Learning From Every Death

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The concepts of peer review and the venerable morbidity and mortality conference are familiar improvement approaches to health care providers. These 2 entities are typically provider or patient centric and are not typically extended within hospitals and health systems as a tool for organizational learning for care process or system failures. Out of a desire to deepen our understanding and accelerate learning about quality and safety opportunities in our hospitals, Mayo Clinic embarked on journey to analyze the stories of all patient deaths. This paper illuminates the lessons learned through the development and evolution of the Mayo Clinic Mortality Review System (Rochester, MN).

Guiding principle of Mayo Clinic Mortality Review System:
"No one should ever suffer or die as the result of process of care or system failure."

BACKGROUND

In 2003, we were using the Institute of Healthcare Improvement's (IHI) Global Trigger Tool (GTT) to bolster identification and trending of adverse events. Although we were able to successfully implement the GTT, a discontent grew with its intended purpose of trending rates of events through time. For our institution, the data from the GTT were not specific enough to guide or prioritize process improvement initiatives. Although it is important to trend data, one cannot expect the rates to change through time if causes are not identified and initiatives launched to mitigate future harm.

Safe Practice 4 of the National Quality Forum's Safe Practices for Better Healthcare (2010 Update) speaks to the importance of identifying safety risks to be eliminated.[1] Specifically, the practice statement is written: "Healthcare organizations must systematically identify and mitigate patient safety risks and hazards with an integrated approach in order to continuously drive down preventable patient harm."[1] Nearly 20 years prior, conclusions from the 1991 Harvard Practice Study read: "Reducing the incidence of these events will require identifying their causes and developing methods to prevent error or reduce its effects."[2,3]

As a result of this quest for identification of patient safety issues that can be mitigated, we developed a mixed method (qualitative and quantitative) system to carefully review the antecedent care delivered to patients who died within our hospitals in near real-time. The purpose of this article is to elucidate the lessons learned through the development, implementation, maturation and spread of this multidisciplinary mortality review system (MRS).

SETTING

Mayo Clinic in Rochester, MN, is a multispecialty inpatient and outpatient group practice. The hospitals and clinics operate as one entity and only staff physicians admit and care for hospitalized patients within the system. The initial development and implementation of the MRS occurred within the following hospitals: Rochester Methodist Hospital containing 794 licensed beds and 41 operating rooms for elective surgeries and special services including obstetrics and transplant; St. Marys Hospital, a 1,265-bed hospital with 55 operating rooms serving also as emergency room access; the Eugenio Litta Children's Hospital and a Level 1 Trauma Center; and the Psychiatry Treatment Program, a 108-bed inpatient treatment facility.

Since the onset of the 100% mortality review system, more than 7500 consecutive deaths were reviewed and included in the mortality registry. Approximately 63% of these deaths occurred on medical services, 16% on surgical services, and 21% on medical specialty services (e.g., neurology, oncology, physical medicine, and rehabilitation). The

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median age of these patients at the time of their deaths was 70 years, ranging from newborn to 103 years of age. The median length of hospital stay was 5 days with a range of 0 to 307 days.

METHODS AND LESSONS LEARNED

The MRS began as an unstructured, implicit review of the antecedent clinical care delivered for 100 consecutive patients who died in Mayo Clinic, Rochester, hospitals during the 4th quarter of 2003. Adverse events identified through these mortality reviews were reconciled with the Sentinel Event Program and the adverse event voluntary reporting system. None of the serious events identified in these first MRS reviews were also found in the databases of these other sources. We reached the conclusion that there were missed opportunities to detect patient safety issues, and therefore, missed opportunities to mitigate future harm. A methodology was needed to detect unreported adverse events.

Ideal Mortality Review

After the initial 100 consecutive death review performed in 2003, the MRS methodology developed gradually by a multidisciplinary group of nurses, doctors, a pharmacist, and administrator. From 2004 to 2005, only approximately 30% of the deaths were reviewed while effort was placed into methodological development.

The concept of an ideal mortality review evolved during this timeframe. The basic tenants included the following: (1) at least one nurse and one physician review every death, (2) additional specialty level nurse and physician reviewers are included if any patient safety issues are discovered, (3) reviewers are active care providers, (4) identification of patient safety issues are consensus driven among reviewers, (5) findings are recorded and discussed centrally to promote trans-departmental learning, (6) the feedback loop is closed with all levels of leadership and care providers, and (7) allow everyone the opportunity to learn from the experiences of other providers and reviewers.

To promote the ideal mortality review, the clinical hospital leadership (Hospital Practice Committee) laid out a specific charge for the MRS team.

- to create a meaningful mechanism to review deaths in MCR hospitals:
  - provide a thorough understanding, and
  - identify measurable and improvable patient safety issues;
- to identify and quantify unanticipated deaths;
- to identify rates of adverse events in patients who die in MCR hospitals; and
- to classify and quantify system-level changes which will improve the MCR mortality rate.

Decision to Review 100% of Deaths

The ideal mortality review consumes a significant amount of personnel resources. The initial detailed review requires 30 to 60 minutes each for physician and nurse reviewers depending on length of hospitalization. We explored several sampling methodologies (e.g., random selection, age groups, IHI's "Box 4" during the period of MRS process development to limit the resource requirements. We tested the impact of sampling methodologies on event detection yield. Segmenting the hospital deaths by code or palliative care status at admission did not meaningfully reduce the number of deaths to be reviewed because only 1.6% of the admissions were for palliative care during the testing time period (fourth quarter of 2005). Segmenting patients by location of admission (general medical/surgical floor or intensive care unit) held the potential of decreasing the number of deaths to be reviewed. However, adverse event detection yield was similar between the groups of admission locations. Likewise, we did not find a significant difference in yield of adverse event detection by sex, race, or age. The goal was to identify as many adverse events as possible. Any of these attempts at segmentation significantly decreased the ultimate yield for system-based learning.

Ultimately, the decision to perform reviews of 100% of our deaths was based on recognition of the importance of transparency of learning and information. The MRS team was committed to providing care providers and family members with information regarding events that may have occurred during the hospitalization. Selecting cases to be reviewed by any criteria (code status, type of nursing unit, age, disease, etc.) created a potential biased scenario of inability to provide answers to family members or providers seeking information.

The possibility of decreasing the resource burden for MRS has been reevaluated every couple of years since 2005. Each time the potential loss of adverse event detection yield (30%–50%) was thought too great and MRS continues with 100% of all deaths.

MRS: Not the Traditional Morbidity and Mortality Conference

An important lesson learned was the distinction between MRS and traditional M&M. There is a long tradition of M&M conferences in medical education and practice. Historically these have centered on physician decision making and/or interesting or rare disease processes. The M&M conference is often specialty specific with possible teaching from pathologists or other specialists in a relevant clinical area without multidisciplinary input (e.g., nurses, pharmacists). In contrast, the MRS is a systems review. Names of providers are not included in the review, nor are they ever discussed. The MRS was intentionally designed to incorporate input from all disciplines and specialties relevant to the patient's care. In contrast to traditional M&M conference where the patient's diagnosis or clinical outcome is of primary interest, the MRS was designed to focus on the processes of care along with both patients' and providers' experiences. The aggregate of these perspectives develop a story of the patient's episode of care ending in death.

Local Clinical Expertise and Impediments to Review Completion

The ideal mortality review is performed by practicing clinicians (nurses and doctors) from the area of hospital or specialty providing care at the time of patient's death. We experienced 2 hurdles while reaching toward this ideal: (1) The area of clinical practice is not yet voluntarily involved in the MRS, and (2) Assigned reviews are not completed in a timely fashion.

The first hurdle of localizing reviews to each area of clinical practice resolves through time as the methodology is adopted and spread. At the onset of MRS development, the reviews were completed by a group of interested, voluntary nurses, hospitalists, intensivists, and surgeons. At that time, a more generalist approach was used for the first review and any patient safety issues identified were referred to an appropriate specialist for further detailed review of the clinical processes in question. As MRS matured and evolved, a concerted effort was made to spread the

review process to all areas of the hospital to ensure appropriate level of clinical expertise by first reviewers.

The second hurdle for 100% timely review completion is a consequence of the intent to ensure local clinical expertise in the review process. Decentralizing reviews to local clinical providers lead to a slower review completion rate. To combat this, we placed a goal time to complete the review (approximately 1 month) to ensure timely feedback to clinical leadership regarding events that may have occurred in their respective clinical areas. Another solution implemented for the problem of delayed review completion was the development of "super-reviewer" role. Nurse and physician super-reviewers have years of experience with MRS and are responsible for ensuring that all reviews are completed. Super-reviewers collaborate with local clinical specialists to ensure that the appropriate expertise is brought to the case review. Given the critical importance of completing all reviews, their time required to perform the extra reviews is supported by the quality leadership. This role is necessary to keep the 100% mortality review goal achievable.

Bias

Mortality review system is a retrospective, subjective process wrought with unintended bias. The largest source of bias lies with the reviewer. For mortality reviews performed within the clinical area of the patient's death, hospital leadership raised the concern of objectivity and willingness to report possible clinical process shortcomings in their respective areas. Conversely with a centralized process, where all reviews are performed by a small group of individuals, reviewers may not have the expertise needed to perform the review and the clinical area may not be receptive to opportunities for improvement identified by outside reviewers. Ultimately, the goal for MRS is to learn as much as possible about unreported patient safety issues and mitigate future recurrences. We acknowledged that changing clinical practice to improve safety requires the buy-in and explicit participation of the providers in that area. Their involvement has been easier to secure when they are directly involved in the MRS and identification of the safety concerns.

Professionalism

Professionalism is of utmost importance for reviewers. They are expected to remain as objective as possible and complete reviews on time. Reviewers are expected to maintain the confidence of the providers' whose cases they review, not include names in the qualitative portion of the review and not discuss personal specifics of any provider's experience. MRS is not intended to be peer review, it is process and system review. These expectations are explicitly stated during a thorough training and orientation process. New reviewers are informed that there are 2 historical reasons for reviewers being replaced by another. The first was habitual tardiness or incompletion of case reviews. The second reason for being replaced on the review team was never identifying a safety issue in their respective clinical area. Prior adverse event research performed in our hospitals identified an adverse event rate of 27.7% of all discharges using the GTT.[4] Although MRS uses a different approach than the GTT, we believe that it is unreasonable for reviewers to never find anything that could be improved in their respective practice. We learned that the reviewer selection and orientation processes, both stressing the importance of professionalism, are crucial to ensuring thorough and consistent mortality reviews.

Away From Preventability

Obtaining visible leadership support was crucial for the successful evolution of the MRS. In the beginning, the concept of "preventable deaths" was used based on modifications of the taxonomy used in the landmark Harvard Practice Study.[3,5] We intentionally used it to not only get hospital leadership's attention but also to motivate mitigating changes in clinical practice. All deaths were classified in 4 gradations of preventability (Table 1). We used a multidisciplinary, multispecialty consensus driven process to assign these preventability designations. This consensus was pursued to proactively address expected pushback in labeling any death as preventable. With time, the actual types of issues or adverse events identified became more important and were the most frequent data requested from our leadership. As an example, the clinical leadership recognized that regardless of preventability, a fall or delay in a diagnosis presented opportunities for improvement. Eventually, the designation of preventability was no longer reported and, therefore, not meaningful to the overall MRS process. To align our mortality classification system with this philosophical change, we adopted the system used by the American College of Surgeons (ACS) described for trauma deaths. Table 1 depicts the preventability classification system used at the onset in comparison to the classification adopted from ACS.

Reliability of Reviews and Quality Assurance

The requirement of multidisciplinary reviews necessitates reconciliation of findings between reviewers and validation of events reported. It is anticipated and desired for nurses and physicians find and interpret system issues differently through the course of a patient chart review. The evaluation of the medical record was intentionally designed to be implicit to yield as much learning as possible from the differing perspectives of care providers. All views are crucial to understanding as much of the story of care delivered as possible; therefore, interrater reliability was not an explicit goal of the MRS. The reconciliation process was designed to verify findings and discrepancies between providers. Differences of opinion are resolved with open discussion and consensus development during face-to-face monthly case review sessions.

TABLE 1. Schema Used for Classification of All Deaths

Original Classification Scheme	Current Classification Scheme
Definitely not preventable	Anticipated death with no opportunities for improvement
Not preventable, but with issues	Anticipated death with opportunities for improvement
Possibly preventable	Unanticipated death with opportunities for improvement
Probably preventable	
Definitely preventable	

Although interreviewer reliability for the qualitative identification of issues in the medical record is not expected, consistent use of definitions used to quantitatively classify or label patient safety issues is expected. For example, the classification or label of "delayed diagnosis" must carry the same meaning across cases and through time. This consistency became considerably more difficult to ensure with the decentralization of the review process into local clinical areas across the institution. This decentralization resulted in a larger number of people, each performing relatively few reviews. We, therefore, initiated a formal quality assurance process to assess consistency of definition utilization. A fixed number of cases, randomly selected each month, are re-reviewed by an experienced and specific physician and nurse. The random selection of cases for rereview was weighted to account for areas of the hospital that experience a disproportionate number of deaths (e.g., intensive care unit). We found evidence of definition migration through time and with expansion of number of reviewers. This illumination of an inherent weakness in the MRS resulted in a modification of the orientation and training processes. In addition to the quality assurance re-reviews discussed previously, the first 3 to 5 reviews completed by every new reviewer are re-reviewed by an experienced reviewer with appropriate opportunities for improvement shared with the new member of the team.

RESULTS

As encouraged by the NQF's Safe Practice #4,[1] the MRS was developed to systematically identify safety risks that could be eliminated. The primary aim was to learn as much as possible about nonreported patient safety issues and provide this detailed information to clinical leadership for process improvement prioritization.

Preliminary Results

The clinicians involved in the early reviews believed that mortalities would be an ideal methodology for meeting the requirement established by the NQF's Safe for 3 reasons: (1) the complete clinical encounters were available for review, (2) the population size was limited and easy to identify, and (3) hospitalizations resulting in death were likely to have a higher yield for adverse event detection. To test the latter hypothesis, all deaths that occurred in the fourth quarter of 2005 were reviewed using both the GTT and the MRS process. In 2005, the adverse event rate detected by GTT in these same hospitals was 27.7% of randomly selected discharges.[4] The rate of events identified with the MRS was 3 times the GTT detection rate for patients whose death was characterized as "unanticipated" by the MRS reviewers. Knowledge gained through systematic mortality reviews allowed clinical leadership to gain a better understanding of overall safety issues faced by those who die in our hospitals. The learning opportunities from system reviews of all deaths was validated in 2008 when the event detection yield of all data sources were compared for patients who died. Table 2 details the results of this comparison. The MRS provided information and details for nearly 50% of all events identified in 2008. In addition, 35.7% of all events identified in 2008 mortalities were only identified through the MRS.

Although these system reviews of all deaths have been ongoing for years, learning about safety risks and prioritization of improvement initiatives continues. Several key pieces of organizational learning from the MRS are noted below.

Recognition of Omission Versus Commission Events

In our institution, events previously identified by the GTT and voluntary reporting system could be characterized as events of commission. In other words, these adverse events were associated with the consequences of evaluation or treatment received during a hospitalization for an acute illness. Examples include renal failure secondary to intravenous contrast given during angiography, pneumothorax resulting from a bedside thoracentesis, or gastrointestinal bleed requiring transfusion in a patient with supratherapeutic anticoagulation. However, many of the patient safety opportunities identified during the MRS process are better characterized as events of omission. These events are consequences of care not delivered at the appropriate time or possibly location. Examples include delayed recognition and initiation of treatment for septic shock or failing to call the Rapid Response Team when physiologic triggers are present. This recognition that adverse events include both issues of commission and omission changed the tenor and context of patient safety discussions in our hospitals

Reporting and Transparency

Closing the loop requires a level of comfort with transparency, including a willingness to discuss deficits that may exist in the local health-care delivery system. For providers to be receptive to transparent sharing of events beyond the team that was involved in the care, the data must be meaningful, constructive, and modifiable through practice change. We formed a data morbidity and mortality council to concentrate on developing mortality reports that would engender comfort with this transparency. Aggregated findings are shared across all

TABLE 2. Sources of Adverse Event Detection and Respective Yield From Each Source in 2011

Source of Event Detection	% Events Identified in Only One Source	% of Total Events Identified
Mortality Review System (MRS)	35.7	49.6
Voluntary Reporting (VR)	10.4	23.9
Infection Control (IC)	31.3	45.2
Sentinel Events (SE)	1.3	6.5
MRS + VR		6.1
MRS + IC		9.1
MRS + SE		2.2
Events identified by 3 sources		3.0
Events identified in all 4 sources		0.4

clinical areas and disciplines in the hospital. All patient information is deidentified in these reports. Patient, clinical provider, and reviewer confidentiality are all strictly maintained, ensuring the transparent focus on the system and not the care providers. This is balanced with the recognition that learning is enhanced when information is relevant to the respective clinical areas. Therefore, clinical department and nursing unit specific reports are generated.

The quarterly mortality reports include a statistical process control chart of mortality rate, Pareto diagrams of events or issues identified during the MRS reviews (if number of issues is large enough to display) and brief summary of the patients' stories specifically cared for in the respective areas. The reports provided to all clinical areas in the hospital were intentionally designed to share patients' and providers' experiences without being prescriptive. To date, no response to these reports is required. The objective of the transparency and reporting process is to promote organizational awareness and learning.

Culture

Not only did culture influence the development and growth of the MRS but also the MRS has had an unexpected impact on the culture of local patient care units. Several intensive care units were early adopters of the MRS and began to incorporate discussions of cases into interdisciplinary meetings, rather than withholding the discussions for discipline-specific meetings. With time, several units developed interdisciplinary meetings for the sole purpose of discussing the deaths that occurred in their clinical area during the preceding month. The MRS helped to facilitate this by incorporating their team findings directly into the MRS, rather than duplicating their effort by assigning yet other providers to review the case. As each clinical area and patient care unit became involved, there has been a broadening of interdisciplinary discussion about patient care and the related adverse events.

MRS Spread

Spread of the MRS has occurred throughout the clinical areas in Rochester, MN (e.g., ICU's, surgery, cardiology, emergency medicine, oncology, etc.). There are now more than 120 nurse and physician reviewers involved in MRS. We believe there were 2 important components of this successful spread throughout the organization. The first, and most powerful, is the use of stories. There are many powerful stories in the lives of our patients. This holds true at the end of their lives as well. As healers, we often shy away from the last moments of life and find it difficult to specifically focus on the events transpiring before death. The stories we are able to tell, because of MRS, shed a bright light on both the exemplary care and on areas where the system could improve. There are very few practitioners who are not motivated to act when presented with clear opportunities for improvement with the potential of saving future lives.

The second component driving successful MRS spread was the guiding philosophy. A set of three guiding principles were laid out as the foundation for each practice area adopting the MRS: (1) a nurse and physician must both review each death, (2) findings must be recorded in the central mortality registry, and 3) reviews need to be completed in a timely fashion. How individual practice areas organize, assign reviewers, form their discussion groups, and so on were left to their discretion. We assumed that practice areas have different local cultures; therefore, what might be effective for one area, may not be for another. There was no attempt to prescribe how the work should be accomplished; only that it is completed in a timely manner according to the guiding principles. The MRS leadership kept track of how each practice area piloted and evolved their local efforts. These lessons learned, and their related stories, were shared with each new clinical area as they engaged in the MRS.

Mortality and Adverse Event Reduction

In the 10 years since the inception of MRS, the stories and data carried back to the clinical practice resulted in educational programs and provided impetus for standardization and spread of best practice. Examples include improved sepsis recognition by nursing, the initiation of sepsis order sets within and outside of the ICU, changes in visualization of vital signs in our electronic medical record, practice initiatives including a new Admissions Coordination Office, and an active promotion with increased utilization of the Rapid Response Team.

Ultimately, the overarching goal of the MRS process is to reduce inpatient mortality through mitigation of patient harm. Mayo Clinic, Rochester, MN, achieved a statistically significant reduction in mortality rate at the end 2009. Figure 1 illustrates the timing of these practice improvement initiatives in relationship monthly average overall mortality rate. The MRS was not the instigating factor in all of these initiatives; many were already conceived or even initiated. However, the MRS results did provide fuel for ongoing movement and allowed leadership to prioritize next steps when there were many quality improvement ideas under consideration.

Figure 1 is a statistical process control chart of raw, unadjusted inpatient mortality rate. It is annotated with some of the major initiatives through to contribute to the mortality rate reduction. Table 3 briefly describes these initiatives.

DISCUSSION

The Mayo Clinic, Rochester, MN, journey to develop a meaningful and measurable mortality review process began more than 10 years ago. The multidisciplinary and multispecialty nurse and physician reviews are the heart of this MRS. The reviewer's mindset, most effective for the MRS, is the ability to step back from the clinical care and visualize the care system from both patients' and providers' perspectives. Reviewers must be able to identify exemplary care when they see it; yet also, willing to acknowledge care that does not meet standards set by the institution. Bias is the greatest challenge because these reviews are completed when the outcome is already known. Resulting limitations include the potential to over or underinterpret sequences of events described incompletely in a medical record.

The most important human quality to endanger the success of a long-lasting MRS is burnout. Reviewing case after case where the patients ultimately die can become discouraging. The reviews are also time consuming. It takes approximately 15 to 60 minutes, for both nurses and physicians, to provide the first comprehensive review with concise written summary of the patient's clinical course. This requires dedicated time to either be built into the providers' job descriptions or time supported away from the clinical practice. Decentralization of the reviews to local practice areas helps with this workload and burnout issue. Although in aggregate, there may be several deaths for the entire hospital, individual floors will have relatively less mortality rate. There is therefore less review burden on any one clinical area or individual. However, this results in less experienced reviewers who do not gain the benefit of efficiency accrued with experience. We continue to work on this issue of burnout and reviewer

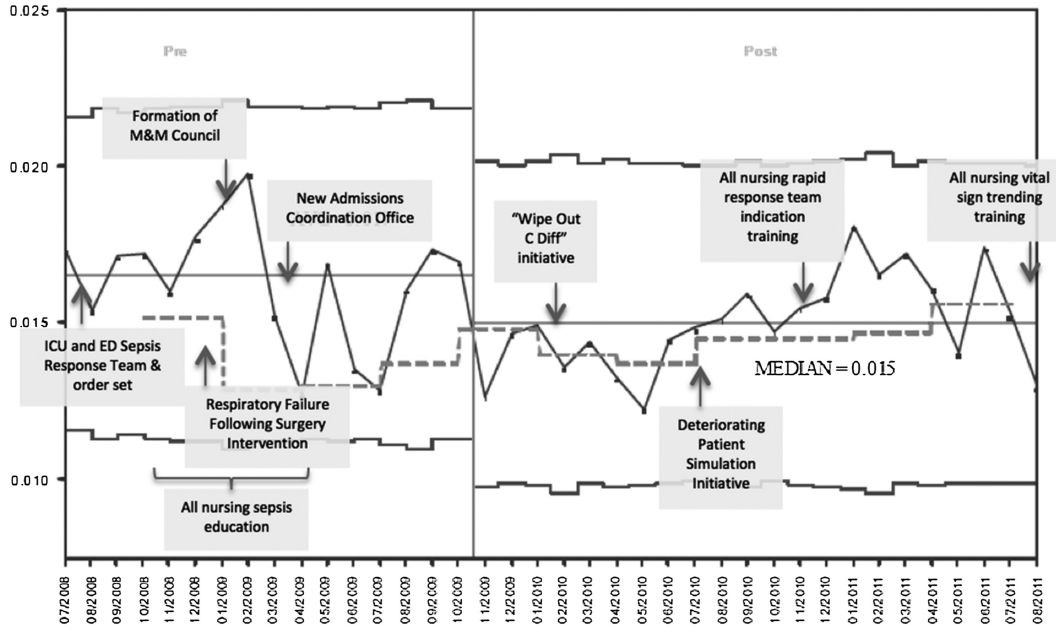

FIGURE 1. Annotated statistical process control chart of raw inpatient mortality rate from mid-2008 through mid-2011. The green line represents the median raw inpatient mortality rate. The break in the green line represents the onset of the statistical decrease in mortality rate. The red lines represent the third standard deviation for the median mortality rate. The blue line represents a calculated benchmark of mortality rates for the top tenth percentile of academic hospitals in the United States. This blue line is calculated from University Healthcare Consortium data. Each of the boxes name major practice initiatives thought to contribute to the reduction and control of the overall mortality rate.

retention. The average duration of physician reviewers' involvement with the MRS is approximately 2 years.

CONCLUSIONS

The MRS in our hospitals evolved gradually over more than 8 years and continues to be enhanced within its own improvement cycles. We view the identification of unreported patient safety opportunities, ongoing MRS spread, reviewer recruitment, reliable data, provision of timely feedback to the clinical practice, transparency of findings, and new quality improvement initiatives responding to MRS findings as evidence of success. However, it is time consuming, labor intensive, and wrought with the subjectivity of retrospective peer review. Our hospital and quality leadership openly discuss these pros and cons. They take the patient safety findings seriously and weigh them in conjunction with other competing priorities for quality improvement resources. The MRS is a powerful driver of the safety culture, increases motivation for

TABLE 3. Major Practice Initiatives Thought to Contribute to the Statistical Reduction and Control in the Overall Mortality Rate

Practice Initiative	Description
ICU and ED sepsis response team and order sets	Standardization of early goal directed therapy for sepsis and septic shock
Respiratory failure following surgery intervention	Remote respiratory monitoring for early postoperative patients receiving analgesia by PCA infusion devices
Admissions Coordination Office	Establishment of standard admission, and within hospital triage, criteria with 24/7 physician and nurse involvement to ensure best match between patient's severity of illness and scope of nursing care delivered on the receiving patient care unit
All nursing sepsis education	Mandatory education for all hospital nurses regarding early recognition of sepsis
"Wipe Out C Diff"	Daily use of bleach wipes to clean all commonly touched surfaces within patient rooms (e.g. door handles, counter tops)
Deteriorating Patient Simulation Initiative	Development of educational simulation cases for multidisciplinary team training
All nursing RRT indication training	Mandatory education for all hospital nurses regarding criteria for calling the RRT
All nursing vital sign trending training	Mandatory online training for all hospital nurses demonstrating an efficient method to evaluate changes in patients' vital signs over time (not the default view in the electronic medical record)

ICU indicates intensive care unit; ED, emergency department; PCA, patient controlled analgesia; 24/7, 24 hours per day and 7 days per week; C Diff, *Clostridium difficile*; RRT, rapid response team.

practice modifications required to mitigate future occurrences of harm, and constantly promotes organizational learning.

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