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The Rapid Response Team Reduces the Number of Cardiopulmonary Arrests and Hospital Mortality

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Abstract

Background: Cardiopulmonary arrest continues to affect inpatients resulting in high mortality. It is frequently preceded by warning signs that if recognized and addressed might prevent arrest. The aim of the rapid response team is early recognition and management of such warning signs to prevent arrest.

Objective: To assess the effectiveness of the rapid response team intervention in reducing the number of cardiopulmonary arrest in adult and pediatric inpatient regular floor patients as part of the performance improvement program.

Setting: An 800-bed tertiary care medical centre.

Design: Prospective observational before-and-after study.

Intervention: Introduction of the rapid response team as a performance improvement project to reduce the number of inpatient cardiopulmonary arrests.

Outcome: Rate of cardiopulmonary arrest per 1000 admissions in adult and pediatric patient outside intensive care units.

Results: The number of cardiopulmonary arrest outside the intensive care units before implementing the RRT was 75 during 2006 (rate of 3.53 per 1000 admissions) and decreased to 59 and 37 cardiopulmonary arrests during 2007 and 2008, respectively (rate of 2.72 for 2007 and 1.68 for 2008 per 1000 admission) after implementing the RRT (p-value = 0.0068). The number of calls to the RRT correlated inversely with the number of arrests.

Conclusion: The rapid response team is effective in reducing the number of cardiopulmonary arrest in adult and pediatric patient in a tertiary care setting.

Keywords: Cardiopulmonary arrest; Resuscitation; Quality improvement; Rapid response team; Medical emergency team; Performance improvement

Introduction

Cardiopulmonary Arrest (CPA) is a catastrophic event that affects hospitalized patient and results in morbidity, high mortality, and added cost. Many patients that develop CPA have warning signs in the few hours preceding the event [1-3]. Unfortunately, such signs are not addressed in many patients how progress to develop CPA [3,4]. Recognizing warning signs early to identifying patients at risk of CPA and initiating proper monitoring and management has the potential to prevent this catastrophic event [5,6]. The rapid response team (RRT) is a multidisciplinary team that aims at early recognition and management of patient at risk of CPA to reduce the number of patients developing CPA in the hospital setting (also known as the medical emergency team) [4,7]. This article provides the practical steps undertaken at a tertiary care medical center to introduce the RRT and the relationship between proper utilization of the RRT and its effectiveness in reducing the number of CPA.

Methods

The RRT initiative was presented to the performance improvement council of the hospital to obtain their approval. After obtaining the approval to implement the RRT as a performance improvement project and to collect data to ensure proper implementation, a multidisciplinary team was formed consisting of Director of Quality, Chief of nursing, Chairman of the cardiopulmonary resuscitation committee, Medical Residency training program director, adult and pediatric critical care consultants, and representative from respiratory therapy and nursing. The team followed the Institute for Healthcare Improvement (IHI) guidelines [8]. After obtaining baseline data on the number of CPA, the criteria to initiate the RRT was selected for both adult and pediatric patients (Table 1). For a patient who is found unresponsive with or without a pulse upon arrival of RRT, code team (identified by the hospital as a team responsible for responding to an individual requiring Cardiopulmonary Resuscitation (CPR) or intubation) was called. The RRT could initiate the CPR until the arrival of code team.

The rapid response team for adult patients consisted of critical care nurse, respiratory therapist, and senior medical resident as first responders. The pediatric RRT (patients up to 14 years of age) consisted of a pediatric critical care nurse, respiratory therapist, and senior pediatric resident as first responders. An adult or a pediatric critical care specialist is a second responder to be called as needed. In addition, one page form was developed to facilitate communication and insure proper documentation of patient care provided by the RRT. All forms were kept in patient charts and a copy was sent to the RRT

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data base coordinator. Data were collected in relation to the number of RRT consultations (starting from time of implementation in January 2007), indication to initiate the RRT, intervention done in the floor, patients transferred to ICU, number of CPA hospital wide (prior to implementation of RRT over the period of January 2006- December 2006 and thereafter), and number of CPA in ICUs.

A comparison between the primary outcome (mean CPA rates/1000 admissions) before and after intervention was done using the t-test. After adjusting for the effect of serial correlation between the event rates within the periods, using Albers (1978) approach.

Before hospital wide application, education was done and the RRT initiative was piloted in part of the hospital that has 160 beds. After the pilot, hospital wide education was done utilizing posters and presentations to all inpatient units and departments. In the first quarter of 2007, the initiative was applied hospital wide. The RRT process was governed by an official hospital policy and procedure that was approved by hospital leadership.

Results

The number of Calls to the RRT during 2007 was 988 (754 calls (76%) in adults and vs. 234 calls (24%) in pediatrics). The commonest reason to call the adult RRT was high respiratory rate followed by low systolic blood pressure while the commonest reason to call the pediatric RRT was staff concern followed by hypoxemia as shown in figures 1 and 2. The commonest interventions started by the RRT were to provide oxygen, order arterial blood gases and chest x-ray, followed by administration of intravenous fluid boluses as shown in table 2. The

Criteria to call Adult RRT	Criteria to call Pediatric RRT
RR less than 8 or greater than 24	HR<80 or>200 (infant up to 12 months) HR<70 or>180 (1 year to 14 years)
HR less than 50 or greater than 120	SBP<70 (infant up to 12 months) SBP<90 (1 year to 14 years)
SBP less than 90 mmHg	Capillary Refill>4 second
O2 Sat less than 90 (on O2>8 L/min)	RR<20 or>80 (infant up to 12 months) RR<15 or>60 (1 year to 14 years)
GCS less than 10	O2 Sat less than 90 (on O2>8 L/min)
Acute mental status changed	GCS less than 10
New onset/Increasing Seizures activity	Acute mental status changed
Acute significant bleeding	New onset/Increasing Seizures activity
Staff concerned/worried	Acute significant bleeding
	Staff concerned/worried

Table 1: Criteria for calling the RRT.

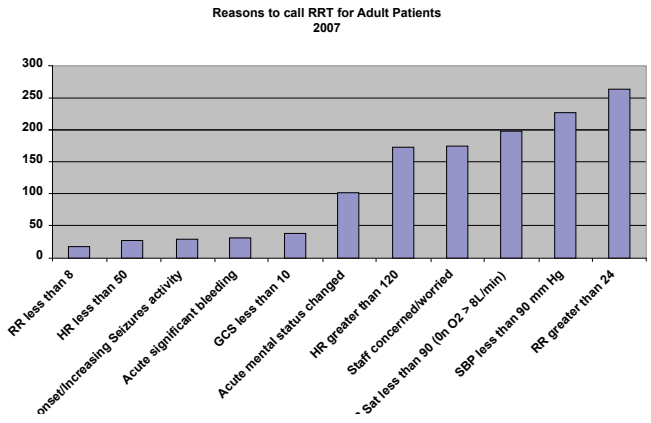

Figure 1: Reasons to consult the adult RRT during 2007.

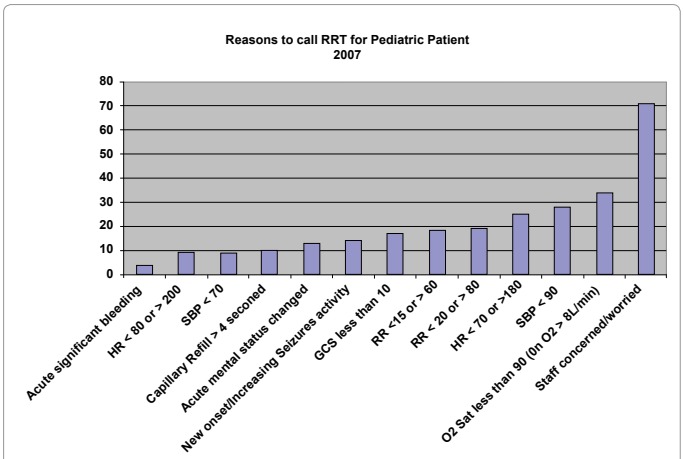

Figure 2: Reasons to consult the pediatric RRT during 2007.

RRT transferred 322 patients to the ICU during the same period out of which 74% survived to discharge. There were 4 expected deaths in patients that stayed in the floor.

The number of CPA was 75 during 2006 (rate of 3.53 per 1000 admissions) before the RRT and 59 CPA during 2007 (rate of 2.72 per 1000 admission, respectively) after implementing the RRT (p-value=0.0068). This translates into a relative risk reduction in the rate of CPA of 23%. The rate of CPA farther decreased to 37 CPA during 2008 with rate of 1.68 CPA/1000 admissions (52% relative risk reduction compared to 2006) after conducting education and feedback to improve the utilization of the RRT and was associated with more consultations to the RRT (Figure 3).

This was not associated with increase in the number of CPA in ICUs. The total number (in both critical care and non-critical care areas) of CPA during 2006 was 305 and decreased to 279 during 2007 (rate of 14.4 and 12.8/1000 admissions respectively).

In the 4th quarter of 2007, there was an unexplained increase in the number of CPA. Analysis of the data in an effort to explain such increase showed that the number of RRT calls was inversely related to the number of CPA as shown in figure 4. Inpatient units with the highest number of CPA were found to have the lowest utilization of the RRT (Figure 4). Focused study on the CPA in one of the inpatient units with the highest number of CPA showed low utilization of the RRT. More detailed review of all patients who arrested in such unit showed that 77% of patients that developed CPA had warning signs that were not addressed (underutilization of the RRT, error of commission). After doing focused education and feedback to the units with the low utilization and high CPA, the number of CPA (rate per 1000 admission) decreased and the number of RRT calls increased in the first quarter of 2008. The rate of CPA decreased to 1.67 CPA/1000 admissions during 2008 after conducting education and feedback to improve the utilization of the RRT and was associated with more consultations to the RRT.

Discussion

The RRT is effective in reducing the number of CPA outside the ICU. This study showed that proper utilization of the RRT remains suboptimal in some areas and needs continuous monitoring and feedback. The inverse correlation of the number of RRT calls and the number of CPA is in support of that proper utilization of the RRT can prevent many unnecessary CPA. The lack of increase in the number of

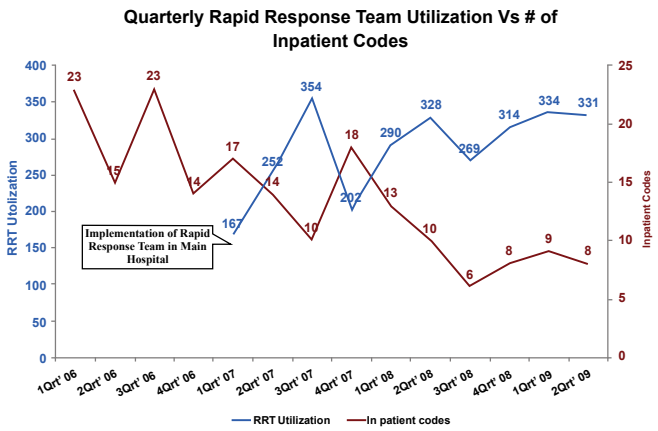

Figure 3: Number of RRT calls versus number of CPA.

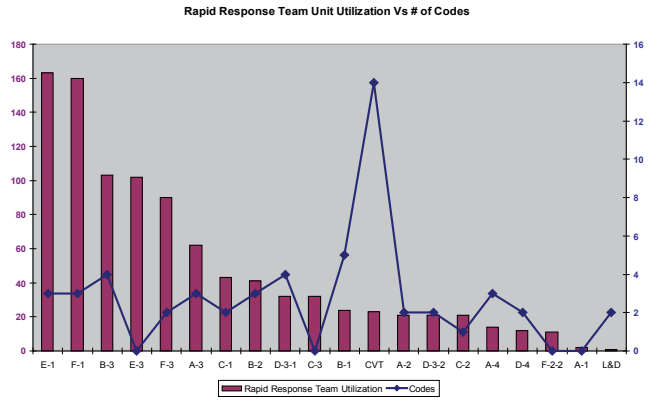

Figure 4: Unit specific relationship between number of CPA and RRT utilization during 2007.

Interventions: Respiratory	Total	Interventions: Circulation	Total
Non-invasive positive pressure ventilation	11	Cardiopulmonary resuscitation initiated	7
Call Code Team	20	Call Code Team	11
No intervention	30	Orogastric-nasogastric tube Insertion	11
Nebulizer Treatment	104	No intervention	20
Suctioned	135	Blood Transfusion	42
Airway maintained*	225	Intravenous access insertion	108
Chest x-ray	253	Electrocardiogram	159
Arterial blood gases	298	Intravenous Fluid Bolus	229
O2 Mask	432		

*Ambubag by ventilation via facemask/trachea and Bronchodilators

Table 2: Frequency of Interventions by adult and pediatric RRT during 2007.

CPA in the ICU despite transferring many patients to ICU indicates that the RRT does not transferring the problem from none critical care areas to the ICU. Other studies showed similar reduction in the number of CPA ranging from 9 to 70% [9-16]. Similar to the finding of this study, it was found that underutilization of the RRT results in potentially avoidable CPA [17]. Such error of commission can be minimized by continuous monitoring of the process as well as feedback and education to healthcare providers.

On the other hand, while pediatric RRT has been shown to be effective in reducing the number of CPA by 71.7%, [18] others showed no reduction in the number of pediatric CPA after introducing the RRT concept [19]. Such differences in the effectiveness of the RRT concept might be to differences in implementation and utilization of the RRT.

The commonest indication to initiate the RRT in this study was respiratory related criteria, similar to findings by others [20].

A retrospective analysis of 3269 MET responses and 1220 cardiopulmonary arrests over 6.8 years showed an increase in MET responses from 13.7 to 25.8 per 1000 admissions ($p<0.0001$) after instituting objective activation criteria. There was a coincident 17% decrease in the incidence of cardiopulmonary arrests from 6.5 to 5.4 per 1000 admissions ($p=0.016$). The proportion of fatal arrests was similar before and after the increase in use of MET [13].

In this study, the RRT was not applied for outpatient areas which might have resulted in decreased effectiveness of the intervention as other studies showed that about one third of the calls for the RRT are from outpatient areas [21]. To overcome this shortcoming, the RRT will be applied for outpatient areas in 2008.

Conclusion

The proper application and utilization of the RRT is effective in reducing the number of cardiopulmonary arrest in a tertiary care setting.

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The subject of this paper has no connections with any company. Hospital available resources were used.

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