



The duration of hospitalization before review by the rapid response team: A retrospective cohort study[☆]



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ABSTRACT

Purpose: The purpose of this study is to compare cases of rapid response team (RRT) review for early deterioration (<48 hours after admission), intermediate deterioration (48 to <168 hours after admission), late deterioration (≥ 168 hours after admission), and cardiac arrest and to determine the association between duration of hospitalization before RRT review and mortality.

Methods: This is a retrospective cohort study of RRT cases from a single hospital over 5 years (2009–2013) using administrative data and data for the first RRT attendance of each hospital episode.

Results: Of 2843 RRT cases, 971 (34.2%) were early deterioration, 917 (32.3%) intermediate, 775 (27.3%) late, and 180 (6.3%) cardiac arrest. Compared with early deterioration patients, late deterioration patients were older (median, 71 vs 69 years; $P = .005$), had a higher Charlson comorbidity index (median, 2 vs 1; $P < .001$), more often had RRT review for respiratory distress (32.5% vs 23.5%; $P < .001$), more often received RRT-initiated not for resuscitation orders (8.4% vs 3.9%; $P < .001$), less often were discharged directly home (27.9% vs 58.4%; $P < .001$), and more often died in hospital (30.6% vs 12.8%; $P < .001$). Compared with early deterioration and adjusted for confounders, the odds ratio of death in hospital for late deterioration was 2.36 (1.81–3.08; $P < .001$).

Conclusions: Late deterioration is frequently encountered by the RRT and, compared with early deterioration, is associated with greater clinical complexity and a worse hospital outcome.

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1. Introduction

Rapid response teams (RRTs) have been introduced with the rationale that early intervention in the care of hospital patients with unexpected clinical deterioration might prevent serious adverse events [1]. There is now a body of literature suggesting that serious adverse events, in particular, cardiac arrests outside intensive care, are reduced by RRTs [2–12]. Despite these favorable results, the hospital mortality of patients attended by the RRT is substantial, with a recent large multicenter study reporting a figure of 24% [13].

The timing of RRT attendance in relation to hospital admission might explain, in part, the high mortality of RRT patients. Approximately 30% of RRT attendances have been found to occur when the patient has already been in hospital for more than 7 days [14,15], and late RRT attendance has been found to have higher hospital mortality than early

attendance [14]. More information is needed to understand the nature and implications of the timing, in relation to hospital admission, of RRT attendance.

We aimed to compare cases of RRT review for early deterioration (<48 hours after hospital admission), intermediate deterioration (48 to < 168 hours after admission), late deterioration (≥ 168 hours after admission), and cardiac arrest with respect to patient characteristics, event characteristics, the incidence of repeat RRT review, and hospital discharge destination. We also aimed to determine the association, adjusted for confounders, between the duration of hospitalization before RRT review and hospital mortality.

2. Patients and methods

2.1. Ethics approval

The project was approved by St Vincent's Hospital Melbourne Human Research Ethics Committee (Ref. QA 043/14). The requirement to obtain patient consent was waived.

2.2. Study cohort

Consecutive acute inpatients admitted to a single hospital during the 5 years 2009 to 2013 and attended at least once by the RRT (an RRT

Abbreviations: RRT, rapid response team; MET, medical emergency team.

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event) during the hospital episode were retrospectively identified from a database of RRT patients. Acute inpatients were defined as those under the care of an acute inpatient unit. Patients admitted for a day procedure (eg, endoscopy) or a day treatment (eg, chemotherapy) were regarded to be acute inpatients. Those attending outpatients' dialysis and those under the rehabilitation unit, the geriatric assessment and evaluation unit, the mental health unit, or the palliative care unit were not regarded to be acute inpatients. Information related to the first RRT event of each hospital visit was analyzed. Events that involved cardiac arrest were classified as "arrests"; all others as "deteriorations." Cardiac arrest was deemed to have occurred if the patient displayed clinical signs of cardiac arrest and was treated with chest compressions and/or electrical defibrillation. Deteriorations were further classified as "early" if they occurred less than 48 hours after admission, "intermediate" if they occurred 48 to less than 168 hours after admission, and "late" if they occurred greater than or equal to 168 hours (7 days) after admission.

2.3. The hospital and its rapid response system

The study was conducted at a university-affiliated tertiary referral hospital for adult patients in Melbourne, Australia. During the study period, the hospital had approximately 400 acute ward beds and provided a comprehensive range of medicine and surgery subspecialties, including cardiac surgery and neurosurgery but did not provide major trauma services.

Since 2002 and continuing throughout the study, 2 types of rapid response operated at the hospital, and both were included in the analysis: "Respond Medical Emergency Team (MET)" and "Respond Blue." These services were available 24 hours per day, 7 days per week. A single parameter trigger system, rather than an aggregate weighted scoring system (an "early warning score"), was used. Respond MET activation criteria were respiratory rate less than 5 per minute or greater than 36 per minute, oxygen saturation as measured by pulse oximetry less than 90% despite supplemental oxygen, heart rate less than 40 per minute or greater than 140 per minute, systolic blood pressure less than 90 mm Hg, repeated or prolonged seizures, unexpected deterioration in conscious state, and serious staff concern. Respond MET personnel were a medical registrar (fellow), intensive care registrar, and an intensive care nurse. Respond Blue activation criteria were cardiac arrest, respiratory arrest, and threatened airway. Respond Blue criteria were problems likely to require the assistance of personnel with advanced airway management skills, so the Respond Blue team consisted of the MET personnel and an anesthetic registrar.

2.4. Rapid response data

Intensive care registrars completed an audit form for every RRT event. Research nurses, under the supervision of the Director of Critical Care Medicine (an attending intensive care physician), kept a log of calls to the hospital paging system to ensure that all events were identified and maintained the RRT database. The information collected included the reasons given by clinicians for activating the system, with the reasons classified according to the activation criteria; the presence of a not for resuscitation (NFR) order before the event; and the interventions performed. Not for resuscitation meant that the patient was not to receive cardiopulmonary resuscitation in the event of cardiopulmonary arrest.

2.5. Administrative data

The hospital's administrative database (PAS; CSC, Falls Church, VA) was maintained by trained personnel to permit accurate reporting to government health authorities the diagnoses and vital outcome of every hospital separation. Administrative data included the admission type (eg, waiting list and emergency) and the discharge destination. The Charlson comorbidity index [16] was calculated using diagnoses

that had been classified according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (National Casemix and Classification Centre, Wollongong, New South Wales, Australia), and assigned at hospital discharge.

2.6. Statistical analysis

We used univariate analyses to compare each of the intermediate deterioration group, late deterioration group, and arrest group to the early deterioration group. Contingency tables were assessed using the Fisher exact test; and continuous variables, which were not normally distributed, were assessed using the Wilcoxon rank sum test. Multivariable logistic regression was used to determine the adjusted odds ratio of death in the hospital for patients in each of the intermediate deterioration group, late deterioration group, and arrest group by comparison with the early deterioration group. The following prespecified variables that were considered to be potential confounders were included in the model and then, beginning with the least important explanatory variable, omitted using backward elimination: hospital admission type (waiting list, other planned, emergency department, interhospital transfer, and residential aged care), calendar year of admission; age group (<60, 60–79, or ≥80 years), sex, treating unit (medicine or surgery), Charlson comorbidity index group (0, 1–4, or ≥5), and the presence of an NFR order before the RRT event. All variables were treated as categorical, and the first category of each variable provided the reference point. *P* values < .05 were taken to signify statistical significance. Analyses were performed using Stata, version 12.1 (StataCorp, College Station, TX).

3. Results

3.1. Total hospital admissions

There were 148 021 hospital visits. Hospital length of stay was median 27 hours (interquartile range [IQR] 5–106). There were 24 511 (16.56%) whose length of stay was greater than or equal to 168 hours.

3.2. Total RRT events and event rates

There were 2843 (1.92%) hospital visits that involved at least 1 attendance by the RRT. Among these were 672 (23.6%) where more than 1 RRT event occurred during the hospital visit. The 2843 RRT patients had a total of 3860 RRT events: 3640 deteriorations and 220 cardiac arrests. The deterioration call rate for the 5-year period was 24.6 per 1000 admissions, and the cardiac arrest call rate was 1.5 per 1000 admissions.

3.3. First RRT events

The first RRT event of the hospital visit for the 2843 RRT patients was early deterioration in 971 (34.2%), intermediate deterioration in 917 (32.3%), late deterioration in 775 (27.3%), and cardiac arrest in 180 (6.3%).

3.4. Patient characteristics

The characteristics of the RRT patients are shown in Table 1. Compared with the early group, the late group had a larger proportion admitted by interhospital transfer (28.0% vs 16.9%; *P* < .001) and a smaller proportion admitted for elective surgery (10.7% vs 18.4%; *P* < .001). Compared with the early group, patients in the late group were older (median, 71 vs 69 years; *P* = .005). Compared with the early group, the late group had larger proportions under hematology and oncology, neurosurgery, and cardiothoracic surgery. Compared with the early group, the intermediate and late groups had more comorbidity:

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