



Clinical paper

The impact of Rapid Response System on delayed emergency team activation patient characteristics and outcomes—A follow-up study[☆]

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ABSTRACT

Objective: To evaluate the impact of Rapid Response System (RRS) maturation on delayed Medical Emergency Team (MET) activation and patient characteristics and outcomes.

Design: Observational study.

Setting: Tertiary hospital.

Patients: Recent cohort of 200 patients receiving a MET review and early control cohort of 400 patients receiving a MET review five years earlier at the start of RRS implementation.

Measurements and results: We obtained information including demographics, clinical triggers for and timing of MET activation in relation to the first documented MET review criterion (activation delay) and patient outcomes. We found that patients in the recent cohort were older, more likely to be surgical and to have Not For Resuscitation (NFR) orders before MET review. Furthermore, fewer patients (22.0% vs. 40.3%, $p < 0.001$) had delayed MET activation. When delayed activation occurred, there was a non-significant difference in its duration (early cohort: 12.0 [IQR 23.0] h vs. recent cohort: 9.0 [IQR 20.5] h, $p = 0.554$). Similarly, unplanned ICU admissions decreased from 31.3% to 17.3% ($p < 0.001$). Delayed MET activation was independently associated with greater risk of unplanned ICU admission and hospital mortality (O.R. 1.79, 95% C.I. 1.33–2.93, $p = 0.003$ and O.R. 2.18, 95% C.I. 1.42–3.33, $p < 0.001$, respectively). Being part of the recent cohort was independently associated with a decreased risk of delayed activation (O.R. 0.45, 95% C.I. 0.30–0.67, $p < 0.001$) and unplanned ICU admission (O.R. 0.5, 95% C.I. 0.32–0.78, $p = 0.003$).

Conclusions: Maturation of a RRS is associated with a decrease in the incidence of unplanned ICU admissions and MET activation delay. Assessment of a RRS early in the course of its implementation may underestimate its efficacy.

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1. Introduction

Unexpected death, cardiac arrest and unplanned intensive care unit (ICU) admissions and other clinical adverse events (e.g. severe sepsis, acute kidney injury, pulmonary edema, myocardial infarction, pulmonary embolism, stroke) have been reported to occur in up to 20% of patients, depending on methodology and type of patients investigated.^{1–4} In the MERIT study (23 hospitals), prior to intervention, unexpected death, unplanned ICU admission or cardiac arrest occurred in approximately 0.7% of more than 124,000 admissions.¹

One approach to the prevention of the above complications is to implement a Rapid Response System⁵ (RRS). Such RRSs are based on the concept that physiological instability (detected by abnormal vital signs) is common in the hours before an adverse event and predicts its occurrence.^{6–8} Accordingly, the calling criteria (the basis of the afferent arm of a RRS⁵) for Medical Emergency Team (MET) review (the efferent arm of a RRS⁵) are based on variables that suggest acute cardiovascular, respiratory, renal, neurological and metabolic derangements.

Maturation of RRSs and continuing education of ward personnel may increase use and improve performance of a RRS.⁵ No data exist, however, to confirm or refute this hypothesis. Accordingly, we compared a cohort of patients receiving MET activation six years after the introduction of a RRS (recent cohort—RC) with a historical control cohort who received MET activation immediately after the introduction of a RRS (earlier cohort—EC). We hypothesized that RRS maturation might improve RRS performance by decreasing the

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incidence of and delay in MET activation among patients who were deemed to require MET review.

2. Methods

The need for informed consent was waived by the Institutional Human Research Ethics Committee as the study was considered a prospective audit of standard care during MET activity and no study-related interventions were applied.

2.1. Hospital

The Austin Hospital campus is a 400-bed teaching hospital campus, which is affiliated to the University of Melbourne and admits approximately 60,000 patients annually. The ICU contains 20 beds with more than 2000 admissions annually, and operates according to a closed model where only ICU physicians can prescribe therapy.

2.2. The Medical Emergency Team

In September 2000, the MET system was introduced at the Austin Hospital after a one-year period of education. The MET at the Austin consists of an ICU registrar (fellow) and an ICU nurse during office hours. After office hours, a medical registrar (internal medicine fellow) also attends. The MET can be activated by any member of hospital staff when a patient deviates from pre-set physiological ranges or when staff members are worried about a patient's condition.^{8,9} The MET is available 24 h a day through the switchboard operator and calls are announced over the hospital public announcement system and/or via MET pager activation. A detailed log of all calls is maintained by the ICU staff. In addition, electronic case report forms are completed by the ICU registrar and nurse at the end of each MET review. These afferent and efferent components of the RRS have been complemented by an administrative arm which has been dedicated to the recording of all MET activations, their location and outcome. This arm has also been responsible for the continuing education of medical staff, of all new medical staff being employed by the hospital, of all nursing staff on a regular basis and of all new nursing staff employed by the hospital. Finally, the RRS has been complemented by a quality improvement arm, which links MET reviews believed to identify important system failures with the Clinical Governance Department of the hospital for detailed investigation, root cause analysis and appropriate protocol or institutional changes aimed at preventing future similar events. MET members receive specific training in addition to advanced cardiac life support. Education of MET team members or hospital wide staff included training on the use of the MET calling criteria, key lessons (choosing roles, responsibilities and improving communication). Training methods also included rehearsing performance skills in a team setting to coordinate task completion and group problem solving towards a common goal instead of focusing on individuals learning facts in isolation. The aim of such activities has been to facilitate greater calling of the MET and overall system maturation.

2.3. Patients

We conducted a prospective study in 200 patients receiving MET review for one of the four major MET syndromes described in literature (see below for definitions).⁹ In the period 05 April 2006 to 17 May 2007, (recent cohort—RC), the first 50 patients receiving a MET review for each syndrome were enrolled. We then used the prospectively collected ICU electronic RRS database to obtain information on 400 patients receiving a MET review in the period September 2000–September 2002 (earlier control cohort—EC). Patients enrolled were the first 100 patients for each

syndrome. Patients with “code blue” calls were excluded. In our hospital, the traditional ‘Code Blue’ call is intended for the resuscitation of cardiac arrests and other acute life-threatening emergencies. A MET call is intended to review all medical emergencies other than cardiac arrests and can be activated by any member of hospital staff according to predetermined criteria.

2.4. MET syndromes

Four MET syndromes have been described in the literature⁹ and they include MET reviews for hypotension (syndrome 1), arrhythmia (syndrome 2), respiratory distress (syndrome 3) and neurologic deterioration (syndrome 4). We refer to syndromes by number in the manuscript as labelled above.

2.5. Data collection

We collected information on baseline patients' demographics. We also collected information on the events surrounding MET review including the acute physiological derangement that triggered the call and the NFR (Not For Resuscitation) status of the patients before and after review (NFR before and NFR after, respectively). We recorded the timing of MET activation in relation to the time when at least one MET criterion was first documented in the patient's records. A MET review was regarded as “delayed” when a MET criterion was documented at least 1 h before the MET was activated. Finally, we documented outcomes following MET review including unplanned ICU admission, length of hospital stay (LOS) and hospital mortality.

2.6. Power calculations and statistical analysis

We hypothesized that maturation of the RRS would decrease the incidence of delayed activation from 40% in the EC^{10,11} to 25%, in the RC. We estimated that we would need to study 182 patients in the recent cohort to have a 90% power of detecting such difference at an alpha of 0.05. We studied 200 patients to compensate for an estimated 10% of patients who might have had incomplete datasets.

Comparisons of nominal data were by means of the χ^2 test or Fisher's exact test where indicated. The Mann–Whitney *U* test was used for comparisons of numerical data. We conducted a univariate comparison of survivor and non-survivors. We considered variables with a $p < 0.1$ on univariate analysis as appropriate for insertion into a parsimonious multivariable model. Multivariable logistic regression analysis was performed using unplanned ICU admission, mortality and delay as the dependent variables in the overall population and after removal of patients already NFR at the time of MET review (NFR before). Significance was set at $p < 0.05$.

Data were analysed using SPSS software, version 13 for Windows (SPSS Inc, Chicago, USA).

3. Results

Key demographic, clinical and outcome data for the two cohorts are summarized in Table 1. Patients in the RC were older and more likely to have a surgical diagnosis. A greater percentage of patients seen by the MET had NFR orders before team activation but fewer patients were made NFR after MET review, such that the overall NFR rate was similar.

In the RC, there was a significant decrease in delayed MET activations and unplanned ICU admissions after MET review. When delayed activation occurred, there was a non-significant difference in its duration with 12 h in the early cohort and 9 h in the recent cohort (Table 1). Regarding unplanned ICU admissions, there were 4/33 ICU admissions in patients with NFR orders before MET review in the early cohort compared with 3/30 in recent cohort ($p = 0.82$).

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