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Medical emergency team response for the non-hospitalized patient★

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Abstract

Objectives—Rapid response systems (RRS) evolved to care for deteriorating hospitalized patients outside of the ICU. However, emergent critical care needs occur suddenly and unexpectedly throughout the hospital campus, including areas with non-hospitalized persons. The efficacy of RRS in this population has not yet been described or tested. We hypothesize that non-hospitalized patients accrue minimal benefit from ICU physician participation in the RRS.

Design—A retrospective review of all RRS events in non-hospitalized patients for a 28 month period was performed in a large, urban university medical center. Location, patient type and age, activation trigger, interventions performed, duration of event and disposition were recorded. Admission diagnosis and length of stay were also recorded for patients admitted to the hospital.

Setting—Academic medical center.

Patients—Non-hospitalized persons requiring evaluation by the medical emergency team.

Interventions—None.

Measurements and main results—There were a total of 1778 RRS activations during the study period. 232 (13%) of activations were for non-hospitalized patients. The patient cohort consisted of outpatients, visitors, and staff. Triggers for RRS activation were neurologic change (42%), cardiac (27%), respiratory (16%), and staff concerns (16%). The mean duration of the response was 38 min. The most common interventions performed included administration of

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oxygen (46%), intravenous fluids (13%) and dextrose (6%). 82% of patients were taken to the emergency department and 32% of the ED cohort were admitted to the hospital.

Conclusions—Perceived emergencies in non-hospitalized patients occur commonly but require minimal emergent intervention. Restriction of critical care physician involvement to inpatient deteriorations should be considered when designing a RRS. Future studies are needed to evaluate the utility of nonphysician provider led rapid response teams with protocol-driven interventions for similar populations.

Keywords

Rapid response; Medical emergency team; Non-hospitalized

1. Introduction

The goal of rapid response systems (RRS) is to provide prompt evaluation, triage, and treatment of individual patients with a recognized clinical deterioration. As studies have shown that hospitalized patients often exhibit sustained physiological changes prior to cardiac arrest, the fundamental concept of RRS is that timely recognition and intervention by appropriately trained personnel will decrease the incidence of cardiac arrest and mortality.^{1,2} A recent systematic review found that implementation of a RRS was associated with a 34% reduction in the incidence of cardiac arrest in adult patients outside of the intensive care unit (ICU).³

The team composition of the efferent limb of RRS may vary. Physician-led teams, labeled medical emergency teams (MET), function on the premise that all personnel will respond to a perceived emergency and non-essential providers can leave as needed (ramp down system). In contrast, rapid response teams (RRT) are led by non-physician providers (usually nurses) anticipating that most patients require comprehensive evaluation and simple interventions which do not require immediate physician presence for all calls. In this system, specialized providers can be called as needed (ramp up). No data to date have shown one approach to be superior to the other.

The prevalence of RRS has grown as hospitals implement teams as part of quality improvement initiatives.⁴ Current evidence and our experience suggest that emergent critical care needs occur suddenly and unexpectedly throughout the hospital, including areas with non-hospitalized personnel.⁵ Although teams may respond to events in ambulatory or outpatient areas, the efficacy of RRS in the non-hospitalized patient has not been described. We hypothesize that non-hospitalized patients accrue minimal benefit from a MET.

2. Materials and methods

The hospital of the University of Pennsylvania is a 650-bed tertiary care center. A RRS was implemented in July 2006 with an afferent arm structured as a MET (physician-led; ramp down), including a critical care nurse, respiratory therapist, clinical pharmacist, a resident physician or covering provider from the patient's primary team, and an ICU attending physician or fellow during daytime hours. An off-site critical care physician is available by phone to provide guidance for overnight MET calls. All hospital staff has been trained on criteria for RRS activation. In addition to changes in vital signs, the criteria call for activating the team can be based on a clinician's judgment or concern. The team can be activated by anyone in the hospital, including non-clinical personnel and families/visitors. The team responds to all clinical emergencies, including responding to non-hospitalized persons who may have a medical emergency.

After obtaining institutional board review (IRB) approval, a retrospective review of the institutional RRS database and individual charts of non-hospitalized RRS patients was conducted spanning a 28 month period September 2006 to January 2009. Inclusion criteria included non-hospitalized patients for whom the rapid response system was initiated. Data collected included location, patient type (outpatient, visitor or employee) and age, activation trigger, interventions performed, duration of event, and patient disposition following the event. In instances where the patient was admitted to the hospital, we also collected the admission and discharge diagnosis and hospital length of stay. The duration of the event was defined as the time interval from overhead page activation to either emergency department arrival or departure of the MET. Data are summarized as mean $\pm$ standard deviation.

Rapid response activation triggers were grouped into the following *a priori* defined categories: neurologic, cardiovascular, respiratory, and staff concern. In the database, RRS nursing clinical coordinators had documented specific call triggers according to pre-populated selection list. Neurologic triggers included mental status change, loss of consciousness, seizure, suspected stroke, and acute agitation. Cardiovascular triggers included bradycardia, tachycardia, chest pain, hypotension, and severe hypertension. Respiratory triggers included tachypnea, dyspnea, and hypoxemia. Other remained a trigger option with free form text entry.

3. Results

There were a total of 1778 RRS activations during the study period. Two hundred and thirty two (13%) of the activations were for non-hospitalized patients and comprise the study cohort. The average age of the patients in the study was 47 ± 19 years. Patient type was noted in 217 (94%) of the cohort and consisted of: 110 outpatients (47%), 56 visitors (24%), and 51 employees (22%). We did not find any difference in the incidence of RRS activation based on month or season.

The triggers for rapid response activation are noted in Tables 1 and 2. Neurologic emergency was the most common trigger (approximately 40% of in each cohort) followed by cardiovascular emergency, respiratory emergency, and finally staff concern. The triggers for activation were similar between the group of patients who were ultimately admitted to the hospital and those who were allowed to go home or refused further evaluation. Interventions performed by the MET are noted in Table 3. The most common therapy administered by the MET was administration of oxygen (46% of events). The mean duration of each event was 39 ± 21 min, and there was no difference in duration of event between patients taken to the emergency department and others.

One hundred eighty nine (82%) of the patients were taken to the emergency department for further evaluation. The remainder of the patients either did not require or refused further evaluation. No patient died during the MET event. Thirty two percent (61/189) of the patients evaluated by the emergency department were admitted to the hospital. Of the 61 admitted patients, 41 (67%) were outpatients, 11 (18%) were employees, 5 (8%) were visitors, and 4 (7%) were not classified. Utilizing the cohort of known patient type ($n = 217$), outpatients were admitted in 37% of presentations ($n = 41/110$); visitors in 20% of presentations (11/56), and employees in 10% (5/51). Patients admitted to the hospital were significantly older than non-hospitalized patients (average age 52.4 ± 17.2 vs. 45 ± 19.5 years, $p = 0.01$). The top three admission diagnoses were syncope, chest pain, and asthma/COPD exacerbation, and the admission and discharge diagnosis were congruent in 91% of cases. The average hospital length of stay was 3.7 ± 4.8 days. Only 3 patients required admission to the ICU following evaluation in the emergency department: one outpatient was found down in a bathroom due to cardiac arrest and required cardiopulmonary resuscitation,

one patient had an ST segment elevation myocardial infarction (STEMI), and one patient had acute respiratory failure following a complication from an outpatient procedure. All but one of the patients who required hospitalization was discharged alive.

4. Discussion

Rapid response systems have been widely adopted by many hospitals as a means to detect impending critical illness and facilitate early intervention in hospitalized patients outside of the ICU.⁶ However, perceived emergencies occur commonly throughout the hospital and can frequently involve non-hospitalized patients. Use of a MET to attend to these emergencies may seem to be a logical extension of the system, but the concept of RRS was not originally designed to address this group. In our review, 13% of total RRS activations were for non-hospitalized patients. Outpatients comprised the largest component of non-hospitalized patients evaluated by the MET, but visitors and employees accounted for 46% of the responses. The most common trigger for activation was neurologic change, which most frequently involved a seizure or syncopal event. Given that this study involves non-hospitalized patients, it is not surprising that staff concern was not a common trigger for activation, and its use was mostly confined to patients who had sustained a fall or were noted to have a near-syncopal event/acute malaise.

Regarding the type of therapies administered by medical emergency teams, prior studies have shown differing levels of intervention.^{7,8} A recent study evaluated treatments delivered during inpatient RRS activations, where 2371 of 2376 MET responses required intensive care unit level interventions. Conversely, our study found only 2 patients have benefited from physician presence. One patient sustained a cardiac arrest and the other required orotracheal intubation. The patient who had a STEMI required emergent cardiac catheterization and did not benefit from the presence of a physician prior to transport to the emergency department. In all cases, a first responding nurse and respiratory therapist could have initiated therapy based on pre-established protocol, including ACLS with use of automated external defibrillation as needed, while waiting for the physician-responder to arrive. Other interventions performed by the MET in our study cohort involved basic therapies that could be protocol directed and do not require direct physician supervision.

A rapid response system may be most efficient by having both a MET (ramp down) and RRT (ramp up) arm. Use of a tiered response system for medical emergencies is a concept that dates back to the 1970s with inception of the first emergency medical systems.⁹ It is now established that less than 10% of perceived medical emergencies in the community require advanced life support, and that a provider trained in basic medical interventions can deliver care that is equally effective to that rendered by paramedics or other advanced practitioners in most instances where rapid transportation to the emergency department is feasible.¹⁰ Furthermore, studies evaluating outcomes of emergency medical systems that utilize a tiered response suggest that response times to critical calls by paramedic-staffed units are shorter than in single-arm systems due to better allocation of resources.¹¹

A ramp down system centered on the MET model may be of benefit if the pre-event probability of severe illness and need for immediate institution of complex therapy is high. This may be the case in hospitalized patients because this group is already acutely ill. However, a MET system utilizes more resources by removing a physician from the patient-care area for which he/she is responsible. This may, in turn, delay administration of care for hospitalized patients – a situation analogous to the delay to response found when paramedic responders are dispatched to all events. Because our MET involves an ICU physician responder, such a delay may be associated with increased morbidity. Conversely, a ramp up system may be ideal when the probability of severe acute physiologic deterioration is low.

Because the events encountered in the nonhospitalized patient cohort closely resemble the types of perceived medical emergencies noted in the community, a ramp up system, led by either nurse or paramedic, may be ideal. Furthermore, as in the prehospital setting, treatment strategy for this group of patients is centered on rapid evaluation and transportation of the patient to the emergency department, and use of a physician-responder is rarely beneficial.

This is the first study evaluating the use of MET in the nonhospitalized patient setting, and our findings should be viewed in light of the limitations of this study. It is not possible for the RRT to document a patient's medical condition in a detailed fashion in the non-hospitalized setting because this group does not have a chart. Therefore, our study was limited to evaluate the RRS database. It is possible that the physician responder may have directed care. Furthermore, a physician presence may enhance patient or family satisfaction, be more willing to discharge a patient without further evaluation, and make the team work efficiently. Conversely, it is also possible that awaiting physician arrival from the ICU further delayed necessary transitions to the ED and lengthy absences from the ICU may result in worsened outcomes in critically ill patients. Analysis of cost, physician time allocation and billing were not conducted. Furthermore, the exact location of the non-hospitalized patient or the exact reason why the person was in the hospital/clinic area was not recorded in the database. We do not have experience using our rapid response nurses as team leaders, and it is possible that a two-tiered system with a MET for inpatients and RRT for outpatients would result in a difference in the care provided. However, this is not likely since the majority of patients were rapidly transported to the emergency department for further evaluation and care. Lastly, the study consists of a single center, retrospective design and has the limitations inherent therein. As such, our results may not be generalizable to other centers and more research is needed to validate our findings in different settings. Additionally, future studies evaluating the safety and efficacy of a 2-tiered response model are needed.

5. Conclusions

Perceived clinical emergencies are common in non-hospitalized patients. Whereas most patients require further evaluation in the emergency department, very few require urgent or advanced intensivist-directed interventions prior to arrival in the emergency department. A ramp up model, functioning as a RRT (as opposed to a MET), may offer an equally effective and less resource intensive approach in the evaluation and management of this patient cohort, but this approach requires further study to gauge both its safety and efficacy.

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References

1. Buist MD, Jarmolowski E, Burton PR, Bernard SA, Waxman BP, Anderson J. Recognising clinical instability in hospital patients before cardiac arrest or unplanned admission to intensive care. A pilot study in a tertiary-care hospital. *Med J Australia*. 1999; 171:22–25. [PubMed: 10451667]
2. Hillman KM, Bristow PJ, Chey T, et al. Antecedents to hospital deaths. *Intern Med J*. 2001; 31:343–348. [PubMed: 11529588]
3. Chan PS, Jain R, Nallmothu BK, Berg RA, Sasson C. Rapid response teams: a systematic review and meta-analysis. *Arch Intern Med*. 2010; 170:18–26. [PubMed: 20065195]
4. Berwick DM, Calkins DR, McCannon CJ, Hackbarth AD. The 100,000 lives campaign: setting a goal and a deadline for improving health care quality. *J Am Med Assoc*. 2006; 295:324–327.

5. Devita MA, Bellomo R, Hillman K, et al. Findings of the first consensus conference on medical emergency teams. *Crit Care Med*. 2006; 34:2463–2478. [PubMed: 16878033]
6. Hillman K, Parr M, Flabouris A, Bishop G, Stewart A. Redefining in-hospital resuscitation: the concept of the medical emergency team. *Resuscitation*. 2001; 48:105–110. [PubMed: 11426471]
7. Bellomo R, Goldsmith D, Uchino S, et al. A prospective before-and-after trial of a medical emergency team. *Med J Australia*. 2003; 179:283–287. [PubMed: 12964909]
8. Flabouris A, Chen J, Hillman K, Bellomo R, Finfer S. Timing and interventions of emergency teams during the MERIT study. *Resuscitation*. 2010; 81:25–30. [PubMed: 19913973]
9. Stout J, Pepe PE, Mosesso Jr VN. All-advanced life support vs tiered-response ambulance systems. *Prehosp Emerg Care*. 2000; 4:1–6. [PubMed: 10634274]
10. Curka PA, Pepe PE, Ginger VF, Sherrard RC, Ivy MV, Zachariah BS. Emergency medical services priority dispatch. *Ann Emerg Med*. 1993; 22:1688–1695. [PubMed: 8214858]
11. Nichol G, Detsky AS, Stiell IG, O'Rourke K, Wells G, Laupacis A. Effectiveness of emergency medical services for victims of out-of-hospital cardiac arrest: a metaanalysis. *Ann Emerg Med*. 1996; 27:700–710. [PubMed: 8644956]

Table 1

Triggers for MET activation.

Trigger	<i>n</i> (%)	
	All patients (<i>n</i> = 232)	Patients admitted to the hospital (<i>n</i> = 61)
Neurologic change	119 (42)	23 (40)
Cardiac	77 (27)	21 (37)
Staff concern	47 (16)	11 (19)
Respiratory	46 (16)	6 (10)

Note: Patients may have had more than 1 trigger.

Table 2

Triggers for rapid response activation and emergency department (ED) diagnoses.

ED Dx (patient total)	Rapid response trigger(s)
Near syncope/syncope (<i>n</i> = 67)	Altered mental status, hypotension, tachycardia, chest pain, dyspnea
Chest pain (<i>n</i> = 14)	Bradycardia, hypotension, altered mental status
Asthma/COPD exacerbation (<i>n</i> = 7)	Dyspnea, altered mental status, chest pain
Anxiety disorder/panic attack (<i>n</i> = 11)	Altered mental status, dyspnea, seizure, chest pain
Seizure (<i>n</i> = 18)	Seizure, dyspnea, altered mental status, chest pain, hypotension
Dehydration (<i>n</i> = 5)	Altered mental status, seizure, chest pain
Hypoglycemia (<i>n</i> = 9)	Respiratory depression, tachycardia, altered mental status
Pneumothorax (<i>n</i> = 1)	Tachycardia
Abdominal pain NOS (<i>n</i> = 7)	Altered mental status, tachypnea, tachycardia, hypotension
Transfusion reaction (<i>n</i> = 1)	Altered mental status
Hip fracture (<i>n</i> = 2)	Altered mental status
Cardiac arrest (<i>n</i> = 1)	Altered mental status
Pneumonia (<i>n</i> = 4)	Seizure, hypotension, dyspnea, chest pain
Mechanical fall (<i>n</i> = 11)	Possible stroke, tachycardia, altered mental status, dyspnea
Anaphylaxis (<i>n</i> = 4)	Dyspnea, chest pain, tachycardia, altered mental status
Stroke (<i>n</i> = 2)	Altered mental status
Severe anemia (<i>n</i> = 1)	Chest pain
Sepsis (<i>n</i> = 2)	Altered mental status
Myocardial infarction (<i>n</i> = 1)	Hypotension, chest pain, altered mental status
Delirium tremens (<i>n</i> = 1)	Seizure
Bradycardia (<i>n</i> = 1)	Bradycardia
Laceration (<i>n</i> = 2)	Hemorrhage
Congestive heart failure (<i>n</i> = 1)	Dyspnea
GI bleeding (<i>n</i> = 1)	Tachycardia, hypotension
Knee injury (<i>n</i> = 2)	Staff concern
Chronic pain (<i>n</i> = 1)	Staff concern
Mononucleosis (<i>n</i> = 1)	Not documented
Acute renal failure (<i>n</i> = 1)	Not documented
Neck pain (<i>n</i> = 2)	Not documented
Unknown (<i>n</i> = 8)	

Note: Patients who were not evaluated in the emergency department following rapid response activation are excluded from this table.

Table 3 Common interventions performed by the MET ($n = 232$).

Intervention	Events including the intervention, n (%)
Oxygen	107 (46%)
Intravenous fluids	29 (13%)
Dextrose 50%	13(6%)
Bronchodilator	7 (3%)
Aspirin	5 (2%)
Sublingual nitroglycerin	4 (2%)
Other	8 (3%)