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## CLINICAL COMMENTARY

# Original Research Inpatient Mortality: Investigating Preventability

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### Abstract

**Background:** The Institute of Medicine estimates that 44,000-98,000 hospital deaths are preventable yearly. Despite its importance, literature on preventable mortality is sparse.

**Methods:** All general medicine deaths at an academic hospital from 2010-2012 underwent an independent retrospective chart review by a physician and nurse. Extracted variables included admission risk of mortality, cause of death, potential preventability, and reasons for potential preventability. In instances of disagreement, another physician reviewed the case.

**Results:** A total of 330 mortalities were identified. Nearly three quarters of deaths occurred in intensive care units, and 74.5% were on comfort care. The relative expected mortality according to the APR-DRG was “extreme” or “major” in 91.8% of patients. The causes of death were diverse, although infection was the most frequent cause (52.1%). About 8.4% of cases had a degree of preventability, but very few were probably preventable (2.4%). The Cohen’s kappa for inter-observer reliability was 0.267. Delays were the most common reason for potentially preventable mortality (42.9%). The remainder of etiologies were divided between medical errors (17.9%), post-procedural complications (14.3%), and other errors (25.0%).

**Conclusions:** In a complex population with a high admission risk for mortality, only a small proportion of deaths had any degree of preventability (8%), and even fewer were likely preventable. Quality improvement initiatives should target early detection of deterioration and advance care planning.

### Introduction

Eliminating preventable hospital deaths is a key aim of the quality movement. The landmark Institute of Medicine (IOM) report, *To Err Is Human*, estimated that 44,000 to 98,000 patients die annually in United States hospitals as a result of medical error.<sup>1</sup> This inspired a number of quality and safety initiatives. Hospital mortality has become an increasingly transparent quality indicator. While inpatient mortality has since decreased,<sup>2</sup> it is uncertain whether this is due to improved patient safety, medical progress, or even an increase in out-of-hospital deaths. One study reported that the amount of error in healthcare remains the same.<sup>3</sup>

A number of studies have sought to further quantify and characterize preventable mortality.<sup>4-7</sup> Estimates are most commonly based on retrospective case record review, in which peer reviewers use structured instruments to identify quality of care problems and determine the impact on patient outcomes. While the early reviews on which the IOM estimate was based, such as the Harvard Medical Practice study,<sup>8</sup> did not consider the expected risk of death in absence of medical error, subsequent studies have attempted to assess the degree to which error contributed to death.<sup>4,5</sup> These studies rated a smaller proportion of deaths as probably or definitely preventable, often in patients with limited life expectancy, suggesting that statistics based on prior studies may be over-estimates. However, the hospital settings studied limit extrapolation to our large academic medical center, definitions used for preventability vary amongst studies, and inter-rater reliability is generally fair to poor.

At the launch of our Mortality Reduction Initiative in the Department of Medicine, we wanted to quantify how many deaths at our own institution might be preventable, assess the degree of preventability, and characterize the quality of care issues seen in these cases in order to inform our quality of care improvement efforts. A key objective of our review was to have a high sensitivity for errors in order to maximize the yield of potential quality improvement endeavors.

### Methods

All inpatient mortalities on the University Health System Consortium (UHC) General Medicine service line at our center over a 3 year period (Q1 2010 to Q4 2012) were reviewed retrospectively. UHC is a group of 117 academic medical centers that share data for benchmarking and collaboration to improve patient quality, safety, and value. The General Medicine service line is defined by certain MS-DRGs so that similar populations of patients can be compared across institutions. Our site is a large academic hospital that receives referrals from a considerable region for specialized care and transplants. It is considered a tertiary and quaternary care center.

Our Institutional Review Board (IRB) did not require a formal IRB approval due to the focus of our project as quality

improvement. To maximize the yield and mitigate limitations of retrospective chart review, each case underwent a systematic evaluation with multiple reviewers who assessed not only preventability but also the likelihood of death in the absence of error. Each case was analyzed by a physician and a nurse clinical quality specialist pair. To maximize inter-rater reliability, we used a small pool of reviewers (5) with common training and resource materials. Reviewers had access to provider notes, orders, medical administration records, and diagnostic test results from the index admission. They identified and categorized the reasons for death and any problems with care. Issues affecting mortality were derived from Behal and Finn.<sup>9</sup> The death was deemed likely preventable, potentially preventable, or not preventable, based on the reviewer's analysis of whether there was an aspect of inadequate care that accelerated mortality (Table 1). Deaths were categorized as likely preventable if a patient was likely (>50% chance) to survive hospitalization if the medical error had not occurred. Possibly preventable deaths were identified by reviewers as cases that had issues with care such as a medical error but regardless of the error, the patient was unlikely to survive the hospitalization. Deaths were deemed not preventable if the standard of care was met and there were no concerns about any aspect of care. When the two reviewers disagreed, a second independent physician reviewer examined the case to break the tie and determine the final classification.

Data were entered into an Excel database (Windows 7, Microsoft Office 14) and analyzed using both Excel and SPSS software (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Summary statistics included proportions, means, and medians. Inter-rater agreement was measured using Cohen's kappa coefficient.

## Results

All inpatient deaths on medicine services between 2010 and 2012 were surveyed. A total of 330 patients were identified and included in the analysis with general characteristics outlined in Table 2. About one half (52.4%) were men. The average age at time of death was 68. The majority of the patients were Caucasian (70.0%), followed by Other (15.8%), Asian (8.8%), Black (4.8%), and Native American (0.6%). Nearly three quarters of the deaths occurred in the intensive care units, and patients were present there an average of 4.77 days. Twenty-six percent of deaths took place on the general inpatient floors. The total length of stay averaged 9.71 days. Transfers from outside hospitals accounted for 6.36% of deaths. At the time of death, 74.5% of patients had been transitioned to comfort care.

Most patients in the sample had a high risk of mortality according to the APR-DRG (All Patient Refined Diagnosis Related Group). The highest risk category, labeled "extreme," was calculated in 67.0% of patients, while the next largest group, categorized as "major," encompassed 24.8% of deaths. Furthermore, the admission severity of illness was also very high with 96.7% of patients falling into the most severe categories of "extreme" and "major." The causes of death were diverse (Figure 1), although infection was the most frequent, accounting for 52.1% of deaths. Other common etiologies included acute medical complications (22.4%) and chronic medical conditions (17.9%).

Three reviewers independently investigated the charts for potential preventability in order to capture any possible errors that could be corrected through future quality improvement initiatives. About 8.4% of cases had a degree of preventability, although very few were probably preventable (2.4%) (Figure 2). The Cohen's kappa for inter-observer reliability was 0.267. Delays were the most common reasons for potentially preventable mortality and were categorized as the primary issue in 42.9% of potentially preventable deaths (Figure 3). Examples include delays in administering antibiotics for sepsis, delay in paracentesis in those with cirrhosis, and delays in diagnostic radiologic studies such as a computed tomography angiography chest to evaluate for an aortic dissection. The remainder of etiologies were divided nearly evenly three ways between medical errors (17.9%), post-procedural complications (14.3%), and other errors (25.0%). Medical errors included incorrect antibiotic choice and incorrect dosing of blood thinners. Post-procedural complications were most often due to complications after gastric tube placement in chronically ill patients. Examples of other errors included inability to obtain dialysis access and hospital-acquired infection. About 93% of deaths that were deemed potentially preventable had an extreme or major risk of mortality on admission according to the UHC risk model.

## Discussion

Our study critically examined all internal medicine service mortalities over a 3-year period at our medical center, thus providing better understanding of the frequency of medical errors and barriers to receiving ideal care. Our patients had a very high risk of mortality on admission, due to our hospital's position as a large academic center with an extensive referral network for patients with difficult-to-treat diseases. To the best of our knowledge, there have been very few studies that are applicable to our population due to the high severity and medical complexity of our patients. Our results indicate that the majority of deaths are not preventable, and the vast majority of patients (97.6%) were unlikely to survive the hospitalization even with the optimal medical care. Our findings may be generalizable to other large academic medical centers and allow for comparison between practices.

Our patients had high severity of illness with high likelihood of death despite any potential inpatient practice modifications. A frequent theme was the lack of documented advance care planning prior to admission. About three quarters of patients were on comfort care and an even greater proportion had "do not resuscitate or intubate" orders at the time of death. However, patients were commonly full code on admission, which was changed during the hospitalization as their clinical status worsened. Interestingly, 50% of patients who died in the emergency department were on comfort care, which suggests that their goals of care may have not been in keeping with transfer to an acute care center.

Patient-centered planning nearing the end of life is a key measure to prevent readmissions according to the Institute for Healthcare Improvement.<sup>10</sup> An increasing number of patients are dying in acute and subacute care settings. In one study, families of decedents were more likely to rate their family member's end of life care as "excellent" if they died on home

hospice as opposed to a hospital or skilled nursing facility (70.1% vs <50%,  $p<0.001$ ),<sup>11</sup> which has been commonly reported in the literature.<sup>12</sup> In a study of patients with lung cancer, early palliative care consultation and support actually increased longevity from 8.9 to 11.6 months when compared to the usual treatment group ( $p=0.02$ ).<sup>13</sup>

Ideally, the subset of patients at our institution with progressive illnesses would have early advanced care planning in the outpatient setting. This would not only allow patients to better convey their wishes in a less pressured environment but also decrease the burden placed on their families to make such difficult, urgent decisions when they are often incapacitated. Improved outpatient discussions regarding goals of care may decrease the frequency of inpatient deaths. In a matched cohort study of elderly patients at high risk for hospital admission, patients underwent goals of care counseling at their primary doctor's office.<sup>14</sup> The authors observed a statistically significant decrease in the rate of admission, number of hospital days, and overall cost when compared to pre- and post-intervention groups as well as to the control group. Of those who died during the study period, 73.3% of the control group passed away in the hospital compared to 18% in the intervention cohort ( $p=0.007$ ), thereby highlighting the impact of counseling high-risk patients in the outpatient setting. Patients often present to the hospital without advanced directives. Even simple inpatient goals of care discussion among stage IV cancer patients has been shown to decrease the rate of intensive care unit admission and increase the rate of hospice.<sup>15</sup> Furthermore, increased spending at the end of life accounts for much of the rising health care costs in America.<sup>16</sup> Among Medicare beneficiaries, about 5% of patients who die each year account for 27.4% of the total expenditures.<sup>17</sup> Early advanced care planning would likely decrease costs, reduce inpatient mortality, and increase patient comfort.

The deaths deemed potentially preventable are similar to those reported by other academic medical centers.<sup>4,6</sup> Our study design allowed for the maximal capture of medical errors by identifying issues with care that had any chance of contributing to the patient's outcome. By having a high sensitivity coupled with determining the reasons for death and reasons for potential preventability, we were able to more finely examine systems issues. This information has translated into hospital-wide quality improvement projects including our early sepsis detection initiative, which aims to decrease preventable inpatient mortality and morbidity. Additional analysis by our independent reviewers categorized cases into potentially preventable and possibly preventable based on the overall trajectory of the patient and whether the issue(s) identified were likely to contribute to the patient's eventual mortality. By focusing on whether the death was likely caused by the problems identified, we could more accurately discern whether mortalities were truly preventable. Another strength of our study is its utilization of multiple independent reviewers, at least one of whom was an MD.

Mortality research is difficult, and we acknowledge several limitations to our study. This is a retrospective study based on existing documentation, and the actual events may have differed if they were not documented appropriately. Next, mortality is a rare event, and we used a low threshold to place

patients in the potentially preventable category and by examined 3 full years of data. However, there are many more adverse events that are not captured by using mortality as an outcome measure. Mortality review can help identify quality issues, but since only a small proportion of deaths are likely preventable, quality monitoring should not be limited to this population. Furthermore, preventability is a subjective assessment. Although the reviewers had the same instructions and guidelines, there still remains an element of subjectivity. This is shown by only a fair rate of inter-rater agreement, which is consistent with prior studies.<sup>4,5</sup> Our experience at a single institution also limits the generalizability; however, it adds to existing literature on an academic medical center practice. Studies with a similar structured review of mortality would help provide further insights in preventable inpatient mortality as well as practice variations among institutions.

By analyzing each mortality during this 3-year period, we have a better understanding about the hospital systems, patient, and provider factors that can affect care. Future directions for our Medicine Mortality Reduction Initiative include targeted quality improvement projects based on the areas of concern identified by our study, which range from medical errors to system delays to advanced care planning. Moreover, our analysis has expanded to in-person meetings with clinicians after a death occurs in order to acquire more information that may not be documented in the medical record, a process that has shown promise in a few other institutional pilots.<sup>6,18</sup> We have found value in structured mortality review to quantify preventability, identify care issues, and target quality initiatives. We believe that other hospitals would benefit from adopting similar practices.

Tables and Figures

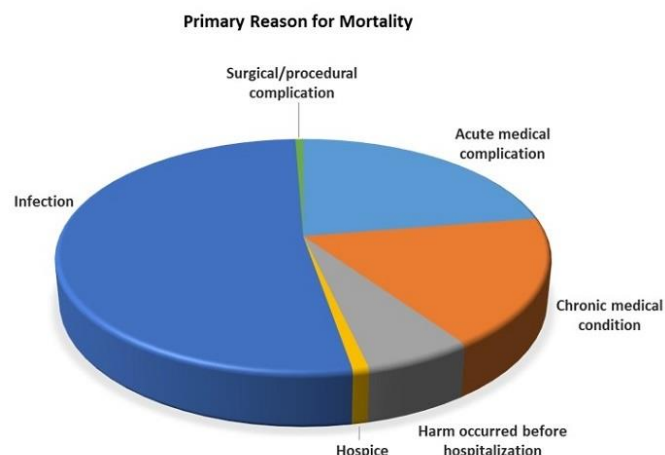
Table 1. Preventability Definitions.

| Category             | Definition                                                                                     |
|----------------------|------------------------------------------------------------------------------------------------|
| Likely preventable   | Likely to survive hospitalization (>50% chance) if standard of care had been met               |
| Possibly preventable | Aspect of care suboptimal but unlikely to survive hospitalization even if standard of care met |
| Not Preventable      | Standard of care fully met                                                                     |

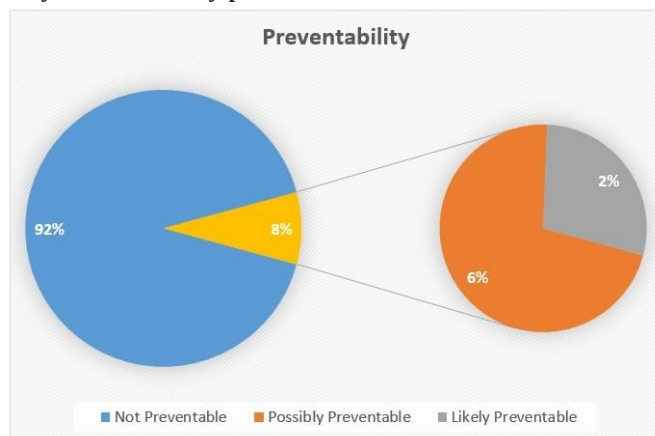
**Table 2.** Patient Characteristics. Demographics and selected traits of the 330 reviewed mortalities.

| Characteristic                            | Number (%)  |
|-------------------------------------------|-------------|
| Male gender                               | 173 (52.4%) |
| <b>Race</b>                               |             |
| White                                     | 231 (70%)   |
| Asian                                     | 29 (8.8%)   |
| Black                                     | 16 (4.8%)   |
| Other                                     | 54 (16.4%)  |
| Average age                               | 68          |
| UCLA primary medical doctor or specialist | 138 (41.8%) |
| Transfers from outside hospitals          | 74 (22.4%)  |
| Transplant patients                       | 49 (14.8%)  |
| Average length of stay in days            | 9.7         |
| Average Intensive Care Unit days          | 4.7         |
| Mean Charges                              | \$161,779   |
| Median Charges                            | \$89,682    |
| Comfort care at time of death             | 246 (74.5%) |

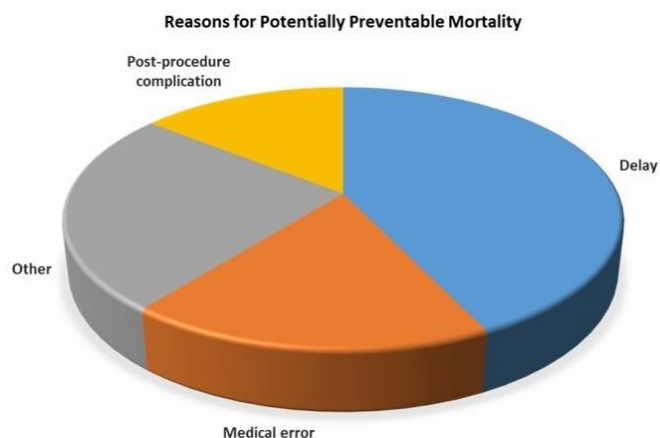
**Figure 1.** Primary reason for mortality. The primary type of decompensation was determined in all reviewed cases. Infectious causes were the most frequent, followed by acute medical complications and chronic medical conditions.



**Figure 2.** Preventability. Most mortalities (92%) were deemed not preventable, while about 8% had a degree of preventability. Only 2% were likely preventable.



**Figure 3.** Reasons for Potentially Preventable Mortality. A variety of etiologies were identified as possibly contributing to preventable mortality including delays (42.9%), medical errors (17.9%), and post-procedure complications (14.3%).



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