Benchmarking the Use of a Rapid Response Team by Surgical Services at a Tertiary Care Hospital

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BACKGROUND: Rapid response teams (RRT) are used to prevent adverse events in patients with acute clinical deterioration, and to save costs of unnecessary transfer in patients with lower-acuity problems. However, determining the optimal use of RRT services is challenging. One method of benchmarking performance is to determine whether a department's event rate is commensurate with its volume and acuity.

STUDY DESIGN: Using admissions between 2009 and 2011 to 18 distinct surgical services at a tertiary care center, we developed logistic regression models to predict RRT activation, accounting for days at-risk for RRT and patient acuity, using claims modifiers for risk of mortality (ROM) and severity of illness (SOI). The model was used to compute observed-to-expected (O/E) RRT use by service.

RESULTS: Of 45,651 admissions, 728 (1.6%, or 3.2 per 1,000 inpatient days) resulted in 1 or more RRT activations. Use varied widely across services (0.4% to 6.2% of admissions; 1.39 to 8.73 per 1,000 inpatient days, unadjusted). In the multivariable model, the greatest contributors to the likelihood of RRT were days at risk, SOI, and ROM. The O/E RRT use ranged from 0.32 to 2.82 across services, with 8 services having an observed value that was significantly higher or lower than predicted by the model.

CONCLUSIONS: We developed a tool for identifying outlying use of an important institutional medical resource. The O/E computation provides a starting point for further investigation into the reasons for variability among services, and a benchmark for quality and process improvement efforts in patient safety. (J Am Coll Surg 2014;218:66–72. © 2014 by the American College of Surgeons)

Rapid response teams (RRT), also known as medical emergency teams, have been implemented in hospitals in order to prevent adverse events in patients with acute clinical deterioration.[1] The rationale for implementing RRTs is simple and intuitive; often patients experience clinical deterioration manifested by changes in sensorium, abnormal vital signs, or other concerning symptoms and signs, well before experiencing a cardiac or respiratory arrest. Therefore, identifying such a patient and intervening at an earlier stage in order to stabilize or triage the patient to a higher level of care could prevent morbidity or mortality. Evidence of the "failure to rescue" such deteriorating patients with existing hospital resources has prompted the widespread adoption of RRTs.[2,3] In addition, RRTs have the potential to save costs by avoiding unnecessary transfer in patients with lower-acuity problems.

Typical RRTs consist of critical care nurses, nurse practitioners, and/or respiratory therapists, with critical care physicians involved as needed. Most hospitals have an RRT oversight steering committee involving ICU medical directors, critical care physicians, nursing leaders, and administrators, who help develop protocols, provide training and education, guide debriefings after calls,

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Abbreviations and Acronyms
AUC = area under the curve
O/E = observed-to-expected
ROM = risk of mortality
RRT = rapid response team
SOI = severity of Illness

collect and review data, and initiate process improvement. Criteria for calling the RRT typically include acute changes in vital signs as well as staff concern ("afferent limb"). The RRT is then tasked with evaluating the patient, providing appropriate treatment including critical care intervention, and triaging the patient to a higher level of care if necessary ("efferent limb"). This model aims to facilitate the "rescue" of deteriorating patients and potentially save lives.

Despite their broad implementation, evidence for the effectiveness of RRTs is mixed, in part due to difficulty demonstrating an impact of RRTs on preventable adverse outcomes and cost of care.[4-7] An alternative to measuring the impact of RRTs on downstream outcomes and cost is to begin by benchmarking the use of RRTs to determine whether a department's use is commensurate with its volume and acuity when compared with other services. Therefore, we aimed to measure and compare service-level use of RRT activations, accounting for the volume and patient acuity on each service.

METHODS

This project was not regulated by the Institutional Review Board because of its primary role as a quality improvement project. After a pilot program from October 2005 to March 2006, Vanderbilt University Medical Center instituted an RRT on April 1, 2006. The RRT at Vanderbilt follows a liberal policy for activation, wherein any doctor, nurse, staff member, patient, visitor, or family member may activate the RRT in response to early warning signs of a medical emergency (Table 1) or, even if they notice "something is just not right." Patients and families are informed of the policy on admission, and a poster displaying the phone number is posted in each patient's room. The team comprises a registered nurse or charge nurse from the ICU, respiratory care supervisor or designee, a nurse practitioner or physician assistant from the ICU, and an ICU attending or physician designee as needed. Once the RRT arrives at the bedside, its goals are to stabilize the patient; decide on and initiate immediate management; triage the patient to the appropriate level of care; and coordinate care and facilitate communication with the primary team and/or ICU physicians. Care is facilitated by a structured process flowchart and a set of algorithms, such as evaluation of the common initiating signs (eg, bradycardia, tachycardia, hypoxemia, tachypnea, hypotension, opiate overdosage or sedation), and management of common diagnoses (eg, sepsis, medication error).

During a 3-year period, from January 2009 to December 2011, data were collected prospectively on all adult patients with RRT activations, using a methodology adapted from guidelines proposed previously.[8] The database of RRT activations was managed using the Research Electronic Data Capture (REDCap) application, a secure web-based data management system developed and hosted at Vanderbilt University.[9] This database was used to identify patients who had an RRT activation and the date of the RRT activation. It was then linked to an institutional administrative claims database, the Enterprise Data Warehouse, through which we obtained additional information on all adult (age $\geq$ 18 years) patients admitted to 18 selected surgical services during this period.

Variables collected from the Enterprise Data Warehouse on each patient included age, sex, race, admission source (home/clinic, emergency department, transfer from another facility), admission type (elective, urgent, emergent), and payer (private, Medicare, other). The number of days at risk for an RRT activation was calculated as length of stay minus days in ICU for patients who did not have an RRT activation, and included days in the step-down unit. For patients who experienced an RRT activation, days at risk were defined as length of stay until the RRT activation. Each admission was treated as a separate subject, such that some patients had more than 1 admission. However, within each admission, we counted only the first RRT among the outcome events and in calculating days at risk. In order to quantify patient acuity, we used modifiers to Medicare-Severity Diagnosis Related Group (MS-DRG), known as severity of illness (SOI) and risk of mortality (ROM), each of which is scored on a 4-level scale: minor, moderate, major, extreme.[10] These are used for billing purposes and are calculated by medical coders at the time of discharge routinely for each patient.

We compared these characteristics across patients who did and did not have an RRT activation, using bivariate statistics. Next, we constructed a series of patient-level logistic regression models to identify the contributors to likelihood RRT activation. The first model contained only days at risk; the next added all remaining variables except the measures of patient acuity; the full model included all covariates, including SOI and ROM. Each model was run with and without a categorical indicator variable representing each surgical service, entered as a fixed effect, in order to estimate the contribution of