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REVIEW

Impact of introduction of an ICU-led Medical Emergency Team (MET) service: Single centre cohort analysis at a metropolitan teaching hospital

Mainak Majumdar, Emmanual Saka, Rodolfo Comandari, Umesh Kadam

Intensive Care Unit, Weribee Mercy Hospital, Werribee, VIC, Australia

SUMMARY

This cohort analysis reviews MET call activity before and after the creation of an ICU-led MET service that provides visible 24-hour response to physiologic deterioration in adult patients in a metropolitan teaching hospital. We describe significant features of non-obstetric adult population requiring MET activation and suggest areas for future study.

Key Words: MET calls; patient outcomes; cohort analysis; mortality; length of stay

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Corresponding Author: Mainak Majumdar (mainakmajumdar@gmail.com): Intensive Care Unit, Werribee Mercy Hospital, Werribee, VIC Australia

ABSTRACT

We evaluated the impact of establishing an ICU-led Medical Emergency Team (MET) service at a metropolitan teaching hospital by conducting cohort analysis: We compared cohorts pre- and post-service establishment, in terms of MET frequency, indications, and associations with mortality and length of stay. Results indicated a significant increase in MET call activity post-establishment, with delayed MET activations (>24 hours post-admission) associated with higher mortality rates and prolonged lengths of stay. We identified respiratory distress and altered level of consciousness as key indicators for adverse outcomes. Age emerged as an important predictor of mortality post-MET call, emphasising the need for prompt intervention, especially in older patients.

BACKGROUND

Medical Emergency Team (MET) calls play a crucial role in modern healthcare systems. By providing both early recognition of patient deterioration and prompt management by critical care trained staff, METs improve patient outcomes and reduce adverse events like unplanned admissions to intensive care unit (ICU), unexpected cardiac arrests, and death.[1,2] The establishment of MET systems in hospitals has enhanced patient safety and is a mandatory feature of health systems in many countries.[3–5]

Understanding the impact of MET activations on the healthcare system as a whole is essential for resource allocation, optimising response protocols, and ensuring timely interventions for deteriorating patients. Cohort analyses examining the frequency, timing, and indications for MET calls can identify areas for improvement, implement targeted interventions, and ultimately enhance patient safety and quality of care.

This study aims to contribute to existing literature on MET calls by examining the impact of opening an ICU and establishing an ICU-led MET service at a metropolitan teaching hospital in Victoria, Australia.

The state of Victoria has an established culture of ICU-led MET systems and this study examines the impact of this transition in a hospital that did not previously have an ICU, in terms of MET activity and patient outcomes and indications for calls through retrospective exploration of MET data to identify patterns, trends, and potential areas for improvement in managing deteriorating patients.

METHOD

Study design and setting

We conducted a retrospective cohort analysis to evaluate the impact of introduction of an ICU-led MET system on care delivery at a metropolitan hospital in Victoria, Australia. The ICU-led MET service was established on September 1, 2018. We compared post-ICU MET data from September 1, 2018 to March 5, 2020 (552 days) with available pre-ICU MET data from June 12, 2017 to August 31, 2018 (446 days).

Data collection and inclusion criteria

We collected data on MET calls, patient demographics, indications for MET activations, and outcomes from the hospital's MET database and clinical records. Inclusion criteria comprised all patients who had MET calls during their admission episodes, with a focus on MET activations within 24 hours of admission compared to those occurring later in the course of admission. We examined variables such as age, gender, timing of MET calls, indications for activation, mortality rates, and length of stay.

Statistical analysis

The hospital's database manager released data to the investigators as an Excel spreadsheet (Microsoft, Redmond, WA) and analysed using R-Studio. We used descriptive statistics to summarise the characteristics of the study population, including frequencies and percentages for categorical variables and means with standard deviations or medians with interquartile ranges for continuous variables. We conducted comparative analyses using chi-square tests for categorical variables and t-tests or Mann-Whitney U tests for continuous variables, as appropriate. We performed subgroup analyses to assess the impact of delayed MET activations on mortality and length of stay.

RESULTS

We compared 542 MET calls across 21,182 admissions within the 446-day period pre-ICU with 1,289 MET calls across 29,249 admissions within the 552-day period following establishment of the ICU-led MET service.

While there was an increase in clinical activity after the inauguration of a new ICU and the addition of 56 ward beds, statistically significant increases in daily admissions and overall hospital mortality were not demonstrated (Table 1). However, there was a notable increase in MET calls following the establishment of the ICU-led MET service, more than could be explained by the non-statistically significant change in daily admissions alone (Table 2).

Table 1: Admission cohort

	Pre-ICU	ICU	*p* value
Admissions	21,182	29,249	
Admissions/day	47.6	53.1	0.08
Median Age	**44**	**46**	
Median Length of Stay	**2**	**2**	
Deaths/1,000 Admissions	**19.5**	**21.1**	0.22

Table 2: MET cohort

	Pre-ICU	ICU	*p* value
MET calls	542	1,289	<0.01
MET calls/1,000 separations	25.6	44.1	<0.01
MET calls resulting in ICU admission		143 (11.1%)	<0.01
Median Age	**69**	**69**	0.91
Gender	346 Females **(63.8%)**	841 Females **(65.2%)**	0.60
Median Length of Stay	**6**	**7**	0.53
MET Mortality	**7.6%**	**8.4%**	0.63

The data showed a progressive increase in MET calls with age in the non-obstetric adult inpatient population, with mortality commencing from the 50–59 age cohort, and the 70–79 and 80–89 age categories accounting for a significant proportion of calls. From the 10th decade of life onwards, there was a downward trend to MET calls (Table 3).

Table 3: Age

Age Group	MET Calls	MET Calls per 1,000 Admissions	Deaths	Median Length of Stay (days) [IQR]
17–29	63 (4.1%)	18.3	0	4 [4]
30–39	89 (5.7%)	19.3	0	5 [6]
40–49	95 (6.1%)	19.9	0	5 [5]
50–59	151 (9.7%)	28.1	3 (2.0%)	7 [8]
60–69	253 (16.3%)	42.5	21 (8.3%)	7 [9]
70–79	369 (23.8%)	59.7	33 (8.9%)	9 [8]
80–89	433 (27.9%)	94.9	73 (16.9%)	9 [10]
90+	98 (6.3%)	85.3	19 (19.4%)	8.5 [8]
All	**1,551**	**43**	**149 (9.6%)**	**8 [8]**

The day (weekday versus weekend) or time (business hours versus after-hours) of hospital admission had little influence on hospital mortality or length of stay in the MET call population studied (Figures 1 and 2). The day (weekday versus weekend) or time (business hours versus after-hours) of the MET call also had little impact on hospital mortality or length of stay in the MET call population studied (Figures 3 and 4).

Figure 1: Impact of time of admission to ward on hospital mortality and LOS after MET

Ward admission time

Time	MET calls	Deaths	Median length of stay (days) [IQR]
0800-1700	602 (38.8%)	56 (9.3%)	7 [9]
1701-0759	949 (61.2%)	93 (9.8%)	8 [9]
p-value		*0.81*	*0.33*
All	1551	149 (9.6%)	8 [8]

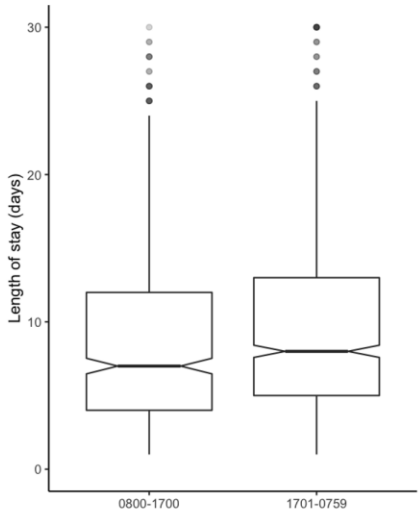


Figure 2: Impact of day of admission to ward on hospital mortality and LOS after MET

Ward admission day

Day	MET calls	Deaths	Median length of stay (days) [IQR]
Weekday	1131 (72.9%)	98 (8.7%)	8 [9]
Weekend	420 (27.1%)	51 (12.1%)	8 [8]
p-value		0.05	0.24
All	1551	149 (9.6%)	8 [8]

Days	*Proportion of week*
Monday - Friday	*71.4%*
Saturday - Sunday	*28.6%*

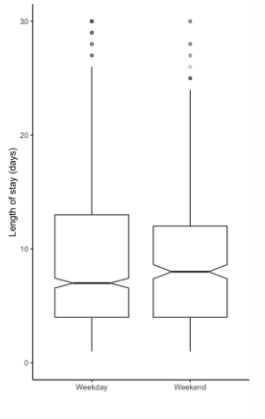


Figure 3: Impact of day MET called on hospital mortality and LOS after MET

MET day

Day	MET calls	Deaths	Median length of stay (days) [IQR]
Weekday	1135 (73.2%)	106 (9.3%)	8 [9]
Weekend	416 (26.8%)	43 (10.3%)	7 [9]
p-value		0.62	0.65
All	1551	149 (9.6%)	8 [8]

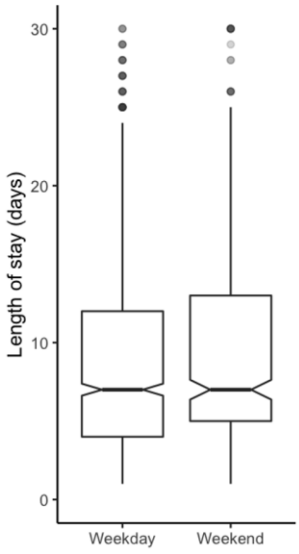
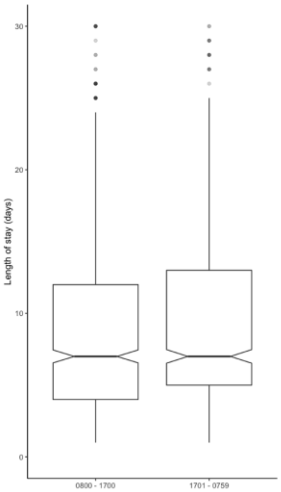


Figure 4: Impact of time MET called on hospital mortality and LOS after MET

MET time

Time	MET calls	Deaths	Median length of stay (days) [IQR]
0800-1700	816 (52.6%)	76 (9.3%)	8 [9]
1701-0759	735 (47.4%)	73 (9.9%)	8 [9]
p-value		0.74	0.93
All	1551	149 (9.6%)	8 [8]



Of the MET calls, 53.4 per cent were called on patients admitted for more than 24 hours. MET call initiation later in the course of hospital admission was associated with higher mortality and length of stay (Figure 5). When the trigger for the MET call was respiratory distress and altered level of consciousness, this was associated with higher mortality rates post-MET activation (Figure 6).

We noted increased mortality for MET calls for respiratory distress (OR 1.89, 95CI 1.21–2.52), for altered levels of consciousness (OR 1.78, 95CI 0.96–2.55), in patients admitted through the Emergency Department (OR 1.78, 95CI 1.13–32.54), and MET activations later than 48 hours after hospital admission (OR 1.47, 95CI 1.07–1.89) (Figure 7).

Figure 5: Impact of earlier (<24 hours) versus later (>24 hours) MET call during admission on hospital mortality and LOS after MET

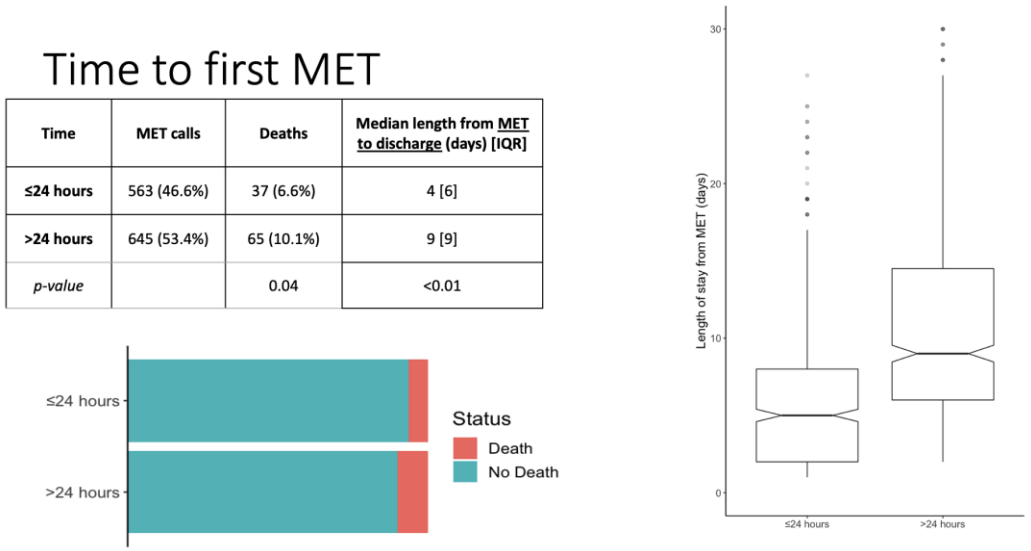


Figure 6: Influence of indication for MET call on hospital mortality

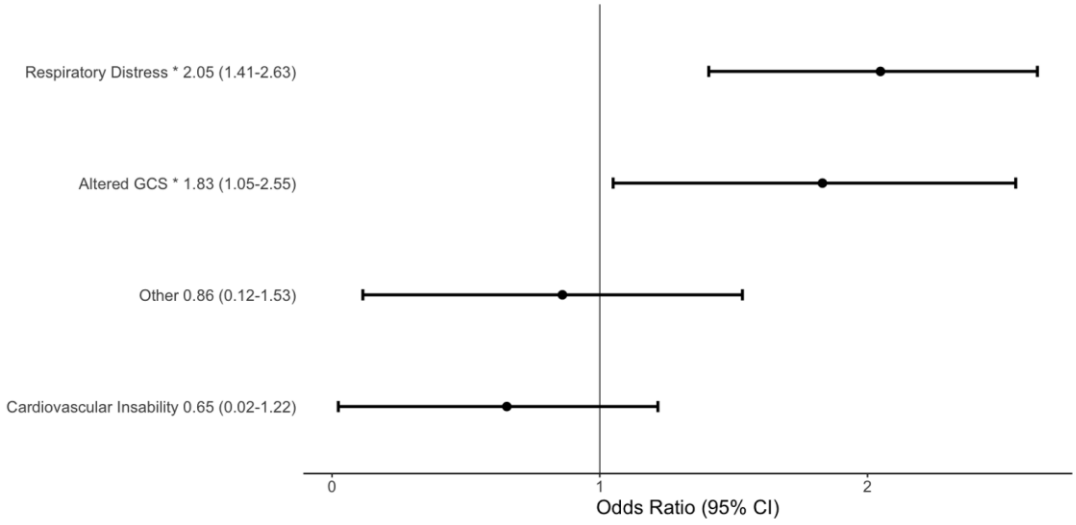
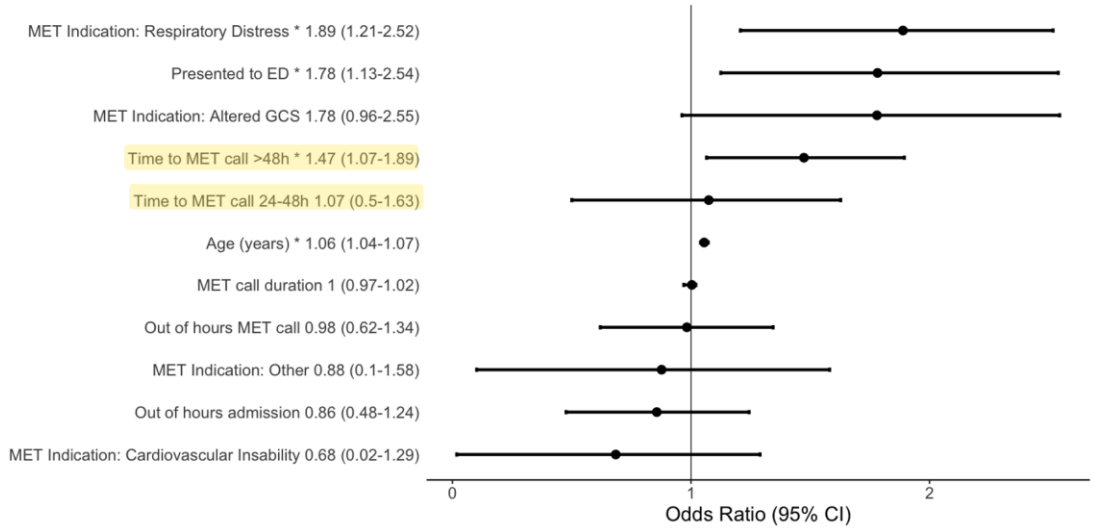


Figure 7: Summary of factors influencing MET call mortality



DISCUSSION

Our study demonstrated significant increase in MET activations after the establishment of an ICU-led MET service. It also identified populations in which MET call activation was associated with higher risks of hospital mortality and increased length of stay. Further exploration of the characteristics of these populations may reveal modifiable factors that lead to improvements in healthcare delivery to deteriorating patients.

The significant increase in MET call activity after the establishment of the ICU-led MET service may indicate there was previous unmet need for early escalation and underscores the cultural shift leading to a more proactive approach to monitoring and responding to deteriorating patients. This is a reasonable conclusion as there was no statistically significant change to hospital activity and the parameters for calling MET calls also did not change. The shift in the hospital's safety culture towards more frequent MET activations post-ICU suggests a heightened awareness of the importance of early intervention in managing acute clinical situations amongst staff, and may also be attributable to the visible presence and accessibility of a 24-hour ICU-led MET service. This trend is consistent with published literature.[6–9]

Patient age appeared to play a role in both the need for MET, and with poorer outcomes (hospital mortality and length of stay) with increasing age. The association between age and hospital mortality post-MET call highlights the importance of considering patient demographics in risk stratification and care management. The exponential rise in mortality risk for patients over 50 years old underscores the need for tailored approaches to care for older individuals, taking into account age-related physiological changes and comorbidities that may impact outcomes following MET activations. Reduction in MET calls after the 10th decade of life may reflect the patients' and/or admitting teams' wishing for fewer interventions in the age group 90 years and over.

The lack of influence of time and day of admission on MET outcome suggests patient deterioration has little relationship to recent review by admitting teams. The literature suggests physiologic deterioration may

in fact be due to delays or deficiencies in medical management by admitting teams prior to deterioration,[10] and nearly 90 per cent of patients who had MET calls were also reviewed by the home teams in the 24 hours preceding this.[11]

The lack of impact of day or time of MET response on hospital mortality and length of stay underscores the importance of a robust 24-hour MET response and early involvement of ICU staff.

The observed impact of MET activations later in the course of admission is also consistent with published data. Published Australasian data suggest about 25 per cent of MET calls get activated within 24 hours of admission,[12] however, this did not increase risk of mortality or increase hospital length of stay, emphasising the critical window of opportunity for effective intervention within the first 24 hours of admission. While our data set had a much higher proportion (46.6 per cent) of MET activation within 24 hours of admission, our findings in this subset were similar.

Patients who received MET calls later in their hospital stay, however, experienced higher mortality rates and prolonged lengths of stay. This finding is also consistent with published literature.[13]

The identification of some indications for MET call activation, particularly respiratory distress and altered level of consciousness, as key predictors of adverse outcomes, provides valuable insights for clinical practice. Better interpretation of these triggers for MET activations and understanding patterns of pathology that predispose for them can guide healthcare providers in identifying high-risk patients and implementing timely interventions to mitigate potential complications and improve patient outcomes.

LIMITATIONS AND FUTURE RESEARCH

Several limitations should be considered when interpreting the results of this study. This is a single-centre study, which may limit the generalisability of the findings to other healthcare settings. Data collection relied on electronic health records, which may be subject to coding errors or missing information. Data matching between multiple data sets—Mercy Health's MET database, inpatient records and Emergency Department Information System (EDIS) records—was necessary and done electronically by the database manager to extract the information for the study investigators. There is inherent risk of data loss in this process, leading to inaccuracies during data analysis. The retrospective nature of the analysis also limited the ability to establish causality between MET activations and patient outcomes.

Despite these limitations, the large sample size and detailed patient information provided valuable insights into the impact of MET activations on mortality and length of stay. The level of detail in the information allowed comprehensive analysis of MET call data, including detailed assessments of timing, indications, and patient outcomes.

As noted in the discussion, patients who received MET calls later in the course of their hospital stay experienced higher mortality rates and prolonged lengths of stay. Whether this represents a cohort of patients with disease progression despite treatment or care delivery issues resulting in nosocomial complications needs to be studied in more detail in the future. Future research should also explore interventions aimed at reducing delays in MET activations, implementing targeted strategies for high-risk patient populations, and evaluating the impact of proactive MET responses on patient outcomes.

CONCLUSION

This study demonstrates that the establishment of an ICU-led MET service significantly increased the volume of MET activations, underscoring a likely pre-existing unmet need for early assessment and intervention by critical care trained staff at a metropolitan teaching hospital.

The association between MET activations later in the course of admission and poorer outcomes (higher mortality rates, longer lengths of stay) and identification of key triggers for MET calls, such as respiratory distress and altered level of consciousness, also associated with poorer outcomes, provide possible directions for future study to understand and identify modifiable causes and improve care delivery.

Moreover, the association between age and mortality post-MET call highlights the need for tailored approaches to care, particularly for older patients who may be at increased risk of adverse outcomes. By considering patient demographics and indications for MET activations, healthcare providers can optimise response protocols, enhance patient safety, and improve the quality of care delivered in acute clinical settings.

By continuing to refine and optimise rapid response systems based on evidence-based practices, healthcare institutions can further enhance patient safety, quality of care, and overall clinical outcomes.

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The coauthors made the following contributions:

- MM conceptualised and planned the study, liaised with the database manager for the health centre, reviewed data collection and assisted with data analysis and manuscript writing;
- RC undertook initial data cleaning and preliminary analysis
- ES completed data cleaning, data analysis, data visualisation and assisted with manuscript writing; and
- UK liaised with HREC, assisted with data visualisation and reviewed the manuscript.

PEER REVIEW

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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ETHICS COMMITTEE APPROVAL

This study was approved by the metropolitan teaching hospital's Human Research Ethics Committee. The author has a copy of the approval on file. For more information, please email the corresponding author Mainak Majumdar at mainakmajumdar@gmail.com.