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Long term trends in medical emergency team activations and outcomes

Ruth Herod[a], Steven A. Frost[b,c], Michael Parr[b,d], Ken Hillman[b,d,e], Anders Aneman[b,d,*]

[a] Intensive Care Unit, Royal Lancaster Infirmary, University Hospitals of Morecambe Bay NHS Trust, Ashton Road, Lancaster LA1 4RP, UK
[b] Intensive Care Unit, Liverpool Hospital, Sydney South West Local Health District, Elizabeth Street, Liverpool, NSW 2170, Australia
[c] University of Western Sydney, Penrith, NSW 2751, Australia
[d] University of New South Wales, South Western Sydney Clinical School, Elizabeth Street, Liverpool, NSW 2170, Australia
[e] Simpson Centre for Health Services Research, Australian Institute of Health Innovation, University of New South Wales, Botany Street, Randwick, NSW 2031, Australia

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ABSTRACT

Aim of study: . To analyze long-term medical emergency team (MET) operational trends including number of MET calls, trigger criteria for activation and clinical outcomes at a tertiary level, university hospital with a mature MET system.

Materials and methods: The characteristics of 19,030 MET calls between 2000 and 2012 were analyzed in a single-centre, retrospective observational study. Rates indexed per 1000 hospital admissions for MET calls, cardiac arrests, unplanned admissions to the intensive care unit (ICU) and hospital mortality were used as performance measures of the MET. Descriptive statistics (mean ± standard deviation) were applied and trends analyzed by one-way ANOVA with year 2000 set as the baseline using Dunn's correction for multiple comparisons, $p < 0.05$.

Results: Activations of the MET increased between 2000 and 2012 (19 ± 3–30 ± 4) and there were changes in reasons for activations over time. Clinical concern (worried) the most common (22%) trigger criterion in 2000 followed by hypotension (21%) and decreased level of consciousness (17%). In 2012, hypotension was the most common trigger (32%), followed by decreased level of consciousness (19%) and clinical concern (15%). Rates of cardiorespiratory arrest (1.4 ± 0.7–1.1 ± 0.4) and unplanned ICU admission (5.0 ± 1.2–5.9 ± 1.0) did not change between 2000 and 2012. Hospital mortality decreased from 2005 onwards (15 ± 3.4–12 ± 2.2).

Conclusions: MET activity progressively increased during the study period and where was a change in pattern of specific triggering criteria. The sustained decrease in hospital mortality independent of cardiac arrest and unplanned ICU admissions rates suggests patient benefit from the MET system.

1. Introduction

The medical emergency team (MET) was introduced at Liverpool Hospital in 1990 aiming to decrease morbidity and mortality through early identification of patients at risk of deterioration. Liverpool Hospital is a tertiary level, university affiliated hospital and the early implementation of the MET makes it a prototype hospital for such a systems intervention.[1]

The MET concept has since been accepted nationally and internationally and the body of literature investigating MET, generically termed rapid response systems (RRS), has grown over the last decade and includes consensus statements on overall design,[2] how to monitor the deteriorating hospitalized patient[3] and report data[4] as well as a wealth of studies on the impact of MET on clinical outcomes. A recent systematic review of RRS[5] concluded, that there is only moderate-strength evidence to support that RRSs are associated with reduced rates of cardiorespiratory arrest and in-hospital mortality. Studies to establish the value of RRS have proven difficult to perform for logistic, financial, cultural and political reasons,[6] resulting in heterogeneity in the quality of evidence.[5] Notwithstanding, RRS has both been endorsed[7] and widely implemented in hospitals, predominantly in Australia/New Zealand, the USA, the UK and increasingly in northern Europe.

* Corresponding author at: Intensive Care Unit, Liverpool Hospital, SWSLHD, Locked Bag 7103, Liverpool BC, NSW 1871, Australia.
E-mail addresses: anders.aneman@gmail.com, anders.aneman@medfak.gu.se (A. Aneman).

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Table 1
MET activation criteria and core MET data captured. * RR criterion changed from >36 to >30 in July 2010.

Primary reason	Data	Outcome
Airway threatened	Age	Transferred to ED
Respiratory arrest	Sex	Transferred to HDU/ICU
RR < 5	Date of hospital admission	Left on ward
RR > 30 (36)*	Time and date of call	Died
Cardiac arrest	Primary reason for call	NFMET
HR > 140	Criteria in preceding 24/8/4 h	DNAR
HR < 40		
BP < 90		
↓ GCS > 2		
Repeated/prolonged seizure		
Worried		

This retrospective review of the Liverpool MET database was performed to evaluate trends in the activation and outcomes from more than 19,000 MET calls over twelve years. The aim was to identify patterns of utilization and clinical impact of a mature RRS operating continuously over a long period of time which could provide information and guidance for other hospitals with less extensive experience and data from their RRS. It was hypothesized that the use of the MET would differ during the time period as the system matured, clinical care evolved and other patient safety innovations were implemented.

2. Methods

This study was approved by the local Ethics and Research Governance Office (LNR/13/LPOOL/169). The MET database utilized in this study is maintained by a dedicated registered nurse who enters and verifies all data. The database was established in 1998 with an excellent data completeness (overall >98%) from 2000 and onwards. Data from 1st of January 2000 to 31st of December 2012 comprising 19,030 MET activations were analyzed. Data for MET date were 100% complete with data available in 99.8% of activations for MET time, 94.6% for date from admission to date of MET call, 93.9% for activation criteria and 99.7% for MET outcomes. The MET activation criteria and the MET data routinely collected are shown in Table 1. Liverpool Hospital uses a track-and-trigger system and apart from the respiratory rate criterion that changed from >36/min to >30/min in 2010, no changes were made to the MET activation criteria or the MET data captured. A two-tiered system to respond to a patient's clinical deterioration was introduced in 2010[8] in which the primary care team responds to less serious signs of deterioration before activating the MET.

Unplanned ICU admissions were defined as admissions from hospital areas other than the emergency department, operating theatres and recovery units, and retrieved from the ICU database used for national benchmark reporting. Hospital admission data (numbers, age and in-hospital mortality) were obtained from the Clinical Information Department at Liverpool Hospital.

The annual variability of MET activations and outcomes was considered by analyzing monthly data to provide average and standard deviation per year and changes by year were analyzed using one-way non-parametric ANOVA (Kruskal–Wallis test) and Dunn's multiple comparisons test with year 2000 set as the index year. Process measures of MET activations and outcomes (cardiac arrest and unplanned ICU admissions) were analyzed by linear regression of the cumulative number of events vs. number of hospitalisations and changes were assessed as any change of slope. Statistical significance was set at $p < 0.05$.

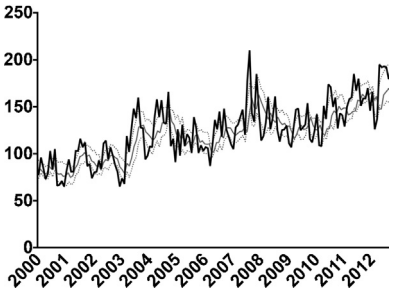

Fig. 1. Exponentially weighted moving average (EWMA) for number of monthly MET activations. The solid black line represents the actual number of MET activations, the solid grey line represents the EWMA of MET activations and the upper and lower dotted grey lines represent the upper and lower 95% confidence limits for the EWMA.

Data were indexed per 1000 hospital admissions when appropriate. An exponentially weighted moving average (EWMA) was calculated for the number of MET activations over time with a smoothing factor (alpha) of 0.3 and a moving average over the preceding six months, including the upper and lower 95% confidence interval limits. All statistical analyses were performed using GraphPad PRISM (v5.0a, GraphPad Software Inc., CA, USA).

3. Results

3.1. MET calls

The monthly number of MET activations doubled in twelve years (from 81 ± 14 calls/month to 170 ± 27 calls/month) with a significant and steady increase from 2006 and onwards (Fig. 1). The average number of MET activations per month per 1000 hospital admissions increased from 18 ± 3.0 in 2000 to 30 ± 4.5 in 2012, similarly during daytime (08–17), evening (17–24) and night (00–08). The proportion of daytime MET activations remained unchanged throughout at 41–48% of all calls. The slope of cumulative MET activations and hospitalisations did not change.

The monthly number of MET activations was above the 95% upper confidence interval limit for the EWMA for 54 out of 156 months with the peaks typically occurring during the winter months.

Only 1% of the total number of MET calls was preceded by activation criteria present but without MET activation in the last 24 h (0.4%) or 8 h (0.6%) and then almost exclusively for a decrease in GCS > 2 points. A previous MET activation had occurred over the last 24 h in 4.9%, over the last 8 h in 6.2% and over the last 4 h in 1.1% of patients.

The time between date of hospital admission to date of first MET activation showed minor annual fluctuations and decreased from 12.9 ± 4 days in 2000 to 11.3 ± 3 days in 2012, also being the lowest observed, with the highest annual average at 16.1 ± 5 days (2009).

Patients triggering MET activations became older over time (62.9 ± 3 years in 2000 vs. 70.7 ± 5 years in 2012), whereas the age of hospitalized patients did not change (67.5 ± 4.3 years in 2000 vs. 70.3 ± 2.3 years in 2012). The proportion male patients remained unchanged between 51 and 56%.

3.2. MET triggers

Consistently increasing trends were observed for a drop in GCS > 2 points (from 17% in 2000 to 19% in 2012), SBP < 90 (from 21% in 2000 to 32% in 2012) and HR > 140 (from 8% in 2000 to 14% in 2012) (Table 2). In contrast, the overall event rate for repeated/prolonged seizures decreased and MET activations for HR < 40 remained at less than 3%. MET activations for RR > 36 (30)

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