

The experience of improving rapid response system performance in a Chinese Joint Commission International Hospital.

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Abstract

To describe the institutionalization of a regional Rapid Response System (RRS) to ensure timely treatment to patients with Serious Adverse Events (SAE). We report data on RRS utilization and describe the organizational aspects, policy framework and procedures in a Chinese Joint Commission International (JCI) hospital. Between May 2013 and December 2015, a total of 198 SAEs were reported at the two hospitals; of these 109 RRS calls concerned inpatients and 89 were activated for outpatients. A total of 192 events were called by medical personnel and 6 were called by auxiliary staff in 385 calling reasons (some patients were suffer from more than one activate reasons): unconsciousness 133 (34.5%), respiratory distress 34 (8.8%), airway obstruction 49 (12.7%), fall were 31 (8.1%), carotid pulse disappear were 49 (12.7%), others were 41 (10.6%); MET average activate time was 2.4 ± 0.1 s and within 5 min; no. of RRS calls between daytime working hours (8:00-17:00) were 123 (62.1%); CPR was performed in 86 (43.4%) cases; 12 (6.1%) RRS calls were deemed to be unwarranted (false alarm): none treatment were 13 (6.6%), disposition were 3 (1.5%) and DNR was 1 (0.5%). Outcomes of RRS activation: vital signs were stabilized in 82 (41.4%) patients; death occurred in 15 (7.6%) patients, 61 (30.8%) patients were evacuated to ICU, unwilling rescue 40 (20.2%). Our experience shows that regional RRS improved rescue speed of SAEs and patient outcomes. Better integrated multidisciplinary cooperation was instrumental for the success of RRS.

Keywords: Rapid response system, Medical emergency team, Early warning system, Serious adverse events, Cardio pulmonary resuscitation, Cardiac arrest.

Accepted on August 30, 2017

Introduction

Adverse events are an inseparable part of medical care, which are common to both inpatient and outpatient settings. A vast majority of adverse events culminate in acute respiratory and/or cardiovascular instability [1]. Up to 80% of in-hospital Serious Adverse Events (SAEs) are preceded by vital dysfunction which may last for several hours before the actual event [2,3]. Many of these vital dysfunctions are easily observable and typically include alterations in respiratory rate, oxygen saturation (SpO₂) levels, heart rate, blood pressure and level of consciousness [4-6].

A Rapid Response Systems (RRS) was designed to respond to seriously ill patients, at-risk patients and patients who show general signs of decompensation/deterioration and abnormal vital signs [7]. RRS is an institutional mechanism that provides health professionals with prompt access to support in the event of deterioration in a patient's condition, before they become critically ill [8]. In an RRS, adequate efferent limb activation

criteria and the corresponding actions forward staff (monitoring of vital signs, early detection of patient deterioration and MET activation) are key factors for reduction in the incidence of SAEs [9]. Several countries have RRSs in place which are aligned to their medical system. Therefore we sought to develop the optimal RRS plan to cater to our health care system.

Our hospital, the Second Affiliated School Hospital Zhejiang University School of Medicine (SAHZU) which is a comprehensive network with 2200 beds across 2 metropolitan teaching hospitals in Hangzhou. We adopted a systems approach to improve the management and outcomes of SAEs patients in our hospital which included multidisciplinary collaboration, operational planning, training, competency criteria for different MET members, staff requirements, modified EMS criterion and related management functions. We developed a regional MET and RRS catering to all hospital staff both in inpatient areas and outpatient areas.

Aim of the work

The aim of this design was to assess the effectiveness to improve the utilization of RRS. We wanted to ensure cooperation of all human resources and reduce the time to get the right response for each patient.

Methods

Ethical approval

The SAHZU research and ethics committee exempted this study from requiring approval as it fulfilled Biomedical Research Ethics Review Method Involving People criteria for a quality assurance project. All patients admitted to the hospital were considered participants in this assessment.

Setting

SAHZU is a comprehensive non-profit university tertiary health care provider in Hangzhou. Over 2000 clinical staffs cater to a catchment population of 8,000,000. The services include acute care services at 2 hospital sites. Annual outpatient visits exceed 3,000,000; hospital admissions are over 100,000 and the number of critical patients is over 100,000. SAHZU was an enthusiastic adopter of the RRS with establishment of MET in two of our hospitals in 2013.

Intervention areas

In addition to the patients in the critical care units (emergency department, Intensive Care Units (ICU), Neurological Intensive Care Units (NICU), Surgical Intensive Care Units (SICU) and anesthesia department), patients admitted in all departments came within the ambit of the RRS.

Moreover, other public areas such as the outpatient areas, cafeteria, garden, consulting rooms, aisles, restrooms and auxiliary units were also covered.

Study design

In this work, we introduce the RRS structure and protocol, and describe the inter-departmental/cross-institutional interface of the RRS. Finally, we present a brief analysis on utilization of RRS and present process indicators.

RRS structure and protocol

The RRS comprises of four key elements, often referred to as the limbs of the RRS. These include an afferent limb (identification of patient deterioration by the ward staff and triggering a response), the efferent limb (response team) and the feedback and administrative components [10].

Organization structure of RRS: The vice-president holds the overall responsibility for technical, administrative and the operational aspects of the RRS. The METs are designated by a committee comprising of the president, medical director, nursing director, anesthesia director, emergency director and ICU director. The committee is responsible for making related

policies as well as the supervision and control mechanisms of the RRS operation. They are also responsible for the establishment of RRS management information system, data analysis and monitoring and evaluation functions.

RRS personnel structure and requirements: Implementation of an RRS requires additional resources for the efferent limb; the workload of MET increases substantially as they also respond to other medical emergencies [10,11]. The RRS includes METs, broadcast system and dedicated staff for RRS. Based on the available infrastructure, catchment area population and the shortest approach to hospital, we established 4 METs. These teams were comprised of personnel from emergency department, ICU, NICU, SICU and department of anesthesia.

MET staff aptitude requirements were laid down by our hospital:

Doctor: a) ICU and emergency physicians; b) cardiology respiration anesthesiology registered doctor who holds intermediate license, resident doctor;

1) Nurse: N2 level nurses at the Departments of internal medicine ICU and emergency, cardiac, respiratory and anesthesia.

2) N2 nurse: a) Minimum clinical experience required: 3 y; b) competent in critical care; c) score of >85 in both practical skills and theory; d) ability to assist in four types of operations; e) complete the minimum course requirements (26 credits in one year); clear continuous quality improvement case report and publish in journal magazines; f) obtain BLS certification.

RRS training content and skill requirements

MET members training and skill requirements: Training methods include lectures on the treatment of SAEs. The training content for MET members includes first aid skills, well-versed with critical disease monitoring equipment and critical care. MET members are required to pass BLS and ACLS certification.

The essential competencies for physician in the MET are: (1) skilled in providing airway support including oral or nasal endotracheal intubation, assisted ventilation, tracheal intubation skills and use of laryngeal mask; (2) skilled in use of portable ventilator, mobile multi-function (ICU); (4) proficient in cardiopulmonary resuscitation, external cardiac pacing, temporary cardiac pacing and defibrillation; (5) well-versed with drug usage, indications and contraindications in the AHA cardiopulmonary resuscitation guidelines [12].

Non-medical staffs training and skill requirements: According to JCI and AHA curriculum requirements, three levels of training courses were developed. Cardiopulmonary resuscitation skills were imparted to all hospital medical staff to inculcate a sense of emergency consciousness and promote their rescue capability.

(1) Basic CPR: Administrative and logistics staff; (2) BLS: doctors, medical technicians and nurses; (3) ACLS: the

emergency unit and ICU, anesthesiology, cardiology, respiratory doctors and provides emergency, intensive care and the N2 nurses of intensive care unit (EICU, ICU, NICU, CCU, cardiovascular monitoring, cardiothoracic surgery monitoring) and post-anesthesia care unit.

Test and evaluation: All medical personnel were required to clear theoretical and practical tests and their clinical skills monitored on an ongoing. Annual performance reviews of MET members were compulsory; performance of other medical personnel was reviewed once in two years.

Operational functioning of RRS

Calling standard (EWS): According to the early warning scoring system (also known as aggregate weighted scoring system or aggregate weighted track and trigger system) scores are assigned to each vital sign from 0 (normal) to 3 (extreme derangement), based on the deviation from the 'normal' reference range [13].

We modified the American calling criteria to monitor vital signs of a critically ill patient.

RRS activation: METs were on-call round the clock for both inpatient areas and outpatient areas. In the event of an SAE, the RRS could be activated by calling 665555. The broadcast system provides details of the SAE to the METs. After completion of the intervention, the rescue nurse is required to fill the SAE response sheet.

The target time for arrival of the MET at the calling place was 'less than 5 min'. A total of four METs were established. Every MET was responsible for its assigned catchment area: (1) Emergency unit: responsible for numbers 3, 8, 9, 10, 11 medical buildings and garden; (2) ICU: responsible for numbers 1, 2, 3, 12 medical buildings and canteen; (3) NICU and SICU: response for number 5-7 medical buildings.

MET evacuation criteria: Based on their assessment of the patient the MET decides on the next step. The evacuation criteria are: (1) Airway: respiratory distress requiring airway support; (2) Breathing: respiratory rate <9/min or >36/min; SpO₂ <90% on O₂ supplementation; (3) Circulation: systolic blood pressure <80 mmHg or ≥ 200 mmHg; Heart rate <40/min or ≥ 130/min; (4) Neurological status: impaired consciousness; (5) discretion of MET: any other serious concern about the patient.

Statistical methods

All statistical analyses were performed using SPSS statistics version 20 (IBM). Descriptive statistics were generated and analysed. Data on the incidence of SAEs, sex-distribution of patients, activation areas, activation status, reasons for activation, MET activation time, calling periods, CPR, reasons for over-activation and patient outcomes.

Results

Between May 2013 and December 2015, RRS activation was performed for a total of 198 SAEs involving 208 patients (109 (55.1%) males and 89 (44.9%) females; mean age ± Standard Deviation (SD): 54.2 ± 1.6 y). These were activated by 192 (97.0%) medical staff and 6 (3.0%) others. Overall, in 385 activations, the cause of activation was unconsciousness in 133 (34.5%), air way obstruction; weak or absent carotid pulse was the second most common reason for activation (98 (25.4%)) (Table 1 and Figure 1); the mean time elapsed from activation of RRS and the arrival of MET at the calling site was 2.4 ± 0.1 min; the corresponding time elapsed in case of emergency was 2.3 ± 1.5 min; that for NICU, ICU and SICU was 2.9 ± 1.0 min, 3.1 ± 1.9 min and 3.5 ± 1.9 min, respectively.

123 (62.1%) calls were in the period between 8:00 h-17:00 h (Table 2). Eighty six (43.4%) patients needed CPR; (7 (9.6%) calls were deemed as over-activation for which the RRS was not applicable (Table 3). After the intervention, 82 (41.4%) patients survived and 61 (30.8%) patients were transferred to ICU units for further treatment (Table 4).

Table 1. Clinic SAE activation reasons.

Activation reasons	N=385	%
Unconsciousness	133	34.5
Respiratory distress	34	8.8
Air way obstruction	49	12.7
Unconsciousness	31	8.1
Blood pressure drop	48	12.5
Carotid pulse weaken or disappear	49	12.7
Others	41	10.6

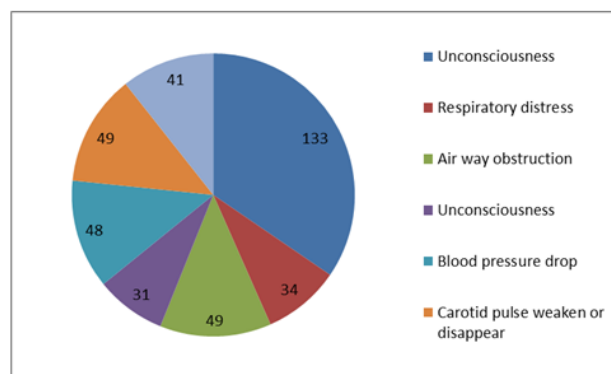


Figure 1. Clinic SAE activation reasons.

Table 2. RRS activation in three working shifts.

Activate periods	n	%	Activate time (s)
8:00-17:00	123	62.1	2.6 ± 1.8
17:01-1:00	35	17.7	2.8 ± 1.3

1:01-7:59	40	20.2	3.2 ± 1.7
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Table 3. Causes of RRS activation.

Reasons for activation	N	%
Valid activation	181	91.4
No additional treatment required	13	6.6
Leave the hospital by own	3	1.5
RRS activation for patient assigned "Do not resuscitate" status	1	0.5

Table 4. Outcomes of RRS intervention.

Patient's outcomes	N	%
Survival	82	41.4
Death	15	7.6
Admitted to medical unit	61	30.8
other	40	20.2

Discussion

The regional RRS administration

The rationale for establishment of a MET is that early recognition and timely response to imminent in-hospital complications will reduce the risk of morbidity and mortality [14].

Multidisciplinary and inter-departmental collaboration is critical to the success of RRS, as is the efficient administrative and logistics support for paging, broadcasting, and maintenance of equipment. The hospital information system is a key resource for planning of RRS.

The use of staff from ICU-related units was found to be an efficient use of human resources and time in ensuring that the MET arrives at the calling site within the target of 5 min.

Training and simulation

Patients tend to display abnormal vital signs for hours or days preceding any serious emergency. Studies have shown that the signs of cardiac arrest may be missed leading to delay in appropriate measures [15,16]. Delay in responding to these signs is a typical cause of failure of CPR [17] and mortality.

Standardized aptitude and skills of MET members is the key to success of quality and efficiency of the RRS. On evaluating the initial experience of RRS, some areas for improvement were identified and incorporated in the training program.

For example, training needs among personnel from the departments of anaesthesia (skills in endotracheal intubation) and pharmacy (refresher training in emergency drugs, dosages, indications and contraindications) were identified and addressed in the BLS and ACLS trainings regularly.

Scenario-building and simulation exercises were particularly helpful in identifying potential bottlenecks and operational challenges in responding to calls from non-clinical areas, e.g., canteens. All simulation exercises were conducted using a medical patient simulator (Medicine Z U S O. Critical care nurses training and test system (Z) 2014).

This training method is widely used in allied health care and aviation industry. Simulation exercises for commonly occurring scenarios are more cost-effective than establishment of special training centers. Moreover, participation in these exercises also helps improve teamwork and facilitate cooperation between multidisciplinary medical personnel.

EWS early recognition

In our hospital all staff members have the right to activate RRS. According to surveys, 48% to 56% of general ward nurses would activate the MET if they were worried about their patient, even if that patient's vital signs were normal [18,19]. Out of the 198 SAEs, six (3.0%) cases were activated by other non-medical staff. This indicates that even non-medical personnel could help improve efficiency and speed of RRS response.

EWS is a recent development and is part of the health care reform and quality of care. Although robust evaluations of EWS are lacking, a EWS helps in early recognition and treatment of adverse events efficiently. Even in resource-constrained settings, EWS can help supplement medical staff and improve overall efficiency. EWS is expected to become an effective tool for SAE administration.

Retrospective analysis

Implementation of RRS may confront a multitude of purely social, political and hierarchical barriers which must be taken into account before and during the implementation phase [11,20].

Regular engagement of all stakeholders for sharing information, feedback and participation in decision-making is important [21]. It is important to emphasize from the outset that a management philosophy with two key elements: data driven continuous improvement of processes focused on the needs of the end user and respect for the people delivering the service. Previous studies have shown every RRS must endeavour to adapt to the clinical environment and need. Therefore, continuous monitoring and formative evaluation is an important aspect of management of the RRS. Use of feedback to institute corrective measures can help resolve problems.

Due to relatively short experience with the RRS, we have focused largely on the qualitative aspects which will help avert instances of MET failures and help fine tune the system [1,22-24]. The direction of future work is to continue to track the data to build an evidence base based on a large sample data. The SAEs activation dates are collected for analysis including the analysis of reasons for activation of RRS.

Current RRS Issues/Questions

Several shortcomings and challenges were encountered during the development and functioning of the RRS. The most important is the definition of MET call criteria, as 8.6% RRS activation was categorized as an over-response. To some extent, this will lead to over-use of medical resources. Especially, the patients who are assigned a Do-Not-Resuscitate (DNR) status and potential suicide attempt e.g., by jumping from building, do not constitute a valid indication for activation of RRS. However, from an ethical and medicolegal perspective, necessary actions should be taken into account.

Conclusion

At present, few domestic hospitals have established RRS. There is a need to improve the standards and operating protocols. Our RRS draws from domestic and overseas experience. It ensures the qualification of MET member and makes optimal use of human resources and related equipment. The target response time for the MET to arrive at the calling place is <5 min. Future steps include further focus on execution, data-based reviews, feedback and impetus on continuous quality improvement.

Acknowledgement

My deepest thanks to Professor Xiaofei Zhang for his constant encouragement and guidance. He has guided the stages of writing of this thesis. Without his consistent and illuminating instructions, this thesis could not have reached its present form.

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