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Research paper

Relationship between diurnal patterns in Rapid Response Call activation and patient outcome

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ABSTRACT

Background: The Rapid Response Call (RRC) is a system designed to escalate care to a specialised team in response to the detection of patient deterioration. To date, there have been few studies which have explored the relationship between time of day of RRC and patient outcome.
Objective: To examine the relationship between the time of RRC activations and patient outcome.
Method: All adult inpatients with a RRC in non-critical care wards of a metropolitan Australian hospital in 2012 were retrospectively reviewed. RRCs occurring between 18:00–07:59 were defined as 'out of hours'.
Results: There were 892 RRC during the study period. RRCs out of hours were associated with a higher rate of ICU admissions immediately after the RRC (19.4% vs. 12.3%, $p < 0.001$). Patients experiencing an out-of-hours RRC were more likely to have an in-hospital cardiopulmonary arrest (OR = 1.7, $p < 0.04$). In-hospital mortality rate was significantly higher for patients with out-of-hours RRCs (35.5% vs. 25.0%, $p = 0.014$). After adjusting for confounders out-of-hours RRC were independently associated with increased need for ICU admissions and in-hospital mortality.
Conclusion: The diurnal timing of RRCs appears to have significant implications for patient mortality and morbidity, patient outcomes are worse if RRC occurs out of hours. This finding has implications for staffing and resource allocation.
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1. Introduction

Rapid Response Systems (RRSs) aim to provide a safety net for hospitalised patients whose condition deteriorates unexpectedly. The RRS is an essential element of the Australian Commission of Safety and Quality Health Service standard 9: Recognising and Responding to Clinical Deterioration in Acute Health Care.[1] The effectiveness of a RRS requires key components including: detection of deterioration; triggering a rapid response call; and the prompt response from the rapid response team.[2] Rapid Response Teams (RRTs) are an internationally recognised resource that has been widely developed and implemented to assist in the treatment and management of the deteriorating patient.[1] RRTs can be nurse- or doctor-led and include Medical Emergency Teams (MET), Patient at Risk Teams, and Critical Care Outreach services.[3]

The impact of RRS review on patient outcomes has been demonstrated in a number of studies. DeVita reported a decrease in the incidence of in-hospital cardiac arrests following the implementation of a RRT[4]; and Jones et al.[5] reported a sustained and progressive reduction in cardiac arrests post MET implementation, with a 69% decrease in non-ICU cardiac arrest over a 4 year period.[5] More recently, Tobin and Santamaria found a statistically significant

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decrease in mortality rate and rate of unexpected death over time across twelve Victorian hospitals with maturing MET systems.[6]

While many studies look at the impact of RRS as a whole, only a limited number have investigated the relationship between time of day that Rapid Response Calls (RRC) occur and patient outcomes. Jones et al. found that 53% of RRCs occurred between 18:00 and 08:00[7]; however a later study by Jones et al. reported low periods of MET activity overnight, corresponding to a statistically increased risk of cardiac arrest that may be attributed to a delay in the detection of a deteriorating patient.[8] A more recent study by the Medical Emergency Team End-of-life Care investigators also found that RRC activations were much less frequent overnight and on weekends.[9] Peberdy et al.[10] focused on survival from in-hospital cardiac arrest in hourly segments throughout the day. They discovered that survival to discharge was lower if the cardiac arrest occurred overnight and at weekends.[10]

This study aimed to further examine the relationship between the diurnal timing of RRCs and patient outcomes. It was hypothesised that patients with a RRC occurring during business hours (08:00–17:59) have better outcomes (including unplanned ICU admission and in-hospital mortality) than those with RRCs occurring out-of-hours.

2. Method

2.1. Study design

This was a retrospective observational study of all RRCs occurring at the study hospital in the calendar year of 2012.

2.2. Ethics

Approval for this project was obtained from the local Human Research and Ethics Committee (HREC). The need for patient consent was waived, with existing databases and hospital records used to obtain the data required.

2.3. Study setting and rapid response system

The setting for this study is a Metropolitan hospital located in Melbourne, Australia. In 2012 this hospital had 383 inpatient beds to provide general and specialty medical and surgical services, mental health, maternity, and paediatric services.

The hospital has a two level escalation protocol in response to clinical deterioration, consisting of a MET and 'Respond Blue' response. The MET system was introduced in 1999 in addition to the traditional cardiac arrest team. The physiological triggers which direct staff to call for a MET response have been derived from late signs of deterioration which have been demonstrated to be antecedents to significant adverse events[11] (see Fig. 1). The MET is comprised of a senior ICU registrar, a medical registrar, and a critical care nurse with post graduate qualifications. During business hours this was an experienced Critical Care Liaison Nurse Consultant (CCLN) and a ICU nurse, with less experience in attending RRC out-of-hours The ward nurse to patient ratios were also higher out of hours.

The second level of response is the 'Respond Blue' which is called for patients in cardiorespiratory arrest or who require advanced life support intervention. Respond Blue calls are attended by the members of the MET with the addition of a Coronary Care nurse. Anaesthetic assistance is obtained by a 'Respond Blue Airway' call which can be made by the response team if airway support is required.

2.4. Patient population

RRC data included in the data analysis was limited to adult inpatients ≥16 years of age for whom a RRC was made during the calendar year of 2012. RRCs for patients located within the ICU or emergency department were excluded.

AIRWAY	· Threatened airway · Obstructed airway
BREATHING	· RR <8 or >36 · SaO2 <90% on O2 · Respiratory distress
CIRCULATION	· SBP < 90 or > 180 · HR < 40 or > 130 · Arrhythmia · Urine < 50 ml over 4 hours
CONSCIOUS STATE	· Decrease in conscious state · Seizures
OTHER	· Staff concern

Fig. 1. MET calling criteria.

2.5. Data collection

In 2012 all RRC data were recorded on a standardised medical record form at the time of the call by clinicians attending the event. The event details from the forms were entered into a RRC database immediately following the event. For this study, details including patient demographics, date and time of RRC and immediate outcomes were retrieved from this database. Acute Physiology and Chronic Health Evaluation (APACHE) III score,[12] ICU LOS and ICU mortality was collected for all patients admitted to ICU following a RRC. Hospital discharge information, including in-hospital mortality was obtained from hospital patient databases. Business hours were defined as the ten hours between 08:00 and 17:59. This interval was chosen to match with the typical day shift of Unit Managers and senior staff. The fourteen hours 18:00–07:59 were deemed to be 'out-of -hours'.

2.6. Statistical analysis

The difference in baseline characteristics (age, sex, admitting unit) and outcomes (unplanned ICU admission, hospital LOS, in-hospital mortality) for patients who had a RRC in-hours were compared to those who had a RRC out-of-hours. In addition, outcomes for those patients who had an unplanned ICU admission included APACHE III scores and ICU LOS and ICU mortality. Continuous data were analysed using Student's t-test and categorical data were analysed using chi squared test. Multivariable binomial logistic regression was used to investigate the association between out-of-hours RRCs and ICU admission and in-hospital mortality, adjusting for age, gender, whether RRCs occurred on weekends, and admission type (medical, surgical, or other).

A p value of <0.05 was used to indicate statistical significance. SPSS software (IBM, v. 20) was utilised to perform statistical analyses.

3. Results

3.1. Characteristics of the overall RRC cohort

During the study period there were 835 MET calls and 57 Respond Blue calls. Mean age at the time of RRC was 71 years (SD = 17.2) and 422 (48%) of RCCs were for men (see Table 1). There were no significant differences in patient characteristics between RRCs occurring in- and out-of-hours (Table 1).

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