

Clinical deterioration in hospital inpatients: the need for another paradigm shift

Proactive recognition and response, pre-emptive management

Despite improvements in medical therapy and improved outcomes, patients admitted to acute care hospitals may suffer clinical deterioration and potentially avoidable morbidity. Recent reports show that patients admitted to hospital suffer cardiac arrests at a rate between 0.66 and 11.2 per 1000 admissions,^{1,2} and the approximately 80% mortality rate due to in-hospital cardiac arrests has not changed since the description of cardiopulmonary resuscitation more than 50 years ago.^{3,4}

In this article, we review the epidemiology of in-hospital cardiac arrests and the evolution of the medical emergency team (MET) model to prevent them. In addition, we outline lessons learned from the MET model and the development of a national approach for recognising and responding to deteriorating patients. Finally, we contend that another paradigm shift is required to further improve patient outcomes via a more proactive and pre-emptive approach that includes improved detection and recognition of deterioration as well as structured management of patients who are at high risk of deterioration.

The old paradigm: cardiac arrest

With introduction of cardiac arrest teams and Code Blue calls around 1970 came the first ubiquitous hospital protocol for escalating the care for deteriorating patients.³ This system is activated when a patient is pulseless and apnoeic, has no recordable blood pressure and is unresponsive. However, several studies published between 1990 and 2002 reported that in-hospital cardiac arrests were not sudden or unexpected, but were preceded by instability that was sub-optimally responded to.⁵⁻⁷ Up to 84% of patients had abnormal vital signs or new problems before cardiac arrest,⁵⁻⁷ and most were in asystole or had pulseless electrical activity.^{8,9}

The current paradigm: METs

In 1995, the first description of the MET as a model for responding to patient deterioration was published.¹⁰ METs are composed of an intensive care, general medicine or emergency medicine registrar, and a critical care nurse. The advent of the MET delivered a mechanism for escalation of care earlier in the course of clinical deterioration than cardiac arrest. Criteria for a MET call are based on deranged vital signs and altered conscious state.^{10,11} A "staff member worried" criterion is often included to empower ward staff to call for assistance and bypass the

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traditional hierarchical model of escalation. Such criteria provide semi-objective thresholds for when ward staff should escalate care for deteriorating patients, and provide an expected and structured institutional response. The MET call is usually activated using a public announcement and pagers, and the team is expected to arrive within about 5 minutes. This system is the first patient-centred, organisation-wide system to be implemented across hospitals throughout the world.

Over the past 16 years,¹⁰ METs have been introduced in at least 100 Australian hospitals.¹² Although evidence of the effectiveness of METs is controversial,^{13,14} the MET model is currently the prevailing paradigm for identification of deteriorating ward patients and rapid escalation of care for them.

Research into the characteristics and outcomes of MET patients has provided epidemiological data on deteriorating ward patients. In a MET-naïve hospital, it was reported that 4.5% of ward patients fulfilled MET criteria on two separate days.¹⁵ Studies of mature METs report that 2.6%–5.6% of patients hospitalised for more than 24 hours receive MET review.¹⁶ Thus, about one in 25 ward patients will experience clinically significant deterioration.

Research into MET patients has also shown that vital sign measurement is inconsistent and often incomplete, deterioration is variably recognised, and staff do not always activate a MET call when patients fulfil the criteria.¹⁷ In addition, activation is often delayed, and this is associated with increased mortality.^{18,19} Two surveys of ward nurses suggest that there is underappreciation of the significance of physiological derangements associated with MET criteria.^{20,21}

A number of studies have reported that patients subject to MET review have a mortality rate of about 25%²²⁻²⁵ — higher than the 11% in-hospital mortality rate of patients admitted to intensive care units (ICUs),²⁶ and much higher than the 2.5% in-hospital mortality rate for overall hospital admissions.²⁷

Finally, about one-third of MET calls involve end-of-life care issues.^{24,25,28} These often occur out of hours, when parent teams are not in the hospital. As the patients are acutely unwell, they are often unable to participate in discussions regarding their preferences for active treatment, or conservative or palliative care. Accordingly, these decisions are typically left up to covering doctors, the MET and family members, and often need to be made expeditiously.

A new paradigm: proactive, pre-emptive

The MET model has emphasised the tenet that early intervention improves outcome (Box 1). Thus, the

1 Criteria for escalation of care and rates of mortality at various phases of patient deterioration

	Hospital inpatient ²⁷	Abnormal vital signs ¹⁵	MET call ²²⁻²⁵	Cardiac arrest ¹⁻⁴
Event rates (per 1000 admissions)	—	138	10–50	0.66–11.2
Criteria for escalation				
Heart rate (beats/min)	—	≤ 50 or > 120	< 40 or > 130	0
Systolic blood pressure (mmHg)	—	< 100	< 90 or > 200	0
Respiratory rate (breaths/min)	—	≤ 10 or > 28	< 8 or > 35	0
Other	—	—	Fall in conscious state or urine output	Unresponsive
In-hospital mortality rate	2.5%	14.6%	Approx 25%	Approx 80%

mortality of patients subject to MET review (25%) is lower than that of cardiac arrest patients (80%) but higher than that for patients admitted to ICUs. However, the MET model is reactive, as it requires a patient to deteriorate before it can be activated. We contend that a new paradigm is needed to promote a more proactive approach to recognising and responding to deterioration, and to provide a pre-emptive, structured, standardised approach to managing patients who are known to be at risk of deterioration (Box 2). This paradigm shift is supported by the *National consensus statement: essential elements for recognising and responding to clinical deterioration*,²⁹ which describes the clinical systems necessary to provide appropriate care to deteriorating patients and the organisational supports needed to ensure that these systems operate effectively (Box 3).

Predicting risk and preventing deterioration

Not all patients admitted to hospital will suffer a complication, but some will suffer sudden and unexpected

deterioration. Increasing evidence suggests that patients can be risk profiled at, or even before, hospital admission. A hospital outcome predictive equation (HOPE) was recently developed using six variables that are associated with increased risk of death: age, sex, diagnosis at admission, emergency admission, aged care resident and inter-hospital transfer.²⁷ In surgical patients, most postoperative complications are medical.³⁰ It remains to be determined whether hospital-wide strategies or models of medical comanagement can improve patient outcomes based on such risk profiling. Similar criticisms were levelled at the MET model of care almost 10 years ago.³¹

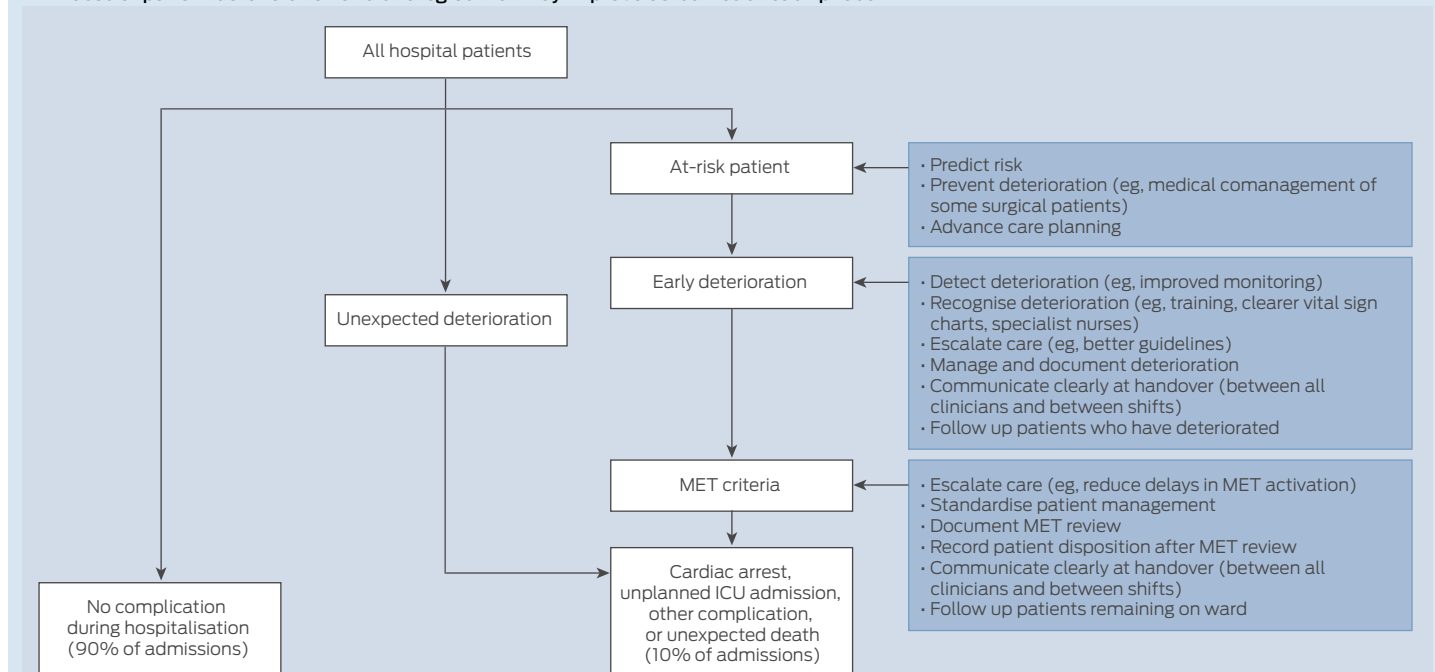
Advance care planning

Advance care planning is particularly important in the context of the ageing Australian population, increasing numbers of comorbidities in hospitalised patients, and increasing complexity and intensity of medical therapies. Patients need to receive therapies that are beneficial to them, and do not cause significant harm or discomfort, and their wishes and choices regarding such care must be considered. Experience with the MET model suggests that many deteriorating patients receive suboptimal end-of-life care planning, and that this planning is done emergently by the MET. Advance care planning should be conducted when a patient is cognitively intact and able to contribute meaningfully to discussions, so that their preferences are known when deterioration is detected. In a recent trial, an advance care planning program improved the rate at which patients received preferred care, improved patient and family satisfaction, and did not increase patient mortality.³²

Detecting and recognising early deterioration

Improved detection of deterioration requires tailoring of vital signs measurement to a level commensurate with a

2 Phases of patient deterioration and strategies that may improve outcomes at each phase



MET = medical emergency team. ICU = intensive care unit.

3 Essential elements for the care of deteriorating patients²⁹

Clinical processes

- Measurement and recording of observations
- Escalation protocols
- Rapid response systems
- Communication processes

Organisational prerequisites

- Organisational supports
- Education
- Evaluation and monitoring
- Use of new technology

patient's diagnosis, acuity, proposed treatments and change in status with time.²⁹ In some patients, this may include the use of continuous automatic electronic monitoring systems that record observations and alert staff when trigger points are reached.³³ Research shows marked variation in the quality and ease of use of vital sign charts.³⁴ Enhanced design of observation charts has been associated with improved documentation of vital sign sets and recognition of deterioration.³⁵

Improving management and follow-up of early deterioration

Improved training in the recognition of and response to early deterioration is needed. A multifaceted approach to this type of intervention — involving a newly designed observation chart, a track-and-trigger system and an education package — has been shown to be associated with increased MET activation, reduced unplanned ICU admission and reduced in-hospital mortality.³⁶

Optimising the outcomes of MET patients

As delayed MET activation worsens patient outcomes,^{18,19} research is needed to better understand the decision-making processes of ward staff with regard to escalating care for deteriorating patients. Specifically, it is important to understand the circumstances under which staff call their parent unit, as opposed to requesting external assistance.

Auditing the clinical causes of MET calls may assist in the development of strategies to improve the outcomes of patients who fulfil MET criteria. The concept of "MET syndromes" has been raised,³⁷ and it has been shown that sepsis, heart failure, pulmonary oedema and arrhythmias (especially atrial fibrillation) may be associated with about 50% of MET calls.³⁸ Implementing checklists, guidelines or bundles of care for common causes of MET review may help to standardise management and improve outcomes of patients after a MET call has been activated. A simulation-based training course for MET members has been shown to be associated with improved team performance, but the effect of such training on MET patient outcomes has not yet been tested.³⁹

Conclusion

In the 50 years since the components of cardiopulmonary resuscitation were described, outcomes of in-hospital

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cardiac arrest have changed little. The failure of cardiac arrest teams to substantially improve outcomes, in conjunction with research showing that cardiac arrests are often preceded by signs of deterioration, facilitated a paradigm shift to encourage detection and escalation of care before the onset of circulatory arrest. Although the effectiveness of the MET approach continues to be debated, METs have highlighted the need for even earlier detection and escalation of care for deteriorating patients. Another paradigm shift is now needed to improve prediction, detection and recognition of deterioration, and to optimise subsequent escalation of care.

Competing interests: Rinaldo Bellomo works as a paid consultant for Philips Healthcare in the development of monitoring technology for general wards. Daryl Jones has received consultancy fees from Eastern Health and a grant from the Australian Commission on Safety and Quality in Health Care for a multicentre study on outcomes of MET patients.

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