The effect of the Medical Emergency Team on unexpected cardiac arrest and death at the VA Caribbean Healthcare System: a retrospective study

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Abstract

***Objectives*: To determine the effect of the implementation of a medical emergency team on the incidence of unexpected cardiorespiratory arrest, unexpected death, unplanned ICU admissions, and advance directive status.**

***Design, setting, and patients*: This is a single center, retrospective, electronic medical record review. Adult patients admitted to regular ward between November 2007 to February 2008 and November 2008 to February 2009 at the VA Caribbean Healthcare System were evaluated. Medical emergency team education and program rollout occurred from February through June 2008.**

***Main outcome measures*: Unexpected inhospital cardiorespiratory arrest, death, and unplanned ICU admission rates.**

***Results*: There was no effect on unexpected death (p=0.23) nor 48 hour survival after the intervention (p=0.37). There was no change in DNR status previous to MET (p=0.18) and after MET implementation (p=0.32). There was no change of unexpected cardiorespiratory arrest (p=0.16), although lower rates of non-ICU codes were observed (31 versus 25) during the study time period.**

***Conclusion*: The implementation of the MET in our institution was not associated with a decrease on rate of unexpected cardiorespiratory arrest, unexpected death, 48 hour survival after the intervention or change of DNR status.**

Key words: Veterans, resuscitation orders, intensive care unit

In-hospital cardiopulmonary arrest is a common finding and it is associated with a low survival rate. (1) It has been documented in several studies that there is a critical period previous to a cardiac arrest when clinical signs of deterioration are present and may be unnoticed. (2) A 1994 study showed that on the hours previous to an inhospital cardiac arrest there was a failure of the nurse to notify a physician of a deterioration in the patient's mental status, failure of the physician to obtain or interpret an arterial blood gas measurement in the setting of respiratory distress and failure of the ICU triage physician to stabilize the patient's condition before transferring the patient to the ICU. (3) During the 1990's the rapid response system (RRS) was first developed within adult medicine with the goal to decrease in-hospital cardiopulmonary arrests and mortality. (4) This system consists either of a rapid response team (RRT) or a medical emergency team (MET). System participants are trained with advanced evaluation skills for the immediate care and stabilization of the acutely ill patient. By definition the RRT is led by an intensive care trained nurse and the MET is led by a physician. (5) The system consists of a multidisciplinary team that could include intensive care unit

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trained personnel such as a physician, nurse and respiratory therapist which are available 24 hours per day, 7 days per week for evaluation of patients not in the ICU who develop signs or symptoms of clinical deterioration.

After the implementation of these systems there have been published several studies including the effect of the system on overall non-ICU hospital mortality, ICU transfers from regular ward and non-ICU cardiorespiratory arrest rate. Results have been mixed with some favoring the implementation of the program.

A recently published meta-analysis concluded that the implementation of RRTs didn't have an effect on hospital mortality. Another important point that was mentioned is the overall reduction of 33.8% on non-ICU treated cardiorespiratory arrest rate. (6) Currently there still remain questions about the effectiveness of the system.

We hypothesized that the implementation of a MET in our institution would decrease the overall mortality and decrease the rate of unexpected cardiorespiratory rate and unplanned ICU admissions.

Methods

We conducted a study to address the effect of the implementation of the medical emergency team on the incidence of in-hospital unexpected deaths (patients with no DNR orders), unexpected cardio-respiratory arrest (patients with no DNR orders), unplanned ICU admissions and overall in-hospital mortality rate.

The medical records of all subjects admitted to internal medicine ward evaluated and managed by the MET in the period of November 2008 to February 2009 were included in the study. The obtained information was compared with data from November 2007 to February 2008, when the same types of events were evaluated and managed by a first year internal medicine resident physician, formerly called on duty physician (OD physician).

Collected data was: reason for team activation, patient's commorbidities, interventions performed, and outcomes such as unexpected cardiac arrest, unplanned ICU admissions, unexpected deaths, overall mortality, 48-hour survival after the intervention and DNR status before and after the intervention.

The study was reviewed and approved by the Institutional Review Board at the VA Caribbean Healthcare System.

Hospital setting

The VA Caribbean Healthcare System (VACHS) at San Juan is a tertiary teaching hospital that consists of 331 beds; twelve beds in the Medical Intensive Care Unit (MICU), ten beds in the Surgical Intensive Care Unit (SICU), four beds in the Coronary Care Unit (CCU) and six beds in the Intermediate Coronary Care Unit (ICCU). This hospital admits approximately 10,565 patients per year; 1,965 to the ICU's, and has an annual emergency department volume of approximately 24,424 patients per year.

Implementation of the system

The MET was first institutionalized on June 2008. During the period of April-May 2008 the medical, nursing and respiratory therapist staff participants of the MET were instructed about the system, how it works, activation criteria (**Table 1**) and their role in the process. During the period of February through June 2008 the general ward nursing staff and resident physicians were divided in small groups and educated about the MET and how to activate it. The process included interactive audiovisual presentations and brochures. Since June 2008 this education process was added to the regular lectures for new employees. Each of the MET members has a common pager number for activation.

Statistical analysis

Descriptive statistics for patient characteristics were generated and compared between the two groups (resident physicians vs MET) using chi-square tests for categorical variables, and Student's t tests for normally distributed continuous variables.

The incidence of unexpected cardiorespiratory arrest, unexpected death and unplanned ICU admissions were compared before and after the implementation of MET using Microsoft Excel. All analyses were two tailed and used a type I error of 0.05 as the criterion for statistical significance.

Results

Baseline characteristics of the patients included in the analysis are described on **Table 2**. There was no major difference between the two groups in terms of age, both been in the elderly range. All the patients were male. Among commorbidities the only statistically significant difference was that patients within the MET group had more diabetes mellitus (p=0.01) and psychiatric conditions (p=0.03).

During the time period evaluated, the most common reasons for activation of the medical emergency team were low oxygen saturation (25.3%) and respiratory distress (17.6%) compared with the control group in which the complaints for activation were respiratory distress (27%) and tachycardia (14.8%) (**Table 3**).

The most common medical emergency team interventions done were oxygen supplementation, intravenous fluids and endotracheal intubation (ventilatory support) compared to control group interventions such as oxygen supplementation, blood samples and electrocardiogram (**Table 4**).

After the implementation of the medical emergency team patients were transferred to an intensive care unit in 37% of cases vs control group transfer rate of 7% (p<0.003) (**Figure 3**).

Overall mortality was 8.25% before the intervention and 8% after the intervention. There was no effect on the unexpected cardiorespiratory arrest (p=0.16), unexpected death (p=0.23) nor 48 hour survival after the intervention (p=0.37), (**Figures 1**, **2**, and **4** respectively). There was no change in DNR status previous to MET (p=0.18) and after MET implementation (p=0.32) (**Figure 5**). Overall cardiac arrest rate previous to the intervention was 31 and 25 after the intervention, with a decrease rate of 19%.

Discussion

Our study evaluated the association between the implementation of a medical emergency team and both non-ICU unexpected cardiorespiratory arrest and unexpected death. To our knowledge this is the first documented study of a rapid response system intervention in Puerto Rico.

We found that the implementation of a rapid response system, in our case, specifically a medical emergency team was not associated with a lower unexpected neither cardiorespiratory arrest nor unexpected death rate. These findings could be explained by the fact that in general wards the nurse:patient ratio is low and most of the patients are alone during a large amount of time without immediate supervision that could detect the initial phase of deterioration that could be subtle, time in which the intervention by the rapid response system could make a difference in outcome. Another point that should be take in consideration is that vital sign shifts take place every 8 hours, as per reported in previous articles the median duration of instability before a critical event was 6.5 hours. (7)

Among the two groups, the most common complaint for activation of the team for patient's evaluation involved respiratory function deterioration. This correlates with previous studies published which stated that critical events are frequently preceded by a clinical deterioration involving the respiratory function. (7,8)

The increase of unplanned ICU transfer after the implementation of the MET (p<0.003) could be related to the fact that among patients evaluated by the MET there was a statistically significant higher rate of complaints of low oxygen saturation (p<0.003) and consequently need of endotracheal intubations (p=0.006). Among patients transferred to an ICU after a MET intervention, 18% did not survive after 48 hours and only one of the subjects signed a DNR order.

Unplanned ICU admissions during the pre-intervention period could be underestimated. We should take in consideration that during that time period patients could be transferred to the ICU by the primary care team and not be evaluated by the OD physician, these subjects could be translated in missed data.

We should mention that there was a slight decrease on non-ICU hospital cardiorespiratory arrest rate from 31 in the control period versus 25 in the MET period. Initially we hypothesized that the implementation could be associated to an increase in DNR status after the implementation of MET, but data did not support this statement in view of no statistically significant difference on the slight increase of DNR status.

In comparison with other studies, our results show similar

findings on terms of no effect on overall non-ICU mortality and a slight trend toward decrease of cardiorespiratory arrest rate but without effect on unexpected death. It should be mentioned that our study population age range is very limited and is basically only elderly and this fact has a tendency toward an increase number of patients with active DNR status which decreases our sample for possible unexpected death.

Our study should be interpreted in the context of the following limitations, the design could have confounded results, before and after studies are retrospective, therefore variables cannot be controlled. This is a single center study and a small sample of patients.

Among the possible modifications that could be implemented on medicine wards is to shorten the time between vital sign rounds (make vital sign rounds every 4-6 hours). By this mean, nurse staff could detect initial patient deterioration period and earlier interventions could be translated on improved outcome or prevention of a fatal event and maybe avoid ICU transfer. Prospective studies should be design in order to analyze the effect of the system after a more stable program and changes on frequency of documentation of patients' condition as well as increased attention to education. Analyze the activation rate and calls that resulted in a cardiorespiratory arrest, which could be interpreted as system underuse.

Table 1. Criteria for activation of the medical emergency team

Respiratory distress or threatened airway
Respiratory rate <8/min or >30/min
Acute oxygen saturation <85% (despite of oxygen supplementation for >5 minutes)
Systolic BP <90 mmHg or Diastolic BP <50 mmHg
Heart rate <40/min or >140/min
Acute chest pain (not responding to nitroglycerin)
Acute change in neurological status
General concern regarding patient's clinical status

Table 2. Baseline patient's characteristics before and after implementation of medical emergency team

	Pre-intervention	Post-intervention	P value
Age (years)	77	74	0.16
Commorbidities (number)			
- Hypertensive vascular disease	46	45	0.23
- Diabetes mellitus	20	29	0.01
- Kidney disease	12	14	0.37
- Dyslipidemia	10	13	0.26
- Hypothyroidism	0	2	0.12
- Chronic smoker	4	3	0.85
- Chronic ETOH	2	1	0.65
- Coronary artery disease	35	22	0.12
- Arrhythmia	13	8	0.42
- History of malignancy	16	18	0.35
- Obstructive sleep apnea	0	1	0.27
- Chronic lung disease	14	11	0.81
- ESRD on HD	0	1	0.27
- Liver disease	8	5	0.56
- Psychiatric disease	3	9	0.03
- Alzheimer disease	16	7	0.09
- Obesity	1	0	0.35
- Rheumatologic disease	2	0	0.18
- Valvulopathy	1	0	0.35

Table 3. Most common interventions performed after the identification of a detrimental sign

Reason for activation	No. (%) of complains		
	Pre-intervention (n=74)	Post-intervention (n=91)	P value
Low O2 saturation	8 (10.8)	23 (25.3)	0.0003
Hypoactivity	0 (0)	7 (7.7)	0.0003
Bradycardia	1 (1.3)	3 (3.3)	0.23
Tachycardia	11 (14.8)	6 (6.6)	0.33
Respiratory distress	20 (27)	16 (17.6)	0.81
Seizures	1 (1.3)	4 (4.4)	0.12
Hypertension	9 (12.2)	6 (6.6)	0.61
Hypotension	10 (13.5)	12 (13.2)	0.38
Altered mental status	0	9 (9.9)	0.0007
Skin flush	0	1 (1.1)	0.27
Dizziness	0	1 (1.1)	0.27
Bleeding	3 (4)	1 (1.1)	0.38
Chest pain	10 (13.5)	1 (1.1)	0.01
Acute neurologic deficit	1 (1.3)	0	0.35
Fall	0	1(1.1)	0.27

Table 4. Most common interventions after the activation of the emergency team

Interventions	Pre-intervention	Post-intervention	P value
Oxygen	26	16	0.2
Electrocardiogram	20	9	0.06
Arterial blood gases	10	5	0.29
ACLS	0	4	0.02
Inhaled nebulizing therapy	7	3	0.28
Intravenous fluids	13	16	0.26
Endotracheal intubation	4	13	0.006
Vasopressor	2	5	0.16
Intravenous diuretic	9	4	0.24
Antihistamines	0	1	0.27
Imaging studies	8	5	0.56
Antihypertensive medications	9	7	0.84
Anticonvulsant medication	0	3	0.05
Comfort measures	2	1	0.65
Antibiotics	2	4	0.3
Blood transfusion	1	1	0.91
Blood samples	24	3	<0.04
Intravenous steroids	4	4	0.81
Antiarrhythmic medication	9	2	0.05
Vasodilator medication	4	0	0.06
Discontinuation of antihypertensive meds	1	0	0.35
Intravenous morphine	4	0	0.06
Nasogastric lavage	1	0	0.35
Non-invasive ventilation	1	0	0.35

Figure 1. Number of unexpected cardio-respiratory arrest pre and post intervention

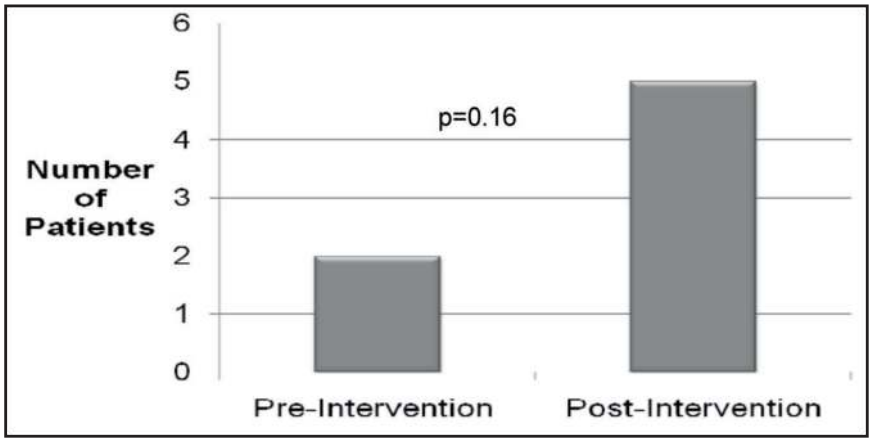


Figure 2. Number of unexpected death pre and post intervention

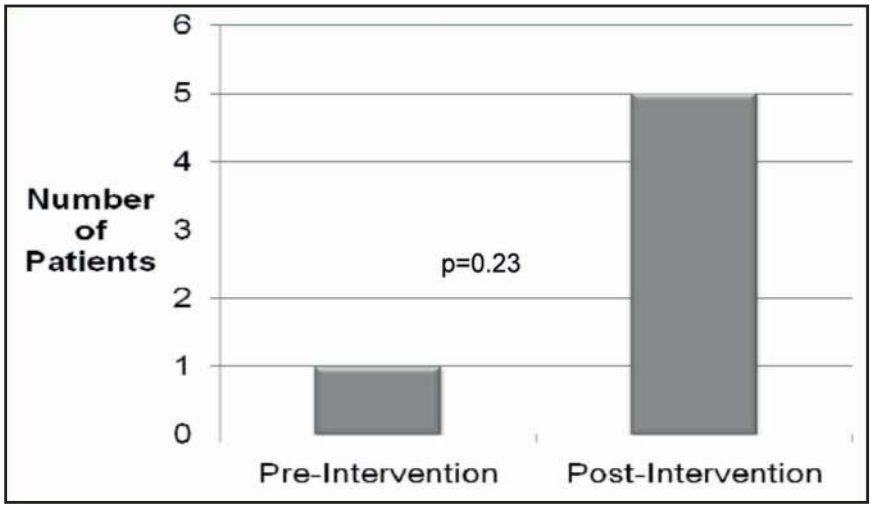


Figure 3. Number of unexpected ICU admissions pre and post intervention

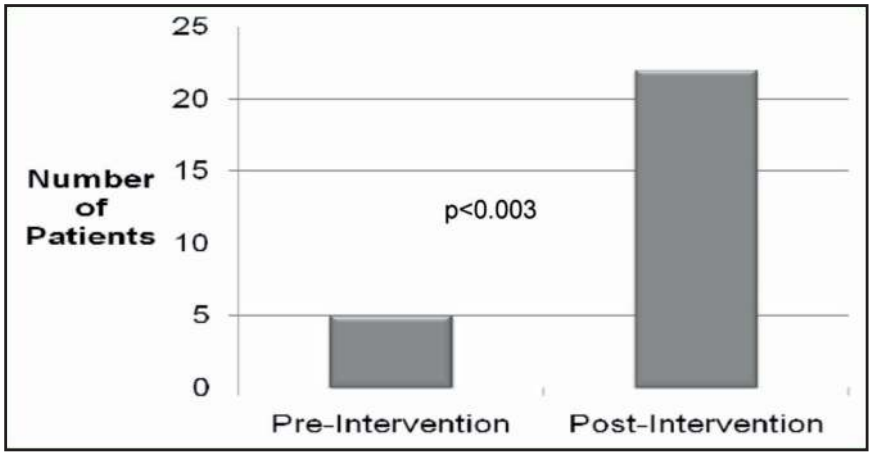


Figure 4. Forty-eight-hour survival pre and post intervention

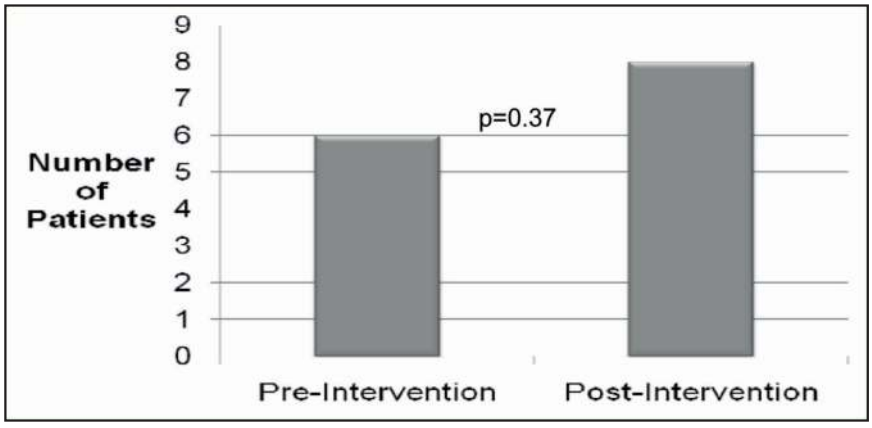
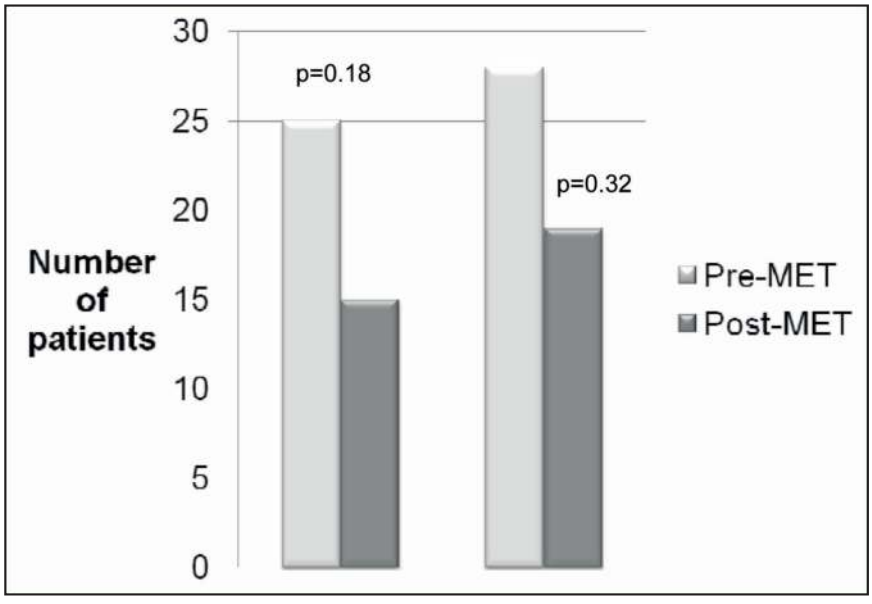


Figure 5. Change in DNR status pre and post intervention



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