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Rapid response systems

Nurse-led medical emergency response reduces code blue team activations in non-hospitalized patients

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Abstract

Objective: We describe the creation of a two-tier emergency response system with a nurse-led first responder program titled "MET-RN" (Medical Emergency Team-Registered Nurse) created for ambulatory settings supported by a critical care code blue team for escalation of care. This observational study evaluated the clinical characteristics and effects of a MET-RN program on the code blue response.

Methods: A retrospective review of the MET-RN response data was assessed from January 2016 to June 2021. Data collected included time of call, call location, patient comorbidities, triage category (minor, urgent, or emergent), activation trigger, interventions performed, duration of the event, and patient disposition. In instances where the patient was admitted to the hospital, the discharge diagnosis and emergency department (ED) triage score were collected. Differences were tested using analysis of variance (ANOVA) F-tests, with Tukey post-hoc testing where applicable.

Results: MET-RN responded to 6,564 encounters from January 2016 to June 2021. The most frequent trigger call was dizziness/lightheadedness, with a prevalence of 12.0%. 33.9% of the patients seen by MET-RN were transported to the ED for further evaluation. Establishing a MET-RN system led to an estimated median of 58.3% reduction in utilization of the code blue team per quarter.

Conclusion: The creation of MET-RN first responder system enabled the ambulatory areas to receive minor, urgent, and emergent patient care support, leading to a decrease in utilization of the code blue team for the hospital. A two-tiered response system resulted in an improved allocation of hospital resources and kept critical care teams in high-acuity areas while maintaining patient safety.

Keywords: Rapid response teams, Medical emergency response, Code blue teams

Introduction

The Institute of Medicine report *To Err is Human: Building a Safer Health System* in 2001 highlighted the need for improvements in healthcare quality and advocated for enhancements in patient safety to prevent avoidable harm and provide the necessary care to patients who could benefit from it.[1,2] The most common systems devised for inpatient settings for urgent triage and rescue are code blue teams and Rapid Response Teams (RRTs).[3–5] Most rapid response systems in literature are physician-led and have been described for inpatient settings.[6] Emergencies and perceived emergencies occur commonly throughout the hospital and can frequently involve non-hospitalized patients.[7] It is important that ambulatory care patients continue to receive prompt care aligned to their needs, rapid triage, stabilization, and transfer to acute hospital admission as needed.[8,9] Emergency Medical Service (EMS) system response is the most common rescue system employed for clinics and outpatient services. EMS systems have a scope of practice defined by state statutes, rules, regulations, or licensure broad interpretations, and their standard of care is often more variable and may be case-dependent.[7] A nurse-led response for outpatient settings has limited evidence. Dechert et al.[7] suggested nonphysician provider-led teams with protocol-driven interventions for non-hospitalized patients, while Lakshminarayana et al.[10] described a standardized physician-led interprofessional team composition for both inpatients and

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non-hospitalized patients in hospitals where ambulatory and inpatient facilities are combined. At our institution, a 316-bed (403 with current expansion) quaternary care non-trauma hospital, a standardized code blue team led by an intensivist, responded to patient deterioration calls for non-hospitalized patients like hospitalized patients. In 2016, we transitioned to a two-tier system with a nurse first responder team called "MET-RN" (Medical Emergency Team-RN) for the outpatient settings supported by the code blue team for escalation of care.

This observational study evaluated the clinical characteristics, the reason for MET-RN calls, interventions, and the effect on the code blue team by creating a two-tier response system within an academic medical center for non-hospitalized patients.

Methods

Our institution is a 316-bed (increased to 403 beds since the study period) quaternary care hospital that treats a broad spectrum of non-trauma and non-obstetric adult patients. The ambulatory areas are in adjacent buildings physically connected to the hospital building. Acute deterioration of patients in the inpatient setting is covered by a code blue team (members of the Critical Care team) and a Rapid Response Nurse Team (Critical Care nursing) based on clinical triggers. Until January 2016, the code blue team covered all ambulatory areas, the lobby, the cafeteria, and other non-patient care areas, with rapid response nurse involvement restricted to the inpatient units.

A resuscitation committee monitors resuscitation activities and reports to the clinical practice leadership of the hospital. The concept of a MET-RN team was created in collaboration with multiple stakeholders led by the committee. Four nurses with experience ranging from emergency department (ED), trauma, to progressive care units were hired into the role of the MET-RN. A backup system was created from a pool of ambulatory nurses who could provide support if the primary MET-RN had to field simultaneous calls and responses. MET-RNs underwent a training program to supplement their Advanced Cardiac Life Support (ACLS) certification. Important aspects of their curriculum involved triage rules, clinical triggers, vital signs acquisition and monitoring using portable technology, and basic therapies for stabilization and transfer of medical and minor trauma patients.

The MET-RN team has a restricted set of nurse-initiated protocols with orders authorized by the program's medical director. When patients fulfill predetermined criteria (such as for hypoglycemia treatment and oxygen therapy), adherence to protocol-based care pathways ensures prompt alleviation of distressing symptoms. In the case of an urgent or emergent patient, immediate transfer to the ED or activation of the code blue team is necessary when encountering select conditions, such as stroke symptoms per the F.A.S.T. guidelines.

The MET-RN covers all ambulatory areas of the hospital, including the clinic areas, hospital cafeteria, lobby, and select parking areas. Represented specialties in outpatient areas include hematology oncology, cardiology, nephrology, surgical specialties, transplant, and palliative care. Our institution provides quaternary care and as such, ambulatory settings are areas of high acuity with an increased number of complex patients being managed in the outpatient setting. The MET-RN team's operational hours, spanning from 06:00 to 20:00, coincide with the presence of patients and visitors in the ambulatory areas. A MET-RN call can be initiated by any healthcare personnel, support staff or patients/caregivers who witnesses a patient in distress or in need of urgent medical attention. Based on resuscitation team data, it was determined a MET-RN should assess a responsive patient, and an unresponsive patient should lead to the initiation of a code blue team response. Based on code blue operator call logs, a script was developed to educate staff on the new process for medical emergency activation in ambulatory settings. The phone operators were instructed to ask if the patient in concern was "responsive" or "unresponsive." If unresponsive, a code blue would be called. If responsive, a MET-RN call would be sent to the MET-RN pager and not announced overhead as a code blue response.

While not actively responding to MET calls, the MET-RNs are responsible for ensuring that all equipment and supplies are readily available and in optimal working condition for any potential emergencies. The MET-RN team also leads various educational initiatives, often requested by ambulatory departments, focused on fostering an emergency preparedness culture. During downtime, additional responsibilities include performing administrative tasks, analyzing data, and suggesting enhancements related to overall emergency response effectiveness.

A retrospective review of all MET-RN calls was conducted from January 2016 to June 2021. This study was IRB-exempt as this was a quality improvement study. Inclusion criteria included non-hospitalized patients for whom the MET-RN was initiated. Data collected included time of call, age, sex, call location, patient comorbidities, triage category (minor, urgent, or emergent), activation trigger, interventions performed, duration of the event, and patient disposition following the event. "Minor" triage categories are for calls related to transfer assistance, care coordination, or other minimal risk call triggers. "Emergent" triage categories are for calls requiring immediate transfer to the ED or escalation to a code blue. "Urgent" calls were classified as the ones that did not meet the above criteria. This triage category designation is subjective; however, a patient displaying sustained abnormal vital signs following the initial assessment would fall into the urgent or emergent category (i.e., persistent HR < 50 or >110, SBP < 90 or MAP < 60, SBP > 200 or MAP > 130, RR < 8 or RR > 30, or oxygen saturation < 90% despite supplemental O2). The event's duration was defined as the time needed for clinical care and episode documentation. The Emergency Severity Index (ESI) score (an ED-based triage score) was used to assess severity of illness. The ED triage team provided this score for patients arriving in the ED. ESI is a five-level ED triage algorithm that helps with clinical risk stratification from 1 (most urgent) to 5 (least urgent) based on acuity and resource needs.[11]

Continuous data are summarized as the median and interquartile range (IQR); differences were tested using analysis of variance (ANOVA) F-tests, with Tukey post-hoc testing where indicated. Categorical data are summarized as counts and percentages; differences were tested using Chi-square or Fisher's exact tests. MET-RN activation triggers and interventions were documented according to a pre-populated selection list that can be found in Appendix 1. The percentage of prevented code blue calls per quarter was calculated as the number of MET-RN calls with an ED ESI score of 1 or 2, divided by that number plus the total number of code events. All analysis was performed using R version 4.1.0, 0.05 was used as the threshold for statistical significance.

Results

Patient demographics

MET-RN responded to 6,564 encounters from January 2016 to June 2021 (Table 1). The busiest quarter was Q1 2020, accounting for more than 350 patients (Fig. 1). MET-RN encountered more female (53.4%) than male (46.6%) patients (Table 1). The median patient age was 65.0 (IQR 53–75 years) (Table 1). Appendix 2 illustrates patient comorbidities by system encountered during MET-RN calls, considering patients who have more than one health comorbidity. The most prevalent comorbidities fall under the vascular (36.5%) and cardiovascular (34.6%) systems, with the least prevalent falling under the psychiatric (4.5%) and musculoskeletal (6.4%) systems (Appendix 2).

Call demographics

The median time MET-RNs spent in a call was 31.0 min (IQR 22, 45 mins)—including travel time, patient assessment, and documentation (Table 1). There were significant pair-wise differences between urgent and minor triage (10.8 min longer on average for urgent [95% CI: 9.5–12.1], $p < 0.001$), between emergent and minor (6.7 min longer for emergent [95% CI: 3.9–9.5], $p < 0.001$), and between emergent and urgent (4.1 min shorter for emergent [95% CI: −1.2 to −7.0], $p < 0.001$) (Fig. 2, Appendix 3).

Table 1 lists the overall distribution of the triage category (minor, urgent, or emergent). MET-RN responded to 3,546 minor calls (54.0%), 2,677 urgent calls (40.8%), and 341 emergent calls (5.2%) (Table 1). 55.6% of the patients seen by MET-RN were discharged home or discharged to proceed with their appointments (Table 1). 33.9% of the patients seen by MET-RN during the study period were transported to the ED for further evaluation, an average of 405 patients annually (Table 1, Appendix 4). Of those transported to the ED, 54.4% of patients were assigned an ED acuity score of 1 or 2 (Table 1). Table 1 also lists the times of day when the MET-RN team was busiest. Their busiest hours were between 10:00 and 12:00 daily and their least busy hours were between 18:00–20:00 (Table 1). Fig. 3 summarizes the prevalence of MET-RN call triggers

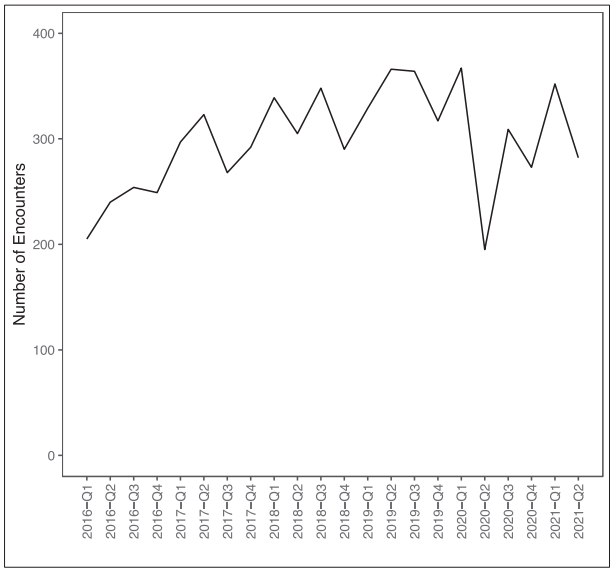

Fig. 1 – Number of MET-RN encounters by quarter.

Table 1 – Overall patient demographics and encounter characteristics.

	Overall (N = 6,564)
Age	
Median (IQR)	65.0 (53.0, 75.0)
Sex	
F	3,506 (53.4%)
M	3,058 (46.6%)
Time of Day	
06:00–<08:00	270 (4.1%)
08:00–<10:00	1,219 (18.6%)
10:00–<12:00	1,611 (24.6%)
12:00–<14:00	1,408 (21.5%)
14:00–<16:00	1,370 (20.9%)
16:00–<18:00	624 (9.5%)
18:00–20:00	52 (0.8%)
Missing	10
Time Spent on Call	
Median (IQR)	31.0 (22.0, 45.0)
Missing	2
Triage	
Minor	3,546 (54.0%)
Urgent	2,677 (40.8%)
Emergent	341 (5.2%)
Disposition (Who D/C Patient)	
Expired	1 (0.0%)
Inpatient (IP)	540 (8.2%)
ED	2,228 (33.9%)
MET	3,647 (55.6%)
Outside Facility	148 (2.3%)
ED ESI	
	n = 2,768
1	67 (2.6%)
2	1,329 (51.8%)
3	1,107 (43.1%)
4	61 (2.4%)
5	2 (0.1%)
Missing	202

ED ESI reported for 2,768 patients discharged to IP or ED.

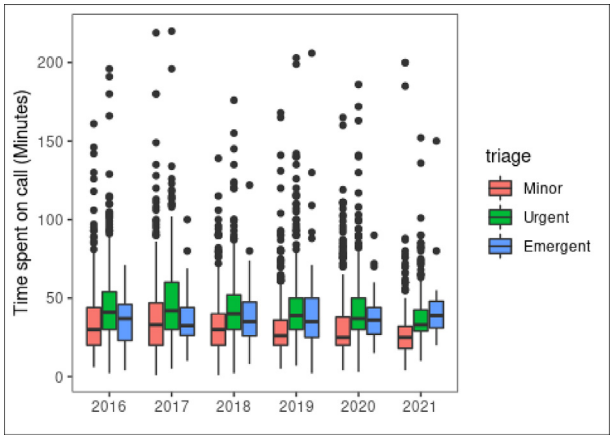

Fig. 2 – Visualization of time spent on call by triage category (minor, urgent, or emergent) by year 2016–2021.

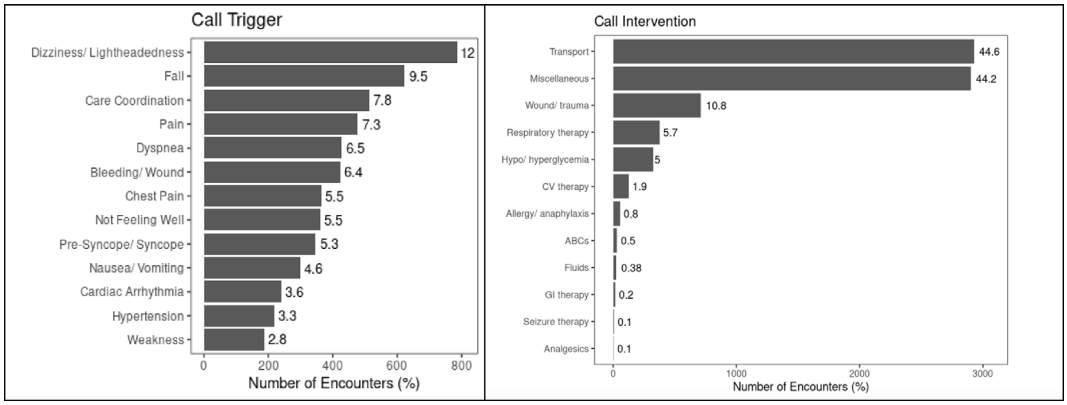

Fig. 3 – Prevalence of MET-RN call trigger and call intervention by category.

Table 2 – Summary of code events and code blue calls prevented per quarter. N = 22 quarters during the study period. We have assumed that MET-RN calls of ESI 1 or 2 represent a group of calls that would have unnecessarily involved the code blue team if MET-RN were not in operation; this count is the numerator of the percent reduction in code events calculation, with total code events plus MET-RN calls of ESI 1–2 as the denominator.

	Median (IQR) Counts per Quarter (N = 22)
Code Events	51.5 (40.5, 56.2)
MET-RN Calls with ESI 1 or 2	62.0 (56.2, 75.5)
Percent Reduction in Code Calls	58.3 (51.2, 60.4)

and interventions. The most common call trigger is dizziness/lightheadedness, with a prevalence of 12.0%.

There was a median of 51.5 (IQR 40.5, 56.2) code blue events called per quarter from Q1 2016-Q2 2021 for in-hospital patients and ambulatory areas (Table 2, Fig. 4). A median of 62.0 (IQR 56.2–75.5) MET-RN calls with an ESI triage acuity score of 1 or 2 per quarter were called from Q1 2016-Q2 2021 based on ED triage (Table 2, Fig. 4). Since MET-RN calls with ESI of 1 or 2 would have led to a code blue call prior to MET-RN system being established, this led to an estimated median 58.3% reduction in utilization of the code blue team per quarter (Table 2, Fig. 4). Among these patients admitted to the ED or directly admitted to the hospital, 35% of the transfers were discharged or admitted from the ED with a cardiovascular-related diagnosis (Appendix 5).

Discussion

Many hospitals have implemented systems that allow for the earlier recognition of deteriorating patients.[3,12] Research into effective hospital-based response systems for outpatient settings is limited.[8,13–15] A MET-RN program was created for this quaternary care hospital system in response to increasing code calls to outpatient areas that did not always require a large critical care team response.

The data shows that a MET-RN team was able to respond to 6,564 encounters from January 2016 to June 2021 with a median of 292.2 (IQR 301, 336.5) calls per quarter (Table 1), illustrating that

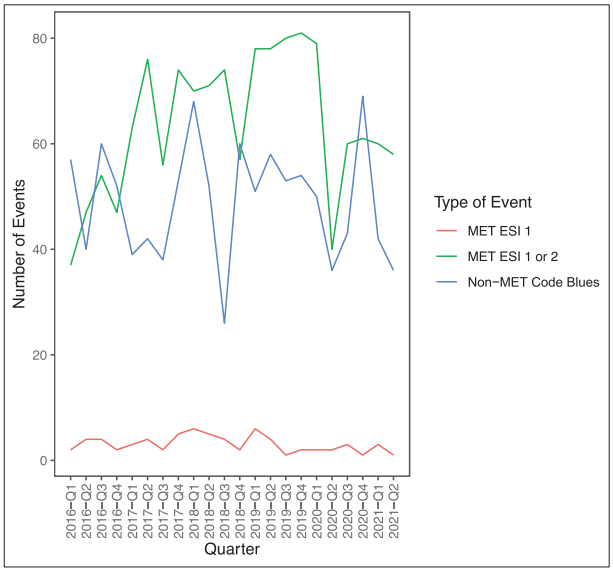

Fig. 4 – Count of all code blue activations in the hospital and MET calls to ambulatory areas with an acuity score of 1 or 2 per quarter from 2016 to 2021. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

MET-RN is a busy, well-adopted service in the outpatient setting. Feedback has been positive from ambulatory care physicians, nurses, and allied health staff. The median call lasted 31 mins, a not insignificant amount of time and similar to a prior study.[7] The length of time on a call can be attributed to three main factors: comprehensive assessment, transport times to the ED (if needed), and documentation.

Minor calls usually require fewer complex interventions (Fig. 2, Appendix 3). Urgent calls may require integrated care coordination, such as speaking with a patient's primary consulting physician and optimizing their stability before transport to the ED. Emergent calls were in between urgent and minor call durations. According to Fig. 3, the primary triggers and therapeutic interventions fall under minor categories. Therefore, we did not see the need for an experienced intensivist or equivalent attending physician presence at these calls, as had been suggested in prior publications.[9,10] Additionally,

the medical emergency team released their patients *without* transporting them to an ED or directly admitting them to the hospital in over 52% of the calls each year, as seen in Table 1. We do not have any report of bounce-back, adverse events, or morbidity/mortality because of the mis-triage of ambulatory patients by our MET-RN team. This illustrates that MET-RN nurses appropriately intervene, and a two-tier system leads to better allocation of hospital resources.

Before MET-RN was created, all calls would have involved the code blue team. Consequently, the number of code blue calls prevented can be equated to the total number of MET-RN calls. However, given that not all MET-RN calls would have been emergent enough to warrant a full code response (i.e., "unresponsive"), our analysis takes patients with acuity scores of 1 or 2 (the most emergent) and calculates a percent reduction by comparing it to the number of code blues called in that quarter. The hospital saw an estimated median 58.3% reduction in utilization of the code blue team per quarter with the new MET-RN workflow without any reported patient safety issues and improved resource utilization (Table 2, Fig. 4). The medical director of MET-RN was available for any triage decisions/workflow concerns.

Over 50% of patients annually are discharged from MET-RN care following observation, averting an ED visit, and alleviating ED volumes and stress. We hypothesize that deploying a trained MET-RN-led team with back up of an ICU based team is a cost-effective strategy reducing ED utilization or code blue activations.

Limitations and future research

The study is retrospective in nature based on data collected and entered in a MET database by the MET-RN. In terms of the interventions performed by the MET-RN team, 44% were documented as miscellaneous, which may include care coordination, education, restroom assist, and transport (Appendix 1). We were unable to determine exactly which patient received which "miscellaneous" intervention. Future research will be focused on quantifying the cost-benefit of implementing a trained MET-RN team to outpatient areas rather than utilizing code blue calls or the emergency department.

Conclusions

Emergency care for non-hospitalized patients in a hospital system needs organization and coordination with hospital-based code blue response teams and the ED. A nurse-led first responder program titled "MET-RN" enabled the ambulatory areas to receive minor, urgent, and emergent patient support, leading to a decrease in utilization of the code blue team for our hospital. A two-tiered response system resulted in a better allocation of hospital resources, an efficient triage system for patient care, and keeping critical care physicians in high-acuity areas while maintaining patient safety.

CRediT authorship contribution statement

Kiley Nelson: Conceptualization, Methodology, Investigation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing. **Melissa Brooks:** Conceptualization, Writing – Review & Editing. **Carolyn Mead-Harvey:** Data Curation, Formal Analysis, Writing – Review & Editing. **Janae Quill:** Data Curation. **Brigid Kiley:** Data Curation, Writing – Review & Editing. **Charles Peworski:** Conceptualization. **Adrienne Ritchie:** Methodology. **Ayan Sen:** Conceptualization, Methodology, Writing – Review & Editing, Supervision, Validation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary material to this article can be found online at https://doi.org/10.1016/j.resplu.2024.100642.

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