saddled with higher acuity patients than...
in the past, particularly those recently transferred from intensive care locations. The key, then, to reversing adverse occurrences in these ward patients would seem to be identification of those at risk, timely recognition, and prompt response and intervention. There is some indication that such safety efforts can, indeed, reduce further complications and mortality in surgical patients. This requires the carefully orchestrated interaction of all levels of health care providers, with timely communication during transitions of care at the heart of the matter.

In keeping with the risk — recognition — response — rescue paradigm, we have sought to identify patients on medical or surgical hospital wards (WARDs) who might be susceptible to unanticipated clinical deterioration, what we have termed failure events, who require a higher level of care, or “rescue,” and any potential warning signs that might alert health care providers of impending trouble. Failure events can represent the first manifestation of complications and as such, should be swiftly recognized and addressed. For that reason, we also were interested in the response of health care providers to failure events and whether there were any preventable issues in patient recognition, diagnosis, or management that might have forestalled further deterioration. Our hypothesis was that failure events were more likely to occur in high risk individuals, and therefore were predictable and probably preventable situations.

METHODS
This was a retrospective observational study in which all surgical WARD patients who experienced unexpected clinical deterioration (failure events) and required admission to the surgical intensive care unit (SICU) or who died during a 12-month period, were reviewed for potentially preventable errors in recognition, communication, or management using the institutional electronic medical record (EPIC). The following parameters were examined: age, sex, admitting service, the Charlson Comorbidity Index with age adjustment,7 the Acute Physiology and Chronic Health Evaluation (APACHE) 2, the American Society of Anesthesiologists Physical Status Classification System (ASA) scores as a measure of acuity of illness and risk, the communication chain and notification pathways, medications given before the failure event, thromboprophylaxis, and WARD vital signs and clinical appearance before the failure event. Vital signs and clinical appearance were assessed as follows: heart rate (HR), systolic blood pressure (SBP), respiratory rate, fever, bedside pulse oximetry (SpO2), chest pain, dyspnea, focal neurologic signs, urine output, bleeding, aspiration, and mental status changes. In particular, vital signs immediately before the failure event were examined and recorded as sentinel vital signs. Hypnotic, antipsychotic, and analgesic medications administered within 4 hours of the failure event were examined and recorded.

The medical record was queried for nursing and physician progress notes and the chronologic unfolding of events. This led to determination of how the failure event was recognized and subsequent communication chains for treatment intervention. Recognition of failure events was grouped into the following communication chains: nurse to resident; resident on rounds; attending surgeon on rounds; activation of an emergency response team activation, termed rapid response, initiated by nurse or physician; or activation of a “code blue” team for cardiopulmonary arrest. Required fields included preoperative diagnosis, postoperative diagnosis, indications for operation, attending surgeon, resident surgeon, assistants, anesthesia provider, operation performed, operative findings, operative description, estimated blood loss, specimens obtained, complications, antibiotics, patient tolerance, and postoperative plan. The level of residency of the responding resident was tracked by postgraduate year (PGY). Delays in response were assessed by the need for multiple calls from nurse to physician. Outcomes measures consisted of patient outcome (lived, died), reason for failure, timing of the failure event, and whether the failure was preventable, possibly preventable, or nonpreventable, as judged by a panel of 3 physician reviewers (TSH, LCM, MEM), who independently reviewed the medical record. Preventability focused on delays in recognition, errors in diagnosis, and errors or delays in management. Some cases were discussed in group for consensus.

Clinical variables at the first call such as heart rate, temperature, systolic blood pressure, and SpO2 were summarized as mean, standard deviation, median, interquartile range, and range. We constructed histograms and boxplots to visualize distributions of these variables. Outliers yielded from boxplots were individually examined to validate data or determine possible exclusion. Patient population was further dichotomized based on the clinically important cut points for these variables. Proportions of patients having critical conditions were tabulated and depicted in bar graphs. Pearson chi-square, unpaired Student’s t-test for continuous variables, and Fisher’s exact tests for dichotomous variables were used where appropriate.

**Abbreviations and Acronyms**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>HR</td>
<td>heart rate</td>
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<tr>
<td>PACU</td>
<td>postanesthesia care unit</td>
</tr>
<tr>
<td>SBP</td>
<td>systolic blood pressure</td>
</tr>
<tr>
<td>SICU</td>
<td>surgical intensive care unit</td>
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<tr>
<td>SpO2</td>
<td>oxygen saturation by pulse oximetry</td>
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<tr>
<td>WARD</td>
<td>standard nursing unit</td>
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All parameters and outcomes were entered into a secured web-based database (Research Electronic Data Capture [REDCAP], Vanderbilt University). The study received the approval of the University of Mississippi Medical Center Institutional Review Board.

RESULTS

During the 12-month study period, 98 patients admitted to WARDs suffered 111 failure events requiring acute intervention. There were 13 patients who had failure events twice on the WARD and required SICU admission. The distribution of patients by service is depicted in Table 1. Acute care surgery and trauma services accounted for the bulk of the patients (57%). Eighty-four of 98 patients (86%) were admitted as emergencies. The median age was 60 years, with an interquartile range of 50.5 to 69 years. There were 33 women and 65 men. The median Charlson comorbidity score was 3.50, with an interquartile range of 2.00 to 5.00. Twenty-seven patients (28%) had a score of 5 or greater. Of 91 patients receiving an American Society of Anesthesiologists score, 79 (87%) scored a 3 or 4. After admission to the SICU, the median APACHE 2 score was 18 (mean 19 ± 9) with a mode of 14. Fifty-eight (58 of 98, 59%) patients were located on the designated surgical ward at the time of their event. The rest were on other medical or surgical wards throughout the hospital. All WARD patients in the study had been transferred from another acute care location. Fifty-eight patients (59%) had been transferred from the SICU, 31 (32%) from the PACU, and 9 (9%) from the emergency department. There were no direct admissions to the WARD in this population. Of the 111 failure events, 90% occurred in patients transferred from the SICU or PACU.

According to days of the week, failure events occurred on Monday (n = 19), Tuesday (n = 11), Wednesday (n = 15), Thursday (n = 18), Friday (n = 20), Saturday (n = 15), and Sunday (n = 13). One-sided p values by Poisson distribution showed no significant difference among the 7 days. According to hours of the day there was a clustering of events from 0600 to 1759 (6:00 AM to 5:59 PM), significantly different than 2400 to 0559 (midnight to 5:59 AM) and 1800 to 2359 (6:00 PM to 11:59 PM) (p = 0.0007) (Fig. 1). The distribution of code blue events did not show a significant difference among these time quartiles; 8 occurred during night-time hours (1800 to 0559 [6:00 PM to 5:59 AM]) and 8 occurred during daylight hours (0600 to 1759 [6:00 AM to 5:59 PM]).

In 71 of 111 failure events (64%), analgesic, hypnotic, or antipsychotic medication had been administered within 4 hours. In 61 of 71 of these failure events, respiratory parameters were responsible for notification compared with 31 of 40 events in which medication had not been given (p = 0.299). There was a statistically significant correlation, however, with medication administered within 4 hours and respiratory derangements as an admitting, or initial, ICU diagnosis (59 of 71 vs 24 of 40, p = 0.012) on patient transfer to the SICU.

The identification of failure events was nurse to resident (n = 60); resident on rounds (n = 30); attending surgeon on rounds (n = 8), rapid response (n = 17), or code blue (n = 16). The nurse was the first identifier in 60 of 111 (54%) failure events and in 11 of 33 (33%) rapid response or code blue activations. Three rapid responses quickly turned into code blue activations. In 14 of 17 rapid responses, the primary concern and apparent reason for activation was respiratory. In 13 failure events the rapid response or code blue was the first and only notification; in the balance there was apparent simultaneous notification of physicians. The failure events were recognized by changes in vital signs or clinical appearance in 100 of 111 events (90%). In 77 of 111 events (69%), there was some derangement of respiratory parameters: tachypnea, dyspnea, low bedside oximetry. Alteration of standard nursing vital signs only—blood pressure, heart rate, respiratory rate, fever—were found in 18 of 111 events (16%). The balance was associated with other abnormal parameters such as patient complaints or appearance, bedside

Table 1. Distribution of Patients with Failure Events by Admitting Service (n = 98)

<table>
<thead>
<tr>
<th>Service</th>
<th>Emergency admissions, n (%)</th>
<th>Nonemergency admissions, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma</td>
<td>31 (32)</td>
<td>0</td>
</tr>
<tr>
<td>Acute care surgery</td>
<td>25 (26)</td>
<td>0</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>11 (11)</td>
<td>3 (3)</td>
</tr>
<tr>
<td>General surgery</td>
<td>7 (7)</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Transplant surgery</td>
<td>0</td>
<td>5 (5)</td>
</tr>
<tr>
<td>Orthopaedic surgery</td>
<td>4 (4)</td>
<td>0</td>
</tr>
<tr>
<td>Medicine (surgery consult)</td>
<td>4 (4)</td>
<td>0</td>
</tr>
<tr>
<td>Urology</td>
<td>2 (2)</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>
oximetry, or abnormal laboratory values. Abnormal bedside oximetry, SpO₂ < 92% or SpO₂ < 90%, either with continuous monitoring or spot checking at the time of failure, was present in 41% and 28% of events, respectively. However, coupled with standard vital signs, at least 1 of the abnormal parameters (HR > 100 bpm, SBP < 100 mmHg, SpO₂ < 92%) was present in 85% of events and using HR > 110 bpm, SBP < 90 mmHg, and SpO₂ < 90%, was present in 69% of events.

The initial, or first, call from nurse to physician providers, or physician response alone, was sufficient to provoke action in 79 failure events. In these calls the sole contact or response was a junior level resident (PGY-1 or -2) in 52 of 79 events (66%). In 32 events (29%) a second call was required, and in 5 failure events a third call was needed. There was a perceived delay in treatment caused by multiple calls from nurse to physician in 13 failure events with the most common reason, judged by physician review, being failure to appreciate the severity of disease. In patients requiring a second call (n = 32), there were no significant differences among vital parameters (HR, SBP, temperature, SpO₂) compared with first call responders (Fig. 2). In 5 failure events, after communicating with the physician, the nurse escalated the situation to a rapid response or code blue activation. In 36 failure events, a chest CT pulmonary angiogram (CTPA) was obtained to rule out a pulmonary embolus; in 6 instances (17%) it was confirmatory.

Twenty-six of 98 patients (27%) died after their failure event. Five patients did not survive to be transferred to the SICU and 21 died after transfer. In 69 of 78 failure events (88%) in which only a physician was notified, the patient survived the event compared with 7 of 15 (47%) for a rapid response (± physician notification) and 7 of 16 (44%) for a code blue (p < 0.0001). The most common cause of death was listed as pulmonary in 20 patients (either respiratory failure or pneumonia), 11 of whom also were septic, and 8 from cardiovascular causes (2 of whom also were in respiratory failure), including all 5 patients who died before reaching the SICU.

By physician review, the reasons for the failure events are listed in Tables 2 and 3. The 3 most common pathophysiologic causes were respiratory, cardiovascular, and infection-related. In 42 failure events, intubation was required after admission to the SICU, vasopressors were begun in 24 events, and antibiotics were used in 35 events. Sixty-three failure events were judged nonpreventable
Table 2. Physiologic Reasons for Failure Events

<table>
<thead>
<tr>
<th>Reason for failure</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory complications</td>
<td>42</td>
</tr>
<tr>
<td>Infection complications</td>
<td>31</td>
</tr>
<tr>
<td>Cardiovascular complications</td>
<td>26</td>
</tr>
<tr>
<td>Bleeding</td>
<td>6</td>
</tr>
<tr>
<td>Renal complications</td>
<td>1</td>
</tr>
<tr>
<td>No detectable reason</td>
<td>5</td>
</tr>
</tbody>
</table>

(57%), 38 were potentially preventable (34%), and 10 (9%) were preventable. Table 3 lists the putative errors in management attributed to these preventable failure events as determined by physician review.

Inappropriate transfer from PACU or SICU to WARD was examined further in terms of failure events. The median time from admission to WARD and failure was 2 days, with an interquartile range of 1.00 to 4.00 days (Fig. 3). Patients with failure events 2 days or less were compared with those with failure events beyond 2 days (Table 4). After physician review, patients who required admission to the SICU less than 2 days after WARD admission were more likely to have been transferred early from acute care units (SICU, PACU) (20 vs 4, p < 0.01) and more likely suffered from preventable or possibly preventable failure events (33 vs 4, p < 0.01).

The most common final diagnosis after SICU admission from WARDs was respiratory failure, noted in 56 failure events (50%), followed by sepsis in 32 failure events (29%). Other causes are listed in Table 5.

DISCUSSION

Theresa Brown, an oncology nurse and regular contributor to the New York Times, recently commented, “We nurses all have stories — if we’re lucky it’s just one — about the time we failed a patient. It’s usually a problem of being too busy... as hospitals face increasing financial pressure, nurse staffing often takes a hit...” Similarly, a study done by Desai and colleagues from the Johns Hopkins Hospital comparing the effect of the 2011 Accreditation Council for Graduate Medical Education (ACGME) duty hours regulations with the 2003 ACGME duty hour regulations found that the number of handoffs (exchange of patient information) between interns increased 130% to 200% with the 2011 regulations and the minimum number of different interns caring for a given patient during a 3-day stay increased 33% to 67%. Clearly, in the present health care climate, particularly at teaching hospitals, there are looming opportunities for patient-centered adverse events, or, in our terminology, failure events, where the majority of patients are now located: on medical/surgical floors (or WARDs).

Our study has shown that failure events occur in high risk individuals, ie, those with age-adjusted Charlson scores of 3 or greater, indicating a relative risk of death from 1.46 to 4.38. Moreover, most patients (86%) were admitted as emergencies rather than elective admissions, perhaps indicating less than ideal optimization of comorbidities. Furthermore, the majority of patients were admitted to the WARDs from another acute care setting such as the SICU or PACU, where alterations in physiology caused by critical surgical illness or operative intervention were likely. Recognition of failure events was, in part, subjective, not necessarily related to more traditional vital signs, but often encompassing nursing assessment of patients as well as their complaints. In fact, vital signs alone were used as an alert mechanism in only 18% of failure events. Although most patients exhibited some perturbations of SBP, HR, or SpO₂, there was a distinct minority of our patients who, despite a worsening condition, maintained vital signs that generally would be considered within the range of normal, that is, SBP > 100 mmHg, HR < 110 bpm, and SpO₂ > 92%.

| Table 3. Reason for Failure Events—Preventable or Possibly Preventable |
|-----------------------------------------------|------------------|------------------|
| Reason for failure event                     | Possibly preventable, n | Preventable, n  |
| Error in recognition                         | 12               | 5                |
| Lack of monitoring                           | 2                | 2                |
| Failure to follow laboratories               | 2                | 4                |
| Inappropriate floor admission                | 3                | 0                |
| Lack of appropriate medication               | 2                | 1                |
| Oversedation                                 | 3                | 1                |
| Inappropriate transfer from SICU             | 10               | 4                |
| Inappropriate transfer from PACU             | 6                | 2                |

PACU, postanesthesia care unit; SICU, surgical intensive care unit.

Figure 3. Distribution of days from discharge to readmission to the surgical ICU (SICU) in 111 failure events. The red line indicates the median time (2 days) to readmission.
Nevertheless, in more than two-thirds of the failure events there was deterioration of respiratory function related to pulmonary parameters (such as oximetry) and subjective complaints by the patient, including altered mental status. In 90% of failure events there was a combination of objectivity (eg, vital signs, oximetry) and subjectivity, lending credence to efforts of others to develop early warning scoring systems to allow recognition of clinical deterioration. Such “track and trigger” systems, usually incorporating vital signs, respiratory parameters, and level of consciousness, have been proposed to alert nursing personnel by way of objective scoring to potential problems. However, performance of most of these systems has been poor and failed to correlate between survivors and nonsurvivors. Yet, some perturbation of these vital signs, similar to our observations, has been found in the majority of patients eventually experiencing cardiac arrest, many up to 48 hours in advance and in particular, changes in respiratory parameters and mental status have been found to correlate with cardiac arrest, unplanned ICU admissions, and unexpected death. From our observations, though, the importance of “eyes on” care by nursing or physician providers cannot be discounted and seems vital in the monitoring of WARD patients.

We observed that more failure events occurred during daylight hours, although there was no correlation with days of the week. This has been reported by Galhotra and coauthors and Offner and colleagues in terms of rapid response team activations. It may be, as suggested by these authors, that clinical deterioration is more quickly detected by day staffing, although we did not find a clustering of “code blue” events as a manifestation of far advanced and possibly unrecognized failure during the night-time hours.

The importance of nursing recognition was seen by the fact that more than half of the failure events were detected by nursing, and then physicians were alerted. So, often, recognition of failure events became a blend of dispassionate identification of objective signs and a distinctly subjective awareness of patient complaints and appearance — something that is quite difficult to order or score in a check-list. Inescapably, common parameters of nursing care, blood pressure, heart rate, respiratory rate, and mental status, continue to be central to identification of those with impending problems whether incorporated into a scoring system or not. Less often, physicians, usually resident surgeons, detected a significant change in condition on rounds or follow-up in handoff communications, so they, too, must be savvy to the subtle or not-so-subtle harbingers of morbidity. What was sobering was the finding that the more inexperienced PGY-1 or 2 residents were the only first responders in more than half of initial contacts.

In 70% of failure events, nursing personnel recognized clinical deterioration and notified physicians. However, in almost one-third of failure events (30%) there was a need to hasten the response, either by invoking a rapid response or code blue, again initiated by nursing. That the situation was viewed as critical by nursing was evident in the significantly higher mortality for these patients.

Table 4. Timing of Failure Events after Admission to WARDs

<table>
<thead>
<tr>
<th>Variable</th>
<th>Respiratory Infection Cardiovascular</th>
<th>Early transfer from SICU or PACU</th>
<th>Possibly preventable or preventable</th>
<th>APACHE II, mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (n = 111), n (%)</td>
<td>41 (37)</td>
<td>31 (28)</td>
<td>25 (23)</td>
<td>24 (22)</td>
</tr>
<tr>
<td>≤ 2 d (n = 59), n (%)</td>
<td>20 (34)</td>
<td>17 (29)</td>
<td>9 (15)</td>
<td>20 (34)</td>
</tr>
<tr>
<td>&gt; 2 d (n = 52), n (%)</td>
<td>21 (40)</td>
<td>14 (27)</td>
<td>16 (31)</td>
<td>4 (8)</td>
</tr>
<tr>
<td>p value</td>
<td>NS</td>
<td>NS</td>
<td>0.08</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

p value comparison ≤ 2 d vs > 2 d.

Table 5. Final Surgical ICU Diagnosis

<table>
<thead>
<tr>
<th>Final surgical ICU diagnosis</th>
<th>Failure events, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory failure</td>
<td>56</td>
</tr>
<tr>
<td>Sepsis</td>
<td>32</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>20</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>19</td>
</tr>
<tr>
<td>Renal failure</td>
<td>14</td>
</tr>
<tr>
<td>Acute anemia</td>
<td>13</td>
</tr>
<tr>
<td>Electrolyte imbalance</td>
<td>13</td>
</tr>
<tr>
<td>Hypovolemia</td>
<td>11</td>
</tr>
<tr>
<td>Intra-abdominal catastrophe</td>
<td>9</td>
</tr>
<tr>
<td>Acute neurologic change</td>
<td>6</td>
</tr>
<tr>
<td>Aspiration</td>
<td>6</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>5</td>
</tr>
<tr>
<td>Acute respiratory distress syndrome</td>
<td>4</td>
</tr>
</tbody>
</table>

Patients may have had more than 1 diagnosis.
the use of analgesic agents. There also seemed to be a
distinct correlation with early transfer from the SICU or
PACU. It was not clear from our data why decisions
were made to transfer patients, whether for medical or
logistical reasons, although our practice is that consensus
between operating surgeon and intensivist before transfer
is allowed. Nevertheless, those experiencing failure events
on WARDs 2 days or less after arriving were more likely
to have been inappropriately transferred from the SICU
or PACU in the judgment of the physician reviewers.
Respiratory issues in the SICU may place patients at even
higher risk after transfer to the WARD, particularly in
the first few days after transition of care and might be preven-
table with the appropriate screening and interventions.
Others have noted similar findings: that the modal time
for ICU readmission was between 24 and 48 hours, and
that ICU readmission bestowed up to a 5-fold increase
in mortality. Some have suggested that ICU readmission
rates be used as a quality benchmark for the care of hospi-
talized patients because these patients suffer higher mor-
tality and represent more serious comorbidity. Others have
proposed yet more scoring systems such as the Stability
and Workload Index, based primarily on respiratory pa-
rameters and level of consciousness, to determine the safety
of transfer from critical care areas, although this also has
not been consistently validated. What seems to be most
beneficial has been the development of some form of tran-
sition in care as the patient moves from the ICU to less
intense care settings. This may take the form of outreach
intensivists, so-called “step-down units,” or liaison
nurses. Whatever the arrangement, it seems that the mere
presence of health care providers who are focused
on the recently discharged ICU patient is the key factor
in reducing ICU readmissions and mortality.

In any event, our observations emphasize that respira-
tory care on WARDs is crucial but, unfortunately, can
be time consuming and tedious. Our results with rapid
response activations parallel published reports of the ques-
tionable effectiveness of emergency response teams,
although there are reports to the contrary. In our
study, in all but 1 instance there was simultaneous noti-
fication of physicians in addition to members of the
emergency response team, and in all such cases the physi-
cian notified seemed to respond promptly. However, it
may be a reassuring resource to the WARD nurses, and
indeed it does bring help to the bedside in times of
perceived crisis.

Response to the first nurse call or recognition by
ranging physicians was usually sufficient to institute
39 treatment. However, in 29% of events, a second call to
physicians was needed, and in more than 10% of failure
events, the nursing staff perceived that multiple calls
resulted in a delay of care, albeit no specific instances of
life-ending events. That there were no discernible differ-
ences in vital signs in patients requiring multiple calls
leads to the conclusion that there was an under-
appreciation of the severity of the problem as reported
by the nursing staff to responding or on-call physicians.
This was borne out by review of the individual failure
events and whether there were any preventable misadven-
tures in management. Again, respiratory derangements
were judged to be the most common cause of failure, fol-
lowed by infections and cardiovascular problems. How-
ever, in terms of management, errors in recognition,
meaning failure to recognize the gravity of the situation,
were the most common preventable or possibly prevent-
able reasons for failure events. It is an inescapable conclu-
sion that inaction was a reflection of level of training and
experience and could illustrate shortfalls in the communi-
cation chain of less to more experience residents to
attending surgeon, all of whom are readily available and
in-house in our institution. Similar disturbing findings
were reported by Symons and colleagues, who noted
that communication failures and delays contributed to
54% of process failures, including failures or delays in
medication delivery, care management, assessment, and
diagnostic investigations.

The layers of resources for the sick hospitalized patient
have traditionally been robust in teaching hospitals. But
there may now be growing weaknesses in the system.
There is no question that nurses represent the first line
of surveillance in hospitals for identification of clinical
problems. This was dramatically illuminated in a report
on Pennsylvania hospitals in 2002 that associated patient
mortality and failure to rescue from complications with
nursing staffing practices. A difference of 4 to 6 patients
per nurse and 4 to 8 patients per nurse was accompanied
by a 14% to 31% increase in mortality and strongly
demonstrated the critical role of nurses and the
tremendous responsibility they shoulder, all the while tak-
ing on new patients, some of whom are fresh from inten-
sive care units, and we illustrated the skills they exhibit in
discriminating those about to fail. As a second line of
care, the surgery resident, in teaching hospitals, is the pri-
mary interface with nursing. As we observed, this is usu-
ally a junior resident, 1 or 2 years from medical school
(sometimes 1 or 2 months) and possibly lacking the expe-
rience and knowledge to sufficiently address nursing con-
cerns and begin prompt and appropriate interventions.
Although there are more senior members available, expe-
rience in our institution and others has identified a lack
of consistency and tendency for errors in care from these
junior residents, perhaps in part because of a failure to
understand the gravity of the situation, or to have been appraised of vital information on shift change, or a failure to avail themselves of the help within reach. The Joint Commission Center for Transforming Healthcare, in their efforts to address hand-off miscommunication, found 20 areas of potential miscommunication between “sender” and “receiver” (generally nursing to physician) including lack of knowledge or recent information on patients, competing priorities by both parties, and lack of standardized procedures for communicating information.26 To this end, De Meester and colleagues27 demonstrated an increased perception of effective communication, an increase in unplanned ICU admissions, and a decrease in mortality after introduction of a systematized process of information transfer using the SBAR methodology (Situation, Background, Assessment, Recommendation). We also feel that in the academic setting, direct involvement of senior level residents is important during periods of patient information transfer, so that critical patient issues can be emphasized and awareness of all residents heightened.

Our study had limitations. Despite the granular nature of our investigation, there were still intangibles that were missed due to retrospective analyses. The subtle interplay of so many health care providers and specialists over time and vagaries of documentation made it difficult on occasion to identify the overwhelming reason for failure or whether management decisions could be justified. In addition, while the sense was that nursing staff were sometimes stretched thin, we could provide no data on staffing practices during some of these critical failure events. Nor could we be sure that we understood the lack of response or perceived inaction by resident physicians, or choices made by attending staff. However, there was a serious and methodical attempt to dissect the medical record, discuss in group, and reach a fair verdict regarding the preventable and nonpreventable outcomes.

CONCLUSIONS
There were some conclusions about which there can be little argument. Those at risk are patients admitted for emergency problems, where optimization of comorbidities has not been possible. Discharge and transfer from intensive care areas is a pivotal point in many patients’ management. These patients may still be at risk on WARDs. Failure events on WARDs are life-threatening occurrences. Most events are respiratory in nature, and it is incumbent on health care providers to recognize and intervene early. Nursing and in teaching hospitals, resident physicians, are the vanguard of this responsibility. Some type of transitional care plan for these high risk patients appears beneficial to reduce adverse occurrences on WARDs and readmissions to the SICU. In general, however, a defined chain of command to include attending surgeons is essential to evoke an appropriate response for any failure event. On a more global scale, perhaps one can infer from our study that it is becoming increasingly delicate to balance the welfare of patients with the welfare of the institution; sicker patients are being sent to traditional WARD units, where close attention may still be necessary but staffing patterns are less than ideal. We also stress the importance of a systematized process of nurse to physician communication and supervised resident handoffs and oversight so as to capture and address all critical patient incidents.

Author Contributions
Study conception and design: Helling, L Martin, M Martin, Mitchell
Acquisition of data: M Martin
Analysis and interpretation of data: Helling, L Martin, Mitchell
Drafting of manuscript: Helling
Critical revision: Helling, L Martin, Mitchell

REFERENCES
Discussion

DR JOSEPH COFER (Chattanooga, TN): In this paper, the authors performed a retrospective review of 98 patients who experienced a total of 111 “failure events” over a 12-month period. Ninety percent of these events occurred in patients who had recently been discharged from the surgical ICU (SICU) or the postanesthesia care unit (PACU) (recovery room). Recognition of this deterioration was by nursing staff 54% of the time, by physicians on rounds 34% of the time, or after initiation of a code or rapid response call. Respiratory deterioration was the single most common occurrence in this patient group that prompted notification. I have the following 4 questions for the authors.

1. Trauma and the acute care surgery service accounted for 58% of the emergency admissions, or transfers from the ward to the ICU in the total patient group, yet vascular, general, and transplant surgery combined accounted for only 11% of the emergency admissions. Was this simply due to the different numbers of patients on these services or a different method of care? In other words, are 58% of your surgical patients on either the trauma or acute care surgery service?

2. In 29% of these events, more than 1 call from the nurse to a physician was required to initiate a response. Did you look into these events specifically? Was the resident in the operating room? Why was more than 1 call needed? You demonstrated no difference in vital parameters between the 1 call group and the greater than 1 call group, but was there a difference in outcome?

3. Would you care to speculate why more of these events occurred during the daylight hours? Was it just that more people were seeing the patient during the daylight hours? As you pointed out, the codes were evenly spaced between night and day.

4. You have shown us your “failure” cycle slide and what I assume are your attempts at correcting the situation. Have you thought about a checklist for any patient leaving the emergency department, PACU, or SICU to determine their suitability for transfer? And how do you intend to implement your Situation, Background, Assessment, Recommendation (SBAR), and how else can we all take away from this very nice paper to improve our patient care?

DR STEVEN STEINBERG (Columbus, OH): Dr Helling and his colleagues are to be complimented for studying failure events in patients on the surgical services in their institution. I have just 1 comment about the fact that more than 30% of their failure events required a second call. We looked at that at our institution. It’s unfortunately not much different. And I suspect it’s not much different from any of the rest of the institutions. It’s unfortunately not much different. And I suspect it’s not much different from any of the rest of the institutions represented in this room. Three of the coauthors served as judges to determine whether the failure events were preventable or not. Do you think that the use of study principles to perform this important aspect of the study, instead of a more blinded set of individuals, could have introduced bias into the findings?

Is there anything specific to your institution that might explain your findings, or do you think that they reflect national trends that we all face? For instance, is there constant pressure to move patients out of your SICU or place patients who would otherwise be placed in the higher acuity units on the medical-surgical units because of lack of ICU or step-down beds?

Do your services have their patients clustered on home units, or are they strewn all over the hospital wherever there is an empty bed?
I just happened to be on service last week on one of our acute care surgery services. We had about 25 patients on the service. To make rounds, we needed to visit 9 different nursing units. I don’t believe that’s an unusual experience.

You mentioned nurse staffing. How is your doctor staffing? Is it sufficient, do you think?

It’s my bias that many of these failures occur because our traditional care team is broken. Our surgical services are taking care of more acutely ill patients than they can handle. The traditional relationships with a unit’s nursing staff have been strained. Nurse staffing has been cut to dangerously low levels in order to control costs. What are your views on the underlying issues leading to these failure events?

What have you done with the information in your institution to minimize the number of failure events? It’s no longer sufficient to simply report on these sorts of problems. We all have them. We all recognize that. We all need help in trying to figure out how to prevent them.

**DR DEAN GRIFFEN** (Shreveport, LA): You showed that 12% of the events were preventable and attribute the cause of this preventability to the failure to appreciate the severity of the event. I have not seen your manuscript, in which you may report causes that are more specific. If not, please revisit these events in an effort to identify the reasons for failure to appreciate severity. Others have found that preventable events are caused largely by behavioral violations that result in failure to apply knowledge and skill instead of failure to possess knowledge and skill. These violations include failure to communicate with other health care providers, failure to see patients in a timely fashion, and failure to consult. These can be collectively referred to as failure to spend time to think and perform ordinary tasks. If we learners and our patients are to benefit from your research, it is imperative that you attribute specific causes of our failures to recognize severity.

**DR FABRIZIO MICHELASSI** (New York, NY): I would like to congratulate Dr Helling and colleagues for a thought-provoking paper and presentation. We all have these kinds of issues, and it’s time that we look at solutions. I have 2 questions.

You presented data on 98 patients who experienced failure events over a certain period of time. What is the number of patients discharged from the surgical ICU and PACUs, and admitted from the emergency room during the same time period, the common denominator, if you will? And, therefore, what is the extent of the issue in your institution?

I was very interested by the timeline of these failures, vis-à-vis the discharge from the surgical ICUs and postsurgical units. And to me, it seems like patients who were just discharged within the immediate 12 or 24 hours really represent a failure to recognize an impending catastrophe before discharge from the high-skilled units. My bias is probably that is the group of patients in whom recognition of impending deterioration and appropriate interventions could alleviate the problems of immediate failure events, rather than the patients who develop a failure event 3, 4, 5, or 6 days after discharge from the units. I was wondering whether my bias is correct, and whether those really represent 2 different groups of patients.

**DR TOM TRACY** (Providence, RI): This is great work, and I think, in my current iteration as a chief medical officer, failure to rescue is a big topic that’s very prominent, at least, in one of our data sets at the University Health System Consortium. It’s a complicated problem, and I think it’s even more complicated in surgery than it has been for medicine.

I would like to ask if you’ve examined in your center whether or not your triggers for your rapid response teams are different between medical and surgical services. In my other life as a pediatric surgeon and chief, we’ve been extremely successful in using physiologic scoring such as PEWS and making it a mandated first step that the rapid response team is called rather than to try to gather together a busy surgical service that may or may not be covered very well. So that’s been an effective help for us. We also use it coming out of our PACU. And, surprisingly, our biggest resistance came from ENT colleagues, but we overcame that by making this mandatory.

We also want to know if there’s any differentiation for the scoring that the services using the system coming out of the ICU. But once on the floor, with nursing being variable, I think that if an absolute physiologic score rules the day, then many of the chances that you notify through communication as well as recognition might be obviated. So I would be interested to hear your thoughts on that.

**DR ANDREW WARSHAW** (Boston, MA): Under the aegis of our malpractice insurer, the CRICO company, a study was done of these adverse events in the Harvard hospitals. Two-thirds of them were due to failure of communication. Many involved the residents and their failure to notify a senior resident or the attending staff at a time of significant change in the condition of a patient. Either the resident did not appreciate the significance of the event, believed it was important to fix the problem alone, or anticipated criticism for calling.

We dealt with that by creating a laminated card with 10 events on it that must be reported to a supervising resident or an attending. This took the onus off the resident as well as making it clear to the supervisors that a call for help is to be expected and welcomed. These included respiratory and cardiac events, unanticipated need for transfusion, transfer to the ICU for instability, etc. Hopefully, the residents internalize the list and don’t need to look at the cards anymore.

**DR JOSE GUILLEM** (New York, NY): I want to congratulate the authors and the Association for presenting this important topic. I just wanted to follow up a bit more regarding the recognition issue. Because to me, it seems that it’s not only an element of the recognition, perhaps a lack of information, lack of sophistication of the junior resident, but what I, as head of the surgical QA, have now begun to recognize is that unfortunately it’s also an element of an attitude. And I think perhaps it’s different than what we older guys faced years ago, the consequences, the accountability factor. I think there’s been a bit of an erosion in that. And we find that maybe not recognizing the problem, not for lack of information, but for a bit of a laissez-faire attitude in the middle of the night.

So I wanted to learn from the author’s perspective, what measures do you have in place? I’m not sure we all face the same issues elsewhere.
DR THOMAS S HELLING: To address Dr Cofer’s questions, we do not have exact figures on the distribution of our services in terms of number of patients, but probably more than 50% of our surgical patients are on acute care surgery or trauma. But there’s also an intermingling of orthopaedic and neurosurgery patients in that.

In those patients who required 1 call from nurse to physician to initiate a response, you asked about outcome. We looked at that. There was no difference in outcome in terms of mortality between those 2 groups.

Why did more events occur during the daylight hours? The obvious answer might be there are more health care providers available during the daylight hours to recognize failure events. Unfortunately, we fear that many of these patients slowly deteriorate during the night and are not immediately recognized. By daytime, they may be pretty far advanced, although not so far as to require a rapid response or a code blue, but far advanced in their deterioration. They’re finally picked up in the morning on rounds. That has been observed and reported by others.

The failure cycle that I showed and the 3 areas of intervention are being addressed by formation of a task force of stakeholders—nurses, intensivists, surgeons, respiratory therapists, and so forth—in order to address some of the findings in the study.

The SBAR is currently used on some of our pediatric units. It’s just a matter of making that institution wide, and I think reporting systems such as that would be very helpful in identifying potential problems when communicating with the physicians. The main takeaway point here is that the patients transitioning from critical care areas are at risk as are emergency admissions who do not have an opportunity for optimization.

Dr Steinberg, as far as bias, of course we tried to eliminate as much bias as possible from our research. We avoided reviewing our own patients. And we sought each other’s help frequently to try to determine preventability and causes. So in that regard, we tried to minimize bias. I am not sure it is ever entirely eliminated, however.

We do not have a step-down unit at our institution. We try to cluster surgical patients on one designated surgical floor. And about 60% of these study patients were from that floor. But that particular unit has no augmented nursing staffing practices.

As far as physician staffing, we have a night float system of 4 residents. We would like to add some physician extenders, and that’s currently in process. That might free up the residents to respond more quickly to night-time calls. And as I mentioned, we are working as a task force to try to address some of these problems.

Dr Griffen, you asked about the 12% that were identified as a failure to appreciate the severity of the situation. We hope that the SBAR reporting method will be a more consistent way to communicate information, particularly from nurses to physicians.

Dr Michelassi, I’m sorry, we do not have a denominator. I asked that question just a few days ago, and we just can’t get at that number. You also talked about early discharge from the ICU. We do it as best we can. We have to have some consensus between surgeon and intensivist before the patient is moved out. So we do review those situations in some detail. There is also input from very experienced nurse practitioners in the ICU. But as far as automatic scoring or other triggers, we do not have that in place as yet.

I’m not sure we will develop a scoring system for ICU discharge. There are some reported in the literature. There’s not uniformity in terms of their validation. But we would certainly consider that in our efforts to correct some of our deficiencies.

Dr Warshaw, we do have a must-call list for the junior residents to attending staff. It’s not quite as granular as we may want. There maybe should be a must-call list for the more senior surgical residents. We would look into developing that as well.

Dr Guillem, what measures do we have for notification? We have 4 residents in house each night, and we have an attending surgeon in house as well. There should be plenty of opportunity to move the situation “up the ladder.” And that is certainly an area of concern. We are now involving our senior level residents in the handoff process, both in the evening and in the morning, to identify problems that may escape the more inexperienced junior resident.