Clinical Excellence Series

Eliminating Preventable Death at Ascension Health

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In 2002 Ascension Health, the largest Catholic and largest nonprofit healthcare system in the country, articulated a call to action with a commitment to provide 100% access to safe, effective care for patients. The 2005 Ascension Health Strategic Direction was based on the call to action, which promised "Healthcare That Works, Healthcare That Is Safe, and Healthcare That Leaves No One Behind." As part of its Healthcare That Is Safe strategy, Ascension Health identified eight priorities for action and adopted a goal of clinically excellent care with no preventable injuries or deaths by July 2008.

In November 2003, Borgess Medical Center (Kalamazoo, Michigan) accepted the invitation to become the alpha site to address the elimination of preventable deaths. The inclusive nature of this priority for action presented the opportunity to create a multifocal approach to the initiative.

Borgess Medical Center, a 424-bed tertiary community teaching hospital, has 30 critical-care beds distributed across four intensive care units (ICUs)—medical/coronary, cardiac surgical, neurocritical, and surgical/trauma. The intensivist and hospitalist models were in place before it undertook the alpha initiative. The multifocal approach to the initiative was integrated into these infrastructures. The alpha initiative included the following strategies for critical care patients:

- Implementation of multidisciplinary rounds and daily goals sheets on each patient
- A bundled approach to prevent ventilator-associated pneumonia
- A bundled approach to prevent bloodstream infections related to central vascular access catheters
- Tight glycemic control with insulin drips

Article-at-a-Glance

Background: Borgess Medical Center, the alpha site, developed innovative strategies to eliminate preventable deaths—one of Ascension Health's eight priorities for action.

Implementation of Strategies: A multifocal approach included the intensivist and hospitalist models and six strategies, four in critical care and two outside critical care.

Results: The results of one critical care strategy—tight glycemic control with insulin drips—and one non–critical care strategy—deploying rapid response teams—are reported for three periods: Period 1 (baseline; April 1, 2003–March 31, 2004), Period 2 (April 1, 2004–March 31, 2005), and Period 3 (April 1, 2005–March 31, 2006). Hyperglycemia (> 150 mg/dL) decreased from 48.12% to 37.18% (Period 2) and 25.08% (Period 3). Hypoglycemia (< 70 mg/dL), beginning at 1.64%, increased moderately, to 1.69% and 2.15%. Rapid response team calls per 1,000 discharges increased by 77.54% from Period 2 to Period 3—from 6.28 to 11.15. With an overall 25% reduction in mortality rate as a realistic expression of "eliminating preventable death" by 2008, observed mortality decreased during a two-year period by 19.2% (± 0.74%).

Discussion: Decreases in mortality were accompanied by control of hyperglycemia in critical care and the implementation of rapid response teams to rescue patients before cardiopulmonary arrest outside of critical care. Most of the preventable deaths occurred among non-end-of-life-care patients and were associated with adverse events, which in most cases, had been identified within Ascension Health's priorities for action.

Patient Groupings Identified During Mortality Chart Review

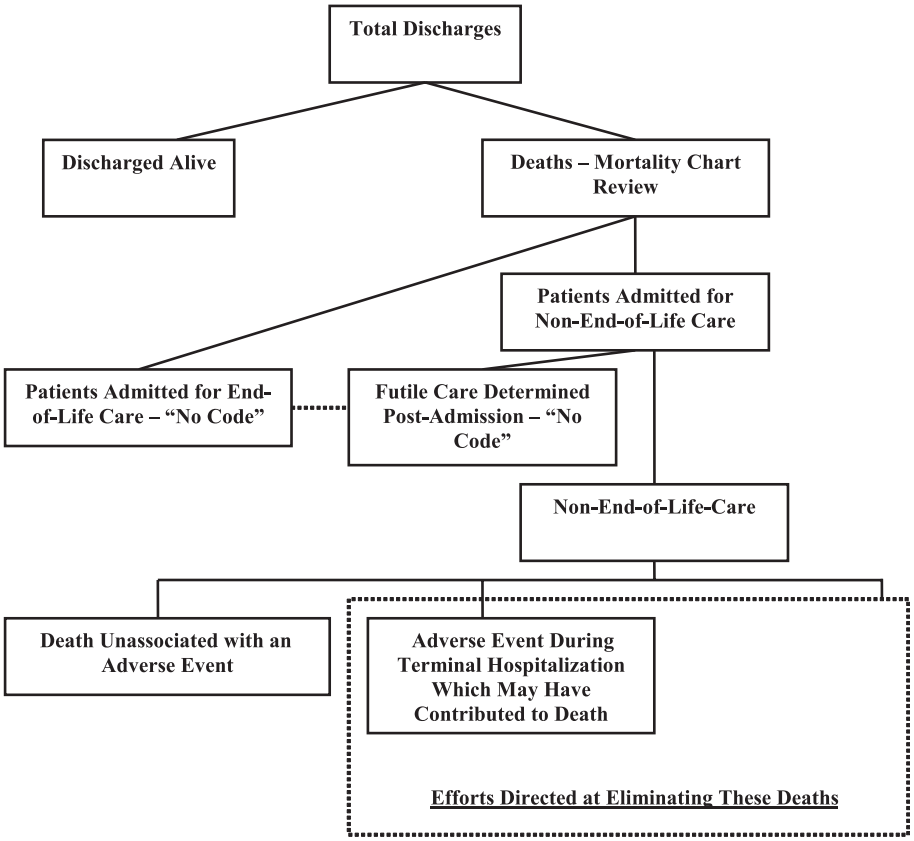

Figure 1. *The figure illustrates the groups of patients identified during mortality record review in an attempt to define deaths that were preventable. Eliminated from consideration were patients admitted for end-of-life care. Also eliminated were patients whose illness or injuries were so overwhelming that further treatment was deemed to be futile. Both these groups were distinguished by being made "no codes" (do not resuscitate). The groups of patients for whom it was appropriate to direct future efforts at eliminating preventable deaths were those identified as having adverse events (either during the terminal hospitalization or a previous admission) that might have contributed to the patient's death.*

A "bundle" is a group of interventions related to a disease process that, when executed together, result in better outcomes than when implemented individually.1

The multifocal approach for non-critical care patients included the following strategies:

- Rapid response teams
- SBAR (*S*ituation, *B*ackground, *A*ssessment and *R*ecommendation) communication among clinicians

Implementation

Getting Started

First, a multidisciplinary steering committee was organized under the leadership of the chief quality and patient safety officer [R.B.]. Members of the steering committee included representatives from the medical staff, nursing, quality improvement, respiratory therapy, and clinical pharmacy departments.

Second, Ascension Health agreed on a working definition for preventable death. Along with this definition, a baseline for measurement of preventable death was established. Defining preventable death, formulating a baseline for the initiative, and establishing how to measure the results of subsequent efforts to eliminate preventable death were critical to creating a measurable study that produced useable feedback for caregivers. The patient groupings identified during mortality chart review are shown in Figure 1 (left).

Agreeing on a definition for a preventable death proved more elusive than first thought. Obviously, not all deaths are preventable; thus, measuring raw mortality rates would not accurately measure efforts to eliminate preventable death. The deaths of patients receiving end-of-life-care or what is frequently termed *comfort care,* as reflected in the orders written by the attending physician, either on admission or sometime during the hospitalization, were excluded from consideration. A group of patients for whom treatment for the presenting condition was initially thought appropriate but was subsequently determined to be futile was identified during the hospitalization.

Extrapolating from a chart analysis of 50 deaths that occurred in the fourth quarter at the end of the baseline year (January 1, 2004 through March 31, 2004), of 539 patients who died at Borgess Medical Center during the baseline year (April 1, 2003 through March 31, 2004), it was estimated that approximately 50% could be categorized as having received end-of-life-care. The determination of possibly preventable death began, then, with the remaining 50% of patients whose care could not be considered end-of-life care (non-end-of-life-care).

With 100% chart review of the patients who died from April 1, 2003 through March 31, 2006 performed by a multidisciplinary team of health professionals, it was observed that 25% of the patients experienced adverse event(s) during the terminal hospitalization that may have contributed to their deaths. In most cases, such adverse events were identified within the Ascension Health priorities for action (adverse drug events, nosocomial infections, falls, pressure ulcers, perioperative complications, or perinatal injury). Further, in most cases, these adverse events were identified in patients not receiving end-of-life-care.

A 25% reduction in the deaths of non-end-of-life-care patients would correspond to 12.5% in total mortality. This estimate was very similar to the estimate of deaths resulting from medical error published in *To Err Is Human* by the Institute of Medicine (IOM) in 1999.[2] Ascension Health observed that estimates of the deaths to be prevented using a commercially available risk-adjustment methodology[3,4] corresponded reasonably well with the IOM estimate.[5]

It was observed during chart review that half of the adverse events that affected non-end-of-life-care patients occurred during a hospitalization before the final hospitalization; such an occurrence could easily be overlooked during chart analysis. Taking this into account, the estimated preventable deaths in non-end-of-life-care patients increased to 50%. It was determined, therefore, that an overall 25% reduction in mortality rate (50% of non-end-of-life care) was a realistic target for "eliminating preventable death." As its alpha process evolved, the authors gained experience in the causes and issues related to preventable death and became further persuaded that conventional estimate rates may be low.

Implementation of ICU Strategies

To ensure optimal implementation of the ICU strategies, each was piloted in one of the ICUs. As the implementation was refined, the strategies were rolled out incrementally to the other ICUs until all were engaged in the initiative.

Intensivist Model. Challenged by the literature demonstrating improved outcomes in ICUs staffed by intensivists,[6–8] the work of the Michigan Hospital Association Keystone ICU Project[9] and the Leapfrog Group's Intensivist Physician Staffing Standard,[10] intensivist staffing of ICUs was begun as a key infrastructure change in the initiative to eliminate preventable death. Intensivists are physicians specially trained to care for critically ill patients in ICUs. An intensivist is present in the ICU without competing obligations and possesses the skill and knowledge to care for critically ill patients, the ability to communicate and work with a team of caregivers, and the skills to manage ICU administrative duties.

Multidisciplinary Rounds and Daily Goals Sheets. With intensivist staffing in place, multidisciplinary rounds were led by the intensivists and conducted on all critically ill patients. In the recognition that nearly all patients admitted to the ICU suffer a potentially life-threatening adverse event,[11,12] the expressed purpose of such rounds was to improve the teamwork climate and communication among health care providers to maximize opportunities to share vital information. Rounds included resident physicians, mid-level providers (physician assistants, nurse practitioners), and representatives of nursing, respiratory therapy, social work, and other allied heath professions as indicated.

As a next step, in the understanding that communication failures lead to patient harm, increased length of stay, provider dissatisfaction, and staff turnover,[13–17] a communication tool, the daily goals sheet, was introduced. A daily goals sheet is a care plan for a patient that prompts caregivers to focus on what needs to be accomplished that day to safely move the patient closer to discharge. In a study at Johns Hopkins of its impact on the effectiveness of communication in a 16-bed surgical ICU, nurses' and residents' understanding of the goals of care for the day increased from < 10% to > 95% and length of stay decreased from a mean of 2.2 days to 1.1 days.[18]

The daily goals sheets were completed by the intensivist in the process of daily rounds and reviewed with the bedside

nurse and house staff; the intensivists were encouraged to revise the goals sheet during the day as the care plan changed. In addition to an organ system checklist, other important items included on the daily goals sheet included discharge planning needs, the patient's greatest safety risks, and scheduled labs and tests. The goals sheets were posted on the door of each patient room for reference by health care professionals; they were not part of the permanent patient chart. Nurses were encouraged to use the daily goals sheet as a tool for facilitating family communication.

A Bundled Approach to Prevent Ventilator-Associated Pneumonia. A bundled approach to the prevention of ventilator-associated pneumonia included four elements:

- Elevating the head of a patient's bed 30 degrees
- Sedation vacation (daily lightening of the patient's sedation)
- Deep vein thrombosis prophylaxis
- Peptic ulcer disease prophylaxis

A clinical nurse specialist closely monitored the patients through chart reviews and direct observation. A multidisciplinary team including physicians, nurses, clinical pharmacists, and respiratory therapists were educated on the beneficial effect of using the bundle and were charged with spreading this information to other staff.

A Bundled Approach to Prevent Bloodstream Infections Related to Central Vascular Access Catheters. Central vascular-access-catheter-associated infections increase morbidity, mortality, and length of stay within and outside the ICU.[19] Integral to the initiative to eliminate preventable death, the intensivists led the use of the central line bundle in the ICUs. The evidence-based steps[19] to prevent central-line-related blood stream infections that were implemented in these units were as follows:

- Cleaning hands with either waterless alcohol-based hand sanitizers or washing hands with soap and water
- Use of a 2% chlorhexidine-based product for skin preparation
- Use of maximal barrier precautions, including cap, face mask, sterile gown, and sterile gloves for the provider and a large sterile drape covering the patient's head and body for the patient
- Selecting the best insertion site, which means avoiding femoral lines as the primary option
- Removing the catheter as soon as possible

Physicians inserting central vascular access catheters were required to be privileged to do so.

Tight Glycemic Control with Insulin Drips. Hyperglycemia in hospitalized patients has been shown to lead to poor outcomes and increased mortality.[20] Studies had shown an association between hyperglycemia and an increase in infections, sepsis, renal failure, neuropathy, congestive heart failure, increased size of myocardial infarctions, and strokes.[21–26] With this understanding, in April 2004 the intensivist physician group and the diabetes team began an intensive insulin therapy protocol with intravenous insulin for Borgess Medical Center ICU patients. The initial protocol called for an insulin infusion when the finger stick or plasma glucose exceeded 200 mg/dL. The diabetes and critical care clinical nurse specialists led a comprehensive education effort, which was championed by the ICU clinical pharmacy staff. Nursing staff, house staff, and physicians were reminded of the signs and symptoms of hypoglycemia, as this was a primary issue of concern about a more aggressive approach to glycemic control.

After gaining familiarity with the insulin protocol and buy-in as to the importance of tight glycemic control, the protocol was revised for insulin drips to begin when the glucose exceeded 150 mg/dL. Then, a mandated automatic insulin drip protocol was implemented in April 2004 that called for an insulin infusion on any patient in the ICU with blood glucose > 150mg/dL. Physicians could opt out of the protocol, but a specific order to do so was required. Monthly data on glycemic ranges (> 150, 110–150, 70–110, and < 70) were collected and shown to all care providers in critical care to reinforce the protocol and to reassure them about the infrequency of hypoglycemia.

Implementation of Strategies in Non-Critical Care Areas

Concurrent with the strategies introduced in the ICUs, rapid response teams and the SBAR communication tool were introduced on the medical/surgical units. Borgess Medical Center had begun a hospitalist model in 1999. Hospitalists care for one in three patients, even though admitting physicians are not obligated to work with hospitalists. The hospitalists are board-certified physicians employed by the hospital and provide

Table 1. Mortality Analysis, April 2003–March 2006

	Period 1	Period 2	Period 3
	April 03–March 04	April 04–March 05	April 05–March 06
Discharges	19,901	19,703	19,761
Observed Deaths	539	450	433
Expected Deaths	576	560	582
Observed – Expected Deaths	–37	–110	–149
Observed Mortality Rate (%)	2.71 ± 0.226*	2.28 ± 0.209*	2.19 ± 0.204*
Expected Mortality Rate (%)	2.90 ± 0.233*	2.84 ± 0.232*	2.95 ± 0.236*
Observed – Expected Rate (%)	–0.1886	-0.5627	–0.7572
Observed Mortality Rate (%) Reduction from Year Before	—	15.9	3.9
Additional Deaths Prevented from Baseline Year	—	73	112

* All confidence intervals were generated at the 95% level.

24-hour coverage, either by on-site presence or by on-call availability.

Rapid Response Teams. The rationale for such teams is to rescue non–intensive-care patients who are clinically deteriorating and who, without prompt intervention, will likely proceed to cardiac arrest. It is clear from early studies[27] that the majority of patients arresting outside the ICU manifest signs and symptoms suggesting deterioration for six to eight hours or before that arrest. Not appreciating this or, appreciating it but not acting, is considered "failure to rescue" and may lead to potentially preventable deaths.

The early studies of such teams were done in Australia and revealed not only a significant decrease in the number of non–critical-care-unit cardiac arrests but an overall decrease in mortality and a decrease in the use of both critical-care and non–critical-care beds for the post-arrest patients.[28–30]

At Borgess Medical Center, the rapid response team was composed of a physician (senior level resident in internal medicine or emergency medicine), a nurse with critical care training, and a respiratory therapist, usually the "charge" therapist. All the team members were Advanced Cardiac Life Support-certified. The physician received the "Fundamentals of Critical Care Medicine" training offered by the Society of Critical Care Medicine,[31] and the nurse and therapists received additional training based on assessment/treatment templates for the usual problems encountered by the team. Recommendations on when to call the team included but were not limited to any one or more of the following:

- Respiratory rate > 24/minute or < 8/minute
- Falling (< 90%) SpO_2 (functional oxygen saturation)
- Change in level of consciousness
- Change in blood pressure and/or heart rate by 20% baseline
- Decreasing urine output
- Staff concern about a patient in the absence of any readily apparent physiological changes

SBAR. This communication tool was introduced along with the rapid response team concept, representing a logical pairing because accurate, helpful communication between the floor nurse and the rapid response team, as well as between nurse and attending physician, is vital. In brief, the communication tool is an organized, logical template for communication regarding a patient's status. The acronym is broken down as follows:

- **S** = Situation: The current problem(s) as perceived by the caregiver
- **B** = Background: The context in which the problem is occurring (for example, reason for hospitalization, course in the hospital, pertinent imaging, laboratory studies)
- **A** = Assessment: The caregiver's impression as to what is going on now, what's causing the problem
- **R** = Recommendation: What the caregiver thinks are the next steps in diagnosis and/or treatment

Results

As shown in Table 1 (above) the results of the alpha initiative to eliminate preventable death are reported for three periods: Period 1 (April 1, 2003 through March 31, 2004), Period 2

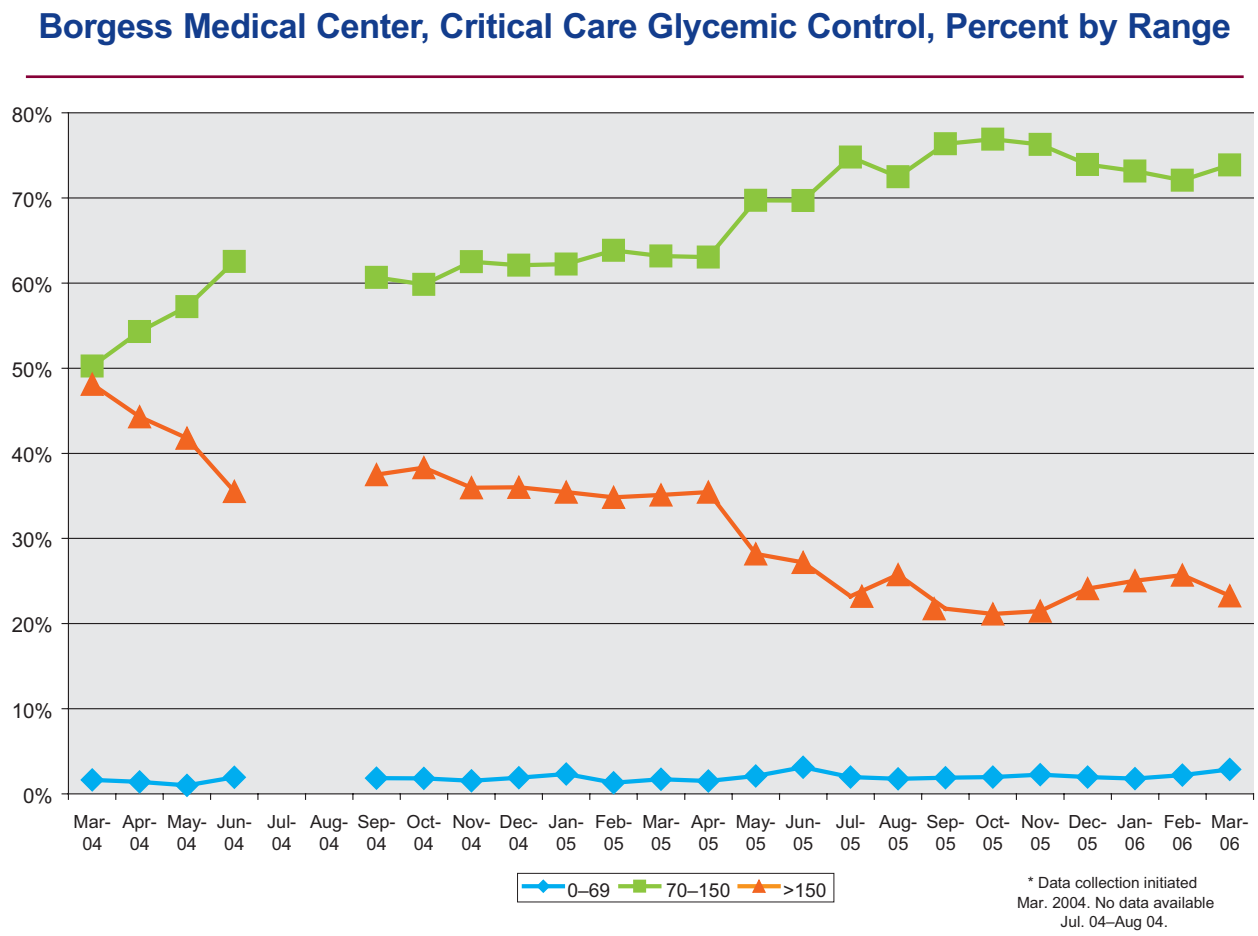

Figure 2. *The figure illustrates that the baseline glycemia data available revealed that only 50.24% of the capillary blood glucose readings were in control. The percentage increased to 61.12% in Period 2 and 72.77% in Period 3 (44.82% improvement from Period 1 to Period 3). Hypoglycemia (glucose < 70 mg/dL) increased moderately from 1.64% to 2.15% from Period 1 to Period 3.*

(April 1, 2004 through March 31, 2005), and Period 3 (April 1, 2005 through March 31, 2006). Period 1 is considered the baseline period; mortality reduction strategies discussed in this article were implemented on or following April 1, 2004. Results for hyperglycemia intervention, rapid response teams, and mortality results are reported.

Tight Glycemic Control in the ICUs

March 2004 data were available for Period 1; Period 2 contained 10 months data (July and August 2004 are not present); and Period 3 contained a full 12 months of data. Although Period 1 contained only one month's data, it is assumed this month was representative of the state of glycemic control in the ICUs at the beginning of the project because there had been no initiatives to eliminate hyperglycemia before April 2004.

Capillary blood glucose tests "in control" (70–150 mg/dL) improved 44.82% from Period 1 to Period 3. The average in control readings were 50.24% in Period 1, 61.12% in Period 2, and 72.77% in Period 3. Hyperglycemia (> 150 mg/dL), beginning at 48.12%, decreased to 37.18% in Period 2 and 25.08% in Period 3. Hypoglycemia (< 70 mg/dL), beginning at 1.64%, increased only moderately, to 1.69% in Period 2 and 2.15% in Period 3 (Figure 2, above).

Rapid Response Teams

Data for total codes were available for January, February, and March 2004 for Period 1, which was representative of

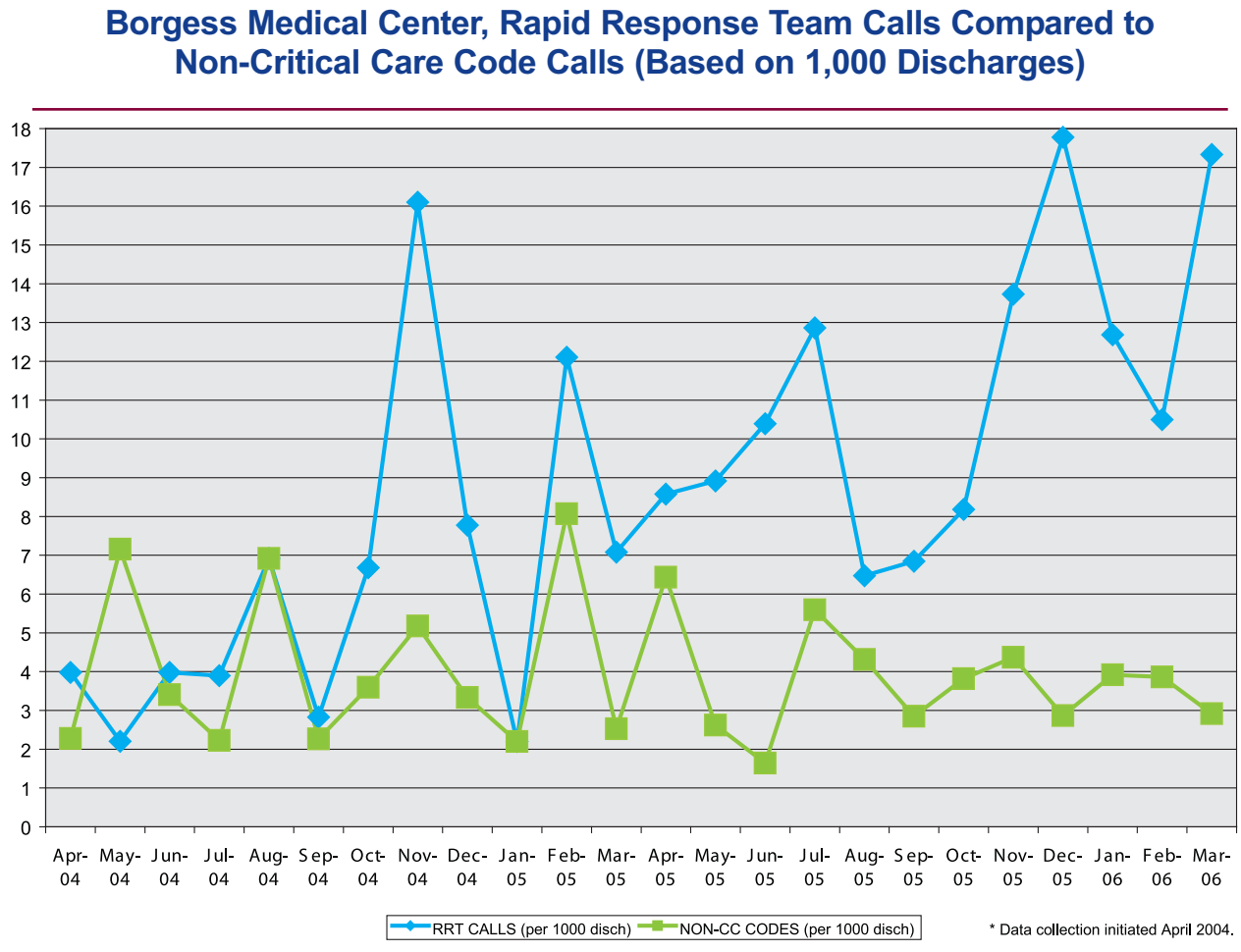

Figure 3. *The volume of rapid response team calls increased from 36 in Period 2 to 241 in Period 3 (increase of 77.54%), with a concomitant 30.62% decrease in codes per 1,000 discharges from Period 1 to Period 3.*

the codes inside and outside the ICUs at the beginning of the project because there had been no initiatives to reduce the number of codes before April 2004. Periods 2 and 3 contained all 12 months of total codes data. Non-critical-care-codes data were available for Periods 2 and 3. Data for the percentage of codes discharged alive were available for Period 2 for September 2004 through March 2005; all such data were available for Period 3.

Rapid response team calls per 1,000 discharges increased by 77.54% from Period 2 to Period 3—from 6.28 to 11.15 respectively. The volume of calls increased from 136 in Period 2 to 241 in Period 3. Hospitalwide, codes per 1,000 discharges decreased 30.62% from Period 1 to Period 3, and non-critical-care codes per 1,000 discharges decreased 6.41% from Period 2 to Period 3 (Figure 3, above.)

Mortality Analysis

Raw (observed) mortality rate decreased by 19.2% (± 0.74%) from Period 1 to Period 3. The greatest decrease in the mortality rate, 15.7% (±0.62%), was observed in Period 2—the first period in which the alpha initiative strategies were deployed. Period 3 showed a 3.9% (± 0.09%) reduction in mortality rate compared with Period 2. Whereas the risk adjustment methodology[4,5] predicted 576, 560, and 582 deaths for Periods 1, 2, and 3 respectively, the observed mortalities for Periods 2 and 3, respectively, were 450 and 433, resulting in a total of 259 fewer deaths than predicted. Periods 2 and 3 recorded 73 and 112 fewer deaths, respectively, using Period 1 as a baseline. This resulted in a total of 185 deaths not occurring as predicted (Table 1).

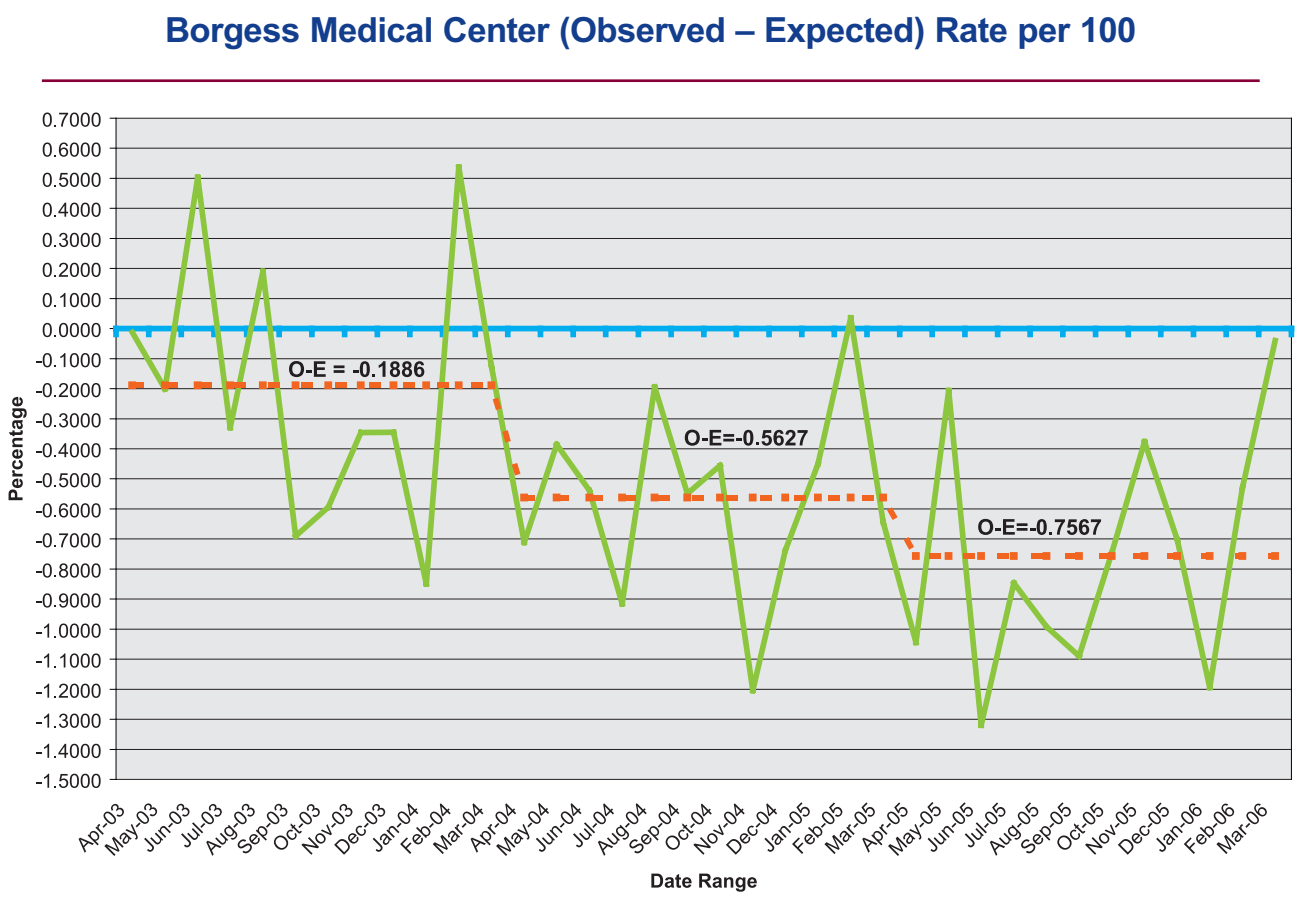

Figure 4. *The graph shows the observed mortality rate for the baseline year (2.71%) compared with the two postintervention years (2.38% and 2.1%, respectively). The mortality rates were less than predicted by the risk-adjusted model, and were significantly less than the baseline year (–0.5627% and –0.7567%, respectively, when compared with –0.1886%).*

During the April 2003–March 2006 period, there were no major changes in risk adjustment coding practices, with the expected mortality rates remaining relatively constant throughout the three periods. The observed-minus-expected mortality rate was –0.1886% for the baseline year (Period 1), –0.5627% for Period 2, and –0.7572% for Period 3 (Figure 4, above). The observed-to-expected mortality ratios for the three periods were 0.934, 0.803, and 0.742, respectively.

Discussion

Decreases in mortality were accompanied by control of hyperglycemia in critical care and the implementation of rapid response teams to rescue patients before cardiopulmonary arrest outside of critical care.

The experience with implementation of the glycemic control program in the ICUs showed that, first, all critical care areas must agree to use the same glycemic control protocol. The use of different protocols resulted in highly uneven control of blood glucose across four ICUs. With the adoption of a uniform protocol in all ICUs, control became more even. Second, physicians' compliance rates increased only after protocol adoption was made "automatic"; that is, each physician was required to "opt out" rather than "opt in."

The major lesson regarding rapid response teams was learned during its introduction; the concept needed to be continuously and redundantly promoted to all the nursing care teams to prevent a falling off of its use.

Finally, in terms of mortality analysis, 100% of all mortalities underwent chart review throughout the alpha

initiative's three-year period. As stated, most of the preventable deaths occurred among non-end-of-life-care patients and were associated with adverse events, which in most cases, had been identified within Ascension Health's priorities for action. Experience with the analysis of mortalities suggested that reviewing for learning as opposed to judgment is more difficult than it would seem and that retrospective chart review does not find all examples of possible preventable deaths because of its reliance on documentation with variable reliability. Also, an adverse event potentially contributing to a preventable death may have occurred during an admission before the patient's final admission and could be missed in the retrospective chart review.

Summary and Conclusions

Borgess Medical Center, asked by Ascension Health to serve as an alpha site, implemented six robust, innovative strategies to eliminate preventable death. In critical care, in addition to adoption of the intensivist model, it used a bundled approach to eliminate ventilator-associated pneumonia, a bundled approach to eliminate blood stream infections related to central vascular access devices, multidisciplinary rounds and daily goals sheets to improve communication among providers of care, and aggressive management of hyperglycemia with insulin drips. Outside critical care, in addition to adoption of the hospitalist model, it deployed rapid response teams and used the SBAR communication tool. Observed mortality decreased by 19.2% in the two years since the successful implementation of these strategies. In addition, the difference between observed and expected mortality decreased from –0.1886% to –0.7572%. J

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