

**Original Article****The Functioning of a Medical Emergency Team at a Finnish Hospital: A Quantitative, Retrospective Study for Quality Improvement****Mina Azimirad, RN, MNS**

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**Abstract**

**Background:** Medical Emergency Teams (METs) were developed in response to the low success rate of Cardiopulmonary Resuscitation (CPR). The MET process is based on recognizing a patient's worsening condition early to avoid CPR. MET usage is still sub-optimal in Finland and many other countries. Knowledge regarding its function in practice is scarce. Thus, it is warranted to assess it.

**Objective:** Analyzing the function of MET at Kuopio University Hospital (KUH) in Finland.

**Methods:** In this quantitative study, the registered data, recorded by MET team per MET call activation at KUH in 2013 and 2014, were analyzed retrospectively. Descriptive statistics cross tabulation and Chi-squared test were used.

**Results:** The distribution of MET calls varied over shifts, weekdays and months. Day shifts (70%) received more calls than night shifts (30%). Fridays received the highest proportion of MET calls (16.6%), and Sundays the lowest (11.2%). The mean time Nurse 1 spent on MET calls was 31.71 minutes (SD=16.73), while Nurse 2 spent 30.21 minutes (SD =15.57). The four most common reasons for activating MET were: "other reasons" (35.3%), "poor general condition of a patient" (33.1%), "O<sub>2</sub> sat < 90" (27.8%) and "loss of consciousness" (22.4%). Following the MET calls, about one-fifth (20.7%) of patients were transferred to the Intensive Care Unit, 3.8% to the Intensive Cardiac Care Unit (CCU) and the rest (68.1%) remained either in the initial ward or was transferred to another ward.

**Conclusions:** Although METs are becoming a popular patient safety initiative, there is not enough knowledge about how they function in hospital settings. There is a strong need for an international cooperation on patient safety to improve the hospitalization and healthcare quality.

**Impact of the study:** The results of this study can be used for quality improvement of the METs function to provide more evidence to improve the patient care.

**Key Words:** Rapid responses teams, Medical emergency teams, METs and Patient Safety.

## Introduction

Medical Emergency Teams (METs), also known as Rapid Response Teams (RRTs), are a patient safety initiative and have been proved rather successful (Jenkins & Lindsay, 2010). METs were first introduced in 1990 after physicians noticed that patients go through a specific process before experiencing cardiac arrest. This was the first time that the recognition of processes preceding cardiac arrest became a part of improving Cardiac Pulmonary Resuscitation (CPR) (Devita, Hillman, & Bellomo, 2006).

The Institute of Medicine (IOM) reported in 1999 “To Err is human: Building a safer Health system”, emphasized the importance of patient safety in healthcare. Following this report, healthcare centers became aware that improvements were necessary to ensure patient safety (IOM, 1999), and METs were thus introduced. Nowadays, there is a strong need for an international cooperation on patient safety to improve the hospitalization and healthcare quality (Rekleiti et al., 2012).

## Background

MET function is based on recognizing the symptoms of a patient’s deteriorating condition early so that the patient is able to recover quickly.

The main aims are early commencement of treatment and prevention of deterioration of patient’s condition. According to a report by the American Heart Association, the survival rate of hospital patients who experienced cardiac arrests requiring CPR was 19% in 2010 (Seethala, Esposito, & Abella, 2010).

Based on European Resuscitation Guideline 2015, CPR survival for in hospital patient is only 20%. Furthermore, an eight-year nationwide study in Taiwan reported that the overall success rate of CPR is only 14.8% (Lin et al., 2012). Hence, the recognition of patient’s deteriorating condition before cardiac arrest is important to increase patient safety.

The success rate of MET depends on the early recognition of symptoms. As a result, bedside nurses play a key role in the functioning of METs (Devita, Hillman, & Bellomo, 2006). As bedside nurses are often the ones who detect the changes in patient’s condition and inform METs.

Early detection of the deteriorating patient and eventually prevention the cardiac arrest is the first step of survival (European Resuscitation

Council Guideline, 2015; Jackson et al., 2016). Certain criteria have been defined to facilitate the recognition of symptoms. Although these criteria may vary between countries, they are fundamentally similar (Table 1).

There is a growing interest in the implementation of MET, especially in developed countries, but there is limited information on how to successfully apply a MET to the hospital environment.

To identify relevant research, a systematic literature search was performed in the Cinahl, PubMed and Cochrane library databases with the following inclusion criteria: published between 2010 and 2015, written in the English language, and a peer-reviewed publication.

The key point that prompts performing this research was finding an array of articles that assessed the effects of specific influential factors on MET function, but only one article (Leach et al., 2012) discussed how a MET functions in clinical practice is. Thus, we noticed that it would be difficult for a hospital to adopt METs if there is limited information.

The influential factors related to MET can be categorized as follows: education, nurse’s perception, nurse’s intuition, barriers and facilitators, none technical skills, patient’s outcome, patient’s intensive care unit (ICU) admission, engaging families and friends to activate MET, the effect of MET on end of life process, sustainability of renovation, and even the social and institutional processes associated with MET. (Table 2)

The purpose of this quality improvement study was to provide detailed information about the functioning of METs at one University Hospital during the years 2013 and 2014.

## Research Questions

1. How is the distribution of MET calls over shifts, weekdays and months?
2. What is the time that a MET call nurse spends on a MET call? What is the time that a MET call nurse spends on MET calls per year?
3. What are the most common reasons for MET calls?
4. What is the proportion of MET calls that lead to ICU admission?

## Methodology

### Setting

The University hospital is a 671-bed acute care hospital. It is one of the five university hospitals in Finland and has about 4,226 professional staff, treating 88,802 patients and receiving 414,949 outpatient visits annually. In 2010, the hospital implemented a MET team of two ICU nurses and one ICU physician. The MET team did not instantly become embedded as a patient safety initiative among the staff, but since 2013 it has performed well as a result of continuous education and improvement.

### MET activation

The MET group at hospital includes a physician and either one or two nurses depending on demand. The MET group is located in the ICU and is called for MET activities around the hospital. The bed-side nurses on the wards and other units are responsible for activating a MET call if they detect any of the MET criteria (Table 1).

### Data Collection

The MET group members at the hospital have filled in a special record for each attended MET call since 2013. The record includes MET criteria, date, time, department, time the nurse(s) spent on the MET case, physician's attendance, nurse's concern, MET type, and the department where the patient was admitted after the call. According to hospital policy, the 'nurse's concern' criterion is only marked as a reason for activating MET if no other MET criteria were met. The hospital offered registered data from the years 2013 and 2014.

### Statistical Analyses

The data were analyzed with SPSS version 21 (IBM, North Castle, NY). Descriptive statistics were used to assess the differences between values, using cross tabulation and the Chi-squared test with a confidence interval set at  $p < 0.05$  (Polit & Beck, 2012).

The weekday and month of a call were extracted from the date of the specific MET call. The hospital's shift schedules and the duration of the MET call were used to determine at which shift(s) the MET call occurred. All data points were either given numbers, and recoded into nominal values, or converted into categorical values.

## Ethics

Permission to carry out the study was granted according to the University hospital approval process. The study did not cause harm to any of the patients and anonymity was maintained by assigning each patient a MET code number, which was then used by MET group members for data collection.

## Results

### Distribution of MET calls over shifts, weekdays, and months

There were a total of 1,413 MET calls, with 646 calls in 2013 and 767 calls in 2014. The distribution of MET calls varied between shifts, weekdays and months. The evening shift experienced the highest proportion of requests, while the night shift experienced the lowest (35.2% vs. 30%,  $p$ -value: 0.033).

The highest proportion of MET calls was on Fridays and the lowest proportion on Sundays (16.6% vs. 11.2%,  $p$ -value: 0.002). The MET call requests also varied significantly between different months, as May and November noted the highest proportion of MET calls, while September showed the lowest proportion (respectively 12.1% and 10.6% vs. 5.3%,  $p$ -value:  $< 0.001$ ), (Table 3).

### The amount of time personnel spent on MET calls

The study also investigated how much time both MET nurses spent attending to MET calls. In most calls (51.6%), Nurse 1 spent between 16-30 minutes on a call. The mean time Nurse 1 spent on MET calls was 31.71 minutes (Standard Deviation=16.73, Min=2 min, Max=180 min). Nurse 2 was required for 159 of the 1413 (11.3%) MET calls in 2013 and 2014. In 48.4% of the cases Nurse 2 spent between 16-30 minutes on a call, The mean time Nurse 2 spent on MET calls was 30.21 minutes (Standard Deviation=15.57, Min=2, Max=80 minutes).

In total, the Nurse 1 spent 7.53 weeks in 2013 and 9.28 weeks in 2014 on MET calls, while Nurse 2 spent 0.84 weeks in 2013 and 1.21 weeks in 2014 on MET calls.

The *results* confirmed that in majority of cases (95.5%) also the physician attended the MET calls (Table 4).

**Most Common Reasons for activating MET**

The most common reasons for activating MET during 2013 and 2014 were: Other Reasons (35.3%), which included events such as MET visits that were planned beforehand, elective visits, and follow-up checkups. The second most common reason for MET calls was Poor General Condition (33.1%).

Considering the fact that nurses were permitted to mark more than one reason in the record, "Poor General Condition" has more possibility to be in companion with other reasons. The rest of the most common reasons for MET calls were

followed by O<sub>2</sub> Saturation<90% (27.8%), Loss of Consciousness (22.4%), Respiratory Rate>30 (20.1%) and Systolic Blood Pressure<90 mmHg (17.6%), (Table 5).

**Intensive Care Unit (ICU) transfer**

The results revealed that 20.7% of patients were transferred to the ICU following the MET call, while in 68.1% of the MET calls the patient remained either in the initial ward or was transferred to another ward. 3.8% of patients were transferred to the Intensive Cardiac Care Unit (CCU) following the MET call.

**Table 1. MET Criteria in Different Countries**

MET Criteria	Finland	Canada	Switzerland (Bern UH)	UK (NEWS)
Temperature	-----	39.5≤T≤35.5	-----	39≤T≤35
Blood Pressure	SBP<90	120≤SBP≤100	SBP<90	230≤BP≤50
Heart Rate	140<HR<40	120≤HR≤40	140<HR<40	140≤HR≤30
Respiratory Rate	30<RR<8 25≤RR≤11	30≤RR≤10	36≤RR≤6	
SPO <sub>2</sub>	SPO <sub>2</sub> <90 SPO <sub>2</sub> <91	-----	SPO <sub>2</sub> <90	
Mental status	----- AVPU	New Altered	GCS≤13	
Patient's general condition	Yes	-----	-----	-----
Nurse's concern	Yes	-----	-----	-----
Other	Yes	-----	Yes	-----

----- Means that this parameter is not used. AVPU= Alert, Voice, Pain, Unresponsive. GCS= Glasgow Coma Scale

**Table 2. Previous relevant MET studies**

<b>Focus</b>	<b>Year</b>	<b>Country</b>	<b>Authors</b>
<b>Education</b>	2013	USA	Astroth et al.
	2012	Australia	Cooper et al.
	2012	Greece	Pantazopoulos et al.
	2014	Denmark	Ramberg, Wolsk, Elkjaer, & Bulow
<b>Nurse's Perception</b>	2013	Australia	Massey, Chaboyer, & Aitken
	2011	USA	Pusateri, Prior, & Kiely
	2011	USA	Williams, Newman, Jones, & Woodard
<b>Nurse's Intuition</b>	2013	USA	Robert & Rekha
<b>Barriers and Facilitators</b>	2013	USA	Astroth et al.
	2015	USA	Braaten
	2013	Australia	Massey, Chaboyer, & Aitken
<b>Non-Technical Skills</b>	2014	Australia	Cooper & Cant
	2013	USA	Chalwin & Flabouris
	2010	Netherlands	Gevers, Van Erven, De Jonge, Maas, & De Jong
	2010	USA	Jenkins & Lindsey
	2013	Australia	Missen, Spakes, Porter, Cooper, & Mc Connel-Henry
<b>Patient's Outcome</b>	2010	Australia	Laurens & Dwyer
	2014	USA	Merchant et al
	2012	USA	Salvatierra & Gobbato
<b>Patient's ICU Admission</b>	2011	USA	Hatlem, Jones, & Woodard
	2012	Canada	Mardini, Lipes, Jayaraman
	2014	UK	Pattison & O'Gara
<b>Families and Friends</b>	2010	USA	Dunning et al.
<b>End of Life</b>	2013	Canada	Downar et al.
	2012	Canada, Australia, Sweden	Jones et al.
<b>Sustainability of Renovation</b>	2013	USA	Stolldorf & Pamela
<b>Social Processes</b>	2014	UK	Mackintosh, Humphrey, & Sandal

**Table 3. The distribution of MET calls over shifts, weekdays and months**

	<b>n</b>	<b>%</b>	<b>P-value</b>
<b>Shifts (n=1341)</b>			<b>0.033</b>
Morning	467	34.8%	
Evening	472	35.2%	
Night	402	30.0%	
<b>Weekdays (n=1167)</b>			<b>0.002</b>
Monday	137	11.7%	
Tuesday	182	15.6%	
Wednesday	168	14.4%	
Thursday	175	15.0%	
Friday	194	16.6%	
Saturday	180	15.4%	
Sunday	131	11.2%	
<b>Months (n=1165)</b>			<b>&lt;0.001</b>
January	85	7.3%	
February	112	9.6%	
March	95	8.2%	
April	70	6.0%	
May	141	12.1%	
June	89	7.6%	
July	76	6.5%	
August	81	7.0%	
September	62	5.3%	
October	117	10.0%	
November	124	10.6%	
December	113	9.7%	

**Table 4. The amount of time spent by Nurses 1 and 2 on MET Calls**

<b>Time Category Minutes</b>	<b>Nurse1</b>		<b>Nurse2</b>	
	<b>n</b>	<b>%</b>	<b>n</b>	<b>%</b>
1-15	134	11.0	25	15.7
16-30	629	51.6	77	48.4
31-45	314	25.7	36	22.6
46-60	90	7.4	14	8.8
61-75	28	2.1	6	3.8
76-90	16	1.3	1	0.6
91 and more	9	0.9		

### Discussion

The distribution of MET requests varied between shifts, weekdays and months. The highest proportion of MET calls came during day shifts, Fridays and the month of May. The four most common reasons for MET calls were "other reasons", "patient's poor general condition", "O<sub>2</sub> saturation <90%" and "loss of consciousness",

respectively. Additionally, following MET calls a majority of patients remained in wards and only about one-fifth required a transfer to the ICU. The MET nurses mainly spent 15-30 minutes on MET calls and the physician attended a majority of them. The finding that the day shifts receive more MET calls than night shifts, as well as the average time that nurses spend on MET calls

reported in this study were in accordance with findings from an earlier study performed in California (Leach et al., 2012).

### ***Distribution of MET calls over shifts, weekdays, and months***

**Shifts** Outnumbering the MET calls in day shifts was in accordance with a result from the only other study that had assessed MET call distribution over hospital shifts since 2010 (Leach et al., 2012). A possible explanation for this finding is that nurses tend to perform interventions during the daytime, when more physicians and hospital staff are present. This presents a problem; however, as MET calls occurring during the night may experience a noticeable delay. When less hospital personnel are present, which can demonstrate a barrier for a MET call (Braaten, 2015), the nurses may prefer to closely monitor a patient rather than activating a MET call. Furthermore, clinical changes may be more difficult to detect at night, for example, when a patient is sleeping. Changes may be very subtle, and the nurses may decide to continue monitoring a patient until the change becomes more obvious or they have a chance to consult with another staff member. These subtle clinical changes have been previously identified as barriers for the activation a MET call (Braaten, 2015).

**Weekdays** The logic discussed above could also be applied to the asymmetrical distribution of MET calls over weekdays. The results showed that the least MET calls were received on Sundays. Lack of human resources during the weekend might act as a barrier to the activation of a MET call (Braaten, 2015), and nurses may prefer close monitoring over an intervention until the off-day is over.

**Months** May appeared to have the most MET requests and September the least. As of 2010, no other studies had investigating the distribution of MET calls during various months. Our finding may have resulted from changes in the number of hospitalized patients during different months, but unfortunately we did not have access to this data.

The increase in MET calls from 2013 to 2014 (18.7%) demonstrates that the service embedded in the hospital.

### ***The amount of time personnel spent on MET calls***

Both Nurses 1 and 2 most often spent between 16-30 minutes on a MET call. The study from

California reported similar results indicating that nurses spend, on average, less than thirty minutes per MET call (Leach et al., 2012). This subject has been largely ignored by researchers even though it is crucial for organizing MET in terms of schedule and the number of members required. It could be useful to investigate the time spent on MET-related activities by personnel, as many hospitals and healthcare facilities are facing a lack of human resources and need to use them as efficiently as possible. This study has presented some evidence and will hopefully stimulate similar research at other hospitals.

In addition, the results show that a considerable amount of a nurse's time goes to MET-related activities. Hospital human resources should take this into account when assessing how many nurses are available and how many are required.

### ***Most Common Reasons for activating MET***

**Other Reasons** was the most reason for activation of MET calls (35.3%) which is about one third of the overall MET calls, most of them being elective calls and follow-up checkups showing that either MET group are overusing MET, or MET has not been introduced and embed fully among nurses. **Poor General Condition** was the second reason (33.1%) of MET requests.

**Respiratory Criteria** included in this study assessed three parameters;  $30 < \text{Respiratory Rate} < 8$  and  $\text{O}_2$  saturation. The proportion of MET requests that were caused by changes in these parameters varied greatly.  $\text{O}_2$  saturation  $< 90\%$  was the third most common reason for MET calls (27.8%),  $\text{Respiratory Rate} > 30$  was the fifth (20.1%) while  $\text{Respiratory Rate} < 8$  was one of the least reasons (3.5%). One reason might be the lesser incidence of  $\text{Respiratory Rate} < 8$  and the other reason might be that in these cases nurses tend to activate CPR teams rather than MET. On the other hand, Respiratory criteria altogether include almost half of the reasons MET was activated (51.4%). This fact shows us the importance of Respiratory criteria for further policy makings for MET in future.

**This study shows that Neurologic Criterion** (loss of consciousness) and Systolic Blood Pressure  $< 90$  mmHg were among the most reasons for MET activation. One should consider that in overcrowded wards, where patients' clinical statuses are not usually being monitored constantly, nurses might easily miss these MET

criteria. However, this can be prevented by regular checkup visits by nurses and in a good Nurse-patient relationship.

**Nurse's concern for the patient**, 140<Heart Rate<40 and Respiratory Rate<8 were among the least reasons for MET activation (overall 15.7%). According to the decision making models presented by Parker (Parker, 2014), nurses should be able to make the decision to activate a MET call even when the only MET criterion that is met is "Nurse's concern for the patient". In other words, sometimes the decision to activate MET follows an intuitive decision making model. The results of this study show that nurses do not rely much on their intuition for activating MET calls, as only 4.3% of all cases in 2013 and 2014 were activated due to "nurse's concern". It would be interesting to investigate how long these nurses had worked at the hospital and MET group, as previous research suggests that a nurse's experience and education can boost their confidence and help them decide to activate MET (Robert & Rehka, 2013).

#### **Intensive Care Unit (ICU) transfer**

Two indicators demonstrate the quality of a MET; 1) The number of ICU admissions and 2) The mortality rate of the hospital. In this study, about one-fifth of MET cases led to ICU admission. The majority of patients either stayed at their ward, or was transferred to other wards following the MET call. These findings are similar to those reported in the study from California (Leach et al., 2012), which also demonstrated that the majority of MET calls did not lead to ICU admission. This result shows how the adoption of METs could especially benefit countries that have an inadequate number of ICU beds per their population, such as England (Pattison & O'Gara, 2014).

A 2012 study from California (Leach et al., 2012) demonstrated that the introduction of a MET led to a reduction in the hospital mortality rate. This finding requires further evidence from other hospitals, however, as the authors mentioned that they could not assess whether MET implementation directly affects mortality rate as many factors exist that also influence a hospital's mortality rate.

#### **Limitations**

This study was limited by a lack of access to the hospital's mortality rate, inadequate knowledge about nurses' points of view, and a short-term

follow-up period (two years). Two years is a short time period when considering the collection of strong, reliable evidence. However, the two years included in this study provided a sufficiently large sample size (n=1413). As the mortality rate of the hospital has been defined as a quality assessment measure for assessing MET's function, the lack of access to this data limited our study (Devita, Hillman, & Bellomo, 2006). Furthermore, there is potential bias from including only English language articles in the literature search criteria because there might be valuable studies on the subject written in other languages. Another bias may be due to potential chance errors in some of the MET criteria, such as measuring blood pressure. The records of the MET calls were well fulfilled, hence being a valid data source for the study (Polit & Hungler, 2004).

#### **Conclusions**

Medical Emergency Teams are a rather new topic within the field of patient safety and there is a gap in knowledge when it comes to how they function. The hospitals that have adopted MET as a patient safety initiative can use this study as a starting point to analyze and improve the functioning of their MET services. Further studies concerning the functioning of METs at hospitals are necessary to confirm our findings and provide additional information to ensure patient safety.

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