

# The Medical Emergency Team

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## SUMMARY

The concept of a Medical Emergency Team was developed in order to rapidly identify and manage seriously ill patients at risk of cardiopulmonary arrest and other high-risk conditions. The aim of this study was to describe the utilization and outcome of Medical Emergency Team interventions over a one-year period at a teaching hospital in South Western Sydney. Data was collected prospectively using a standardized form. Cardiopulmonary resuscitation occurred in 148/522 (28%) calls. Alerting the team using the specific condition criteria occurred in 253/522 (48%) calls and on physiological/pathological abnormality criteria in 121/522 (23%) calls. Survival rate to hospital discharge following cardiopulmonary arrest was low (29%), compared with other medical emergencies (76%).

Key Words: COMPLICATIONS: cardiac arrest, apnoea, resuscitation, emergency treatment, cardiac arrest team

Most acute hospitals employ a cardiac arrest team which functions to resuscitate patients following cardiopulmonary arrest. A review of 42 publications detailing in-hospital resuscitation results showed that mean survival rate to 24 hours was 39%, ranging from 13% to 59% and mean survival to hospital discharge was 15%, ranging from 3% to 27%.<sup>1</sup>

Several studies have attempted to identify factors which may be antecedents of cardiopulmonary arrest.<sup>2-4</sup> To improve outcome and prevent cardiopulmonary arrest, the concept of a Medical Emergency Team (MET) was introduced in 1990 at Liverpool Hospital, a 375-bed teaching hospital in South Western Sydney. The MET superseded the existing cardiac arrest team. This team is modelled on the principles of the early recognition and rapid response used to manage severe trauma.<sup>5</sup> While the pathology of medical emergencies and trauma may be different, the principles of rapid detection and correction of vital signs are similar. In trauma it is usually imposed on the background of a young healthy person; in medical emergencies it usually occurs in older patients with other pathology. This may make it even more important to rapidly correct cardiorespiratory function.

The MET consists of medical and nursing staff trained in the principles of resuscitation. Staff may alert the MET using any one of three predefined criteria: specific conditions, physiological/pathological abnor-

malities and "any time urgent help is required" (Appendix 1).

The aim of this study is to describe the utilization of the MET and outcome of patients who required MET interventions over a twelve-month period.

## MATERIALS AND METHODS

The study was carried out at Liverpool Hospital and was approved by the hospital's ethics committee. Information on all MET calls occurring from March 1992 to February 1993 was collected using a standardized form. Information collected included patient demographic information, location, reasons for and time of the MET calls, physiological observations of the patient and treatments initiated. In addition, patient outcome immediately and 24 hours following MET intervention and at hospital discharge were recorded. An objective measure of the severity of illness was calculated using the APACHE II score<sup>6</sup> collected immediately before the call. Predicted survivals using the APACHE II scores were not determined because the data were collected during rather than at the beginning of the patient's clinical course. The predictive equations have not been validated for these circumstances. For the purposes of the study, critical care areas included Intensive Care, High Dependency and Coronary Care Units.

There were three levels of MET intervention:

1. Resuscitation was defined as an intervention for life-threatening emergencies involving airway, breathing and circulation.
2. Assessment and review included all calls which were not classified as immediately life-threatening.
3. No intervention necessary.

Data was coded and entered into Paradox 4.0 database. Statistical analyses were performed using

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Statistical Analysis System (SAS 6.04). Values are reported as means and standard deviation.

## RESULTS

During the twelve-month period, there were 522 MET calls recorded. The MET was called to the Emergency Department (62%), hospital wards (29%) and Critical Care areas (9%). Of all MET interventions occurring in the Emergency Department, 38% were as a result of advanced notification by paramedics. During night-shift hours from 2000 to 0800, 189 (36%) calls were registered. There were 156/522 (30%) MET interventions during weekends. Nurses summoned the team on 69% of occasions, and junior medical staff on 31% of occasions.

The MET was called to treat 287 males (55%) and 235 females (45%). The mean age was  $55 \pm 24$  years. The majority of patients had a medical diagnosis on admission (76%), followed by surgical (13%) and paediatric (8%). There was only one MET intervention required for an obstetric patient during the study period. The median APACHE II score taken immediately prior to the MET call was 18 (range 0 to 42).

Cardiopulmonary arrest was the reason for 148/522 (28%) of all MET calls. Specific condition criteria were used to alert the MET in 253/522 (48%) of cases, and physiological/pathological abnormalities in 121/522 (23%). Alerting the MET on the basis that staff were worried that the patient would deteriorate if urgent help was not available occurred in only three instances.

MET interventions for acute respiratory failure and status epilepticus were the most frequent conditions to which the MET was called under the specific condition criteria (Table 1). Decreased level of consciousness was one of the main alerting physiological abnormalities (Table 2). The other main alerting physiological abnormality was abnormal blood pressure. Excluding cardiac arrest, hypotension, however, was evident in 101/374 (27%) of patients on examination by the MET. There were also 20/374 (5%) patients with systolic blood pressures greater than 200 mmHg. One hundred and thirteen patients (30%) were tachycardiac and 30 patients (8%) were bradycardiac, yet the abnormal pulse rate was the criterion used to call the MET in only 12 of these patients. Although abnormal respiratory rate was criterion for alerting the team in 14 cases, there were 21/374 (6%) of patients who were found to be bradypnoeic and 73/374 (20%) who were tachypnoeic.

Resuscitation occurred in 71% (371/522) of the total calls. The MET assessed and reviewed a further 24% (125/522) and did nothing in 5% (26/522) of cases. The MET noted that 36/522 calls were inappropriate. Reasons included patients being terminally ill and/or

TABLE 1  
*Frequency of MET interventions for specific conditions*

Type of condition	Frequency	Percentage
Acute respiratory failure	41	16%
Status epilepticus	40	16%
Coma	34	13%
Pulmonary oedema	25	10%
Severe drug overdose	25	10%
New arrhythmia	24	9%
Acute severe exacerbation of asthma	14	6%
Surgical	14	6%
Upper airways obstruction	12	5%
Shock	7	3%
Near drowning	7	3%
Acute psychiatric disturbance	6	2%
Carbon monoxide poisoning	4	2%
TOTAL	253	100%

TABLE 2  
*Frequency of MET interventions for physiological/pathological abnormalities*

Type of abnormality	Frequency	Percentage
Decreased level of consciousness	51	42%
Blood pressure	35	29%
Respiratory rate	14	12%
Pulse rate	12	10%
Other	3	2%
Sodium level	2	2%
Blood glucose	2	2%
Temperature	1	1%
Potassium level	1	1%
TOTAL	121	100%

not for resuscitation, no acute problem identified, or there was already adequate trained staff to treat the patient by the time the MET arrived.

Of the 522 MET calls, there were 443 occasions where it was the first and only in-hospital resuscitation. An additional 35 patients required more than one MET intervention. The cumulative mortality rate is shown in Figure 1. Survival to hospital discharge of cardiopulmonary arrest was low (29%) compared with other acute illness (76%).

## DISCUSSION

The spectrum of acute illness requiring acute intervention may vary between hospitals and has, to our knowledge, not been previously documented in the literature. In this study, cardiopulmonary resuscitation accounted for 28% of all medical emergency interventions. Approximately half of all MET calls were based on the specific condition criteria. Cardiovascular conditions (pulmonary oedema and new arrhythmia) and respiratory conditions (acute severe exacerbation of asthma, acute respiratory failure and upper airways

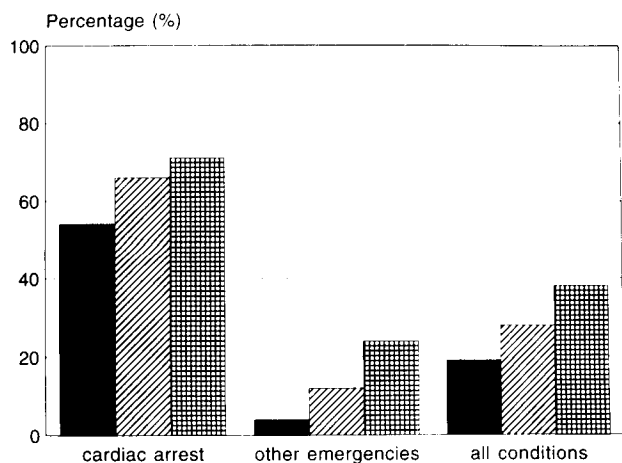


FIGURE 1: Cumulative mortality rate immediately following MET intervention, over 24 hours and at hospital discharge.

■ immediate    ▨ 24 hours    ▩ discharge

obstruction) was observed in almost half of all calls under these criteria. Together with 148 cardiopulmonary arrests, this illustrates that a large proportion of MET interventions were associated with cardiorespiratory conditions.

In response to a high incidence of avoidable deaths, especially in severe trauma, there is growing awareness of the effectiveness of a standardized approach to calling criteria and responses for the critically ill injured patients.<sup>7,8</sup> The MET calling criteria were instituted with the aim of identifying patients with substantial risk of serious sequelae if appropriate acute treatment was not instituted immediately.

Previous studies have highlighted clinical antecedents associated with in-hospital cardiopulmonary arrests. These include clinical deterioration involving either respiratory or mental function,<sup>2</sup> systolic blood pressure equal to or less than 90 mmHg, and azotemia.<sup>9</sup> Both of these studies suggests that efforts should be directed to predicting and preventing cardiorespiratory arrest.

Despite the MET system, mortality from cardiopulmonary resuscitation remains high, with only 29% of patients surviving to hospital discharge. This survival rate is higher than that reported in several studies.<sup>2,3,9-11</sup> However, this study did not specifically address the question of whether early intervention improved outcome from cardiopulmonary resuscitation. In fact, the outcome from cardiopulmonary resuscitation may be worse because potentially salvageable cases have been prevented.

The average MET call rate was ten per week and did not vary according to times when hospital staffing

levels were lower during weekends or "after hours". Thirty-six per cent of MET calls occurred during hours 2000 to 0800, emphasizing the fact that appropriately trained medical cover must be available on a 24-hour basis.

The majority of inappropriate calls (7%) were associated with inadequate communication between medical staff caring for patients who were terminally ill and/or with "not for resuscitation" orders. The inappropriate use of the MET may be reduced if the "not for resuscitation" communication problem is overcome.

The utilization of a new type of resuscitation team was reviewed over one year. The current calling criteria is of high sensitivity but modifications to current calling criteria may further identify patients with acute illness at risk of cardiopulmonary arrest. Further research is planned to evaluate the impact on patient outcome using modified calling criteria. The eventual aim of the system is to minimize inappropriate calls in order to reduce disruption of other clinical activities of the MET members, while maintaining an acceptable adherence rate to the calling criteria.

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**APPENDIX**

Medical Emergency Team Calling Criteria

**ABNORMAL PHYSIOLOGY**

Temperature (°C)	<35.5 °C or >39.5 °C
Systolic blood pressure (mmHg)	<100 or >200
Respirations/minute	<10 or >30
Pulse rate/minute	<40 or >120
Urine output over 24 hours (ml)	<500
Decreased or altered levels of consciousness	

**ABNORMAL PATHOLOGY**

Serum potassium (mmol/l)	<3 or >6
Serum sodium (mmol/l)	<125 or >155
Blood sugar (mmol/l)	<2 or >20
Arterial pH	<7.2 or >7.55
Base excess	<-15 or >+10

**SPECIFIC CONDITIONS**

**Cardiovascular**

- Cardiopulmonary arrest
- Pulmonary oedema
- New arrhythmia

**Shock**

- Hypovolaemic shock
- Cardiogenic shock
- Anaphylactic shock
- Septic shock

**Poisoning/trauma**

- Near drowning
- Carbon monoxide poisoning
- Severe drug overdose

**Neurological**

- Status epilepticus
- Acute psychiatric disturbance (aggressive, uncontrollable)

**Respiratory**

- Acute severe exacerbation of asthma
- Acute respiratory failure
- Upper airways obstruction

**Metabolic**

- Acute diabetic emergencies

**Obstetrics**

- Amniotic fluid embolism
- Pre-eclampsia

**Surgical**

- Excessive bleeding
- Excessive drainage