The medical emergency team and end-of-life care: a pilot study

Daryl A Jones, Tammy McIntyre, Ian Baldwin, Inga Mercer, Andrea Kattula and Rinaldo Bellomo

ABSTRACT

Objectives: To assess the characteristics of patients who died in a teaching hospital and the role of the medical emergency team (MET) in their end-of-life care.

Methods: This was a retrospective analysis of 105 deaths over the month of May 2005 by a blinded investigator, who documented patient age, parent hospital unit, comorbidities, presence and timing of not-for-resuscitation (NFR) designation, and presence and timing of first MET review. We analysed differences between medical versus surgical patients, NFR versus non-NFR patients, and MET-reviewed versus non-MET-reviewed patients.

Results: Of the 105 patients who died, 80 were medical patients and 25 were surgical patients. Five patients were not designated NFR at the time of death, and three of these had antecedent MET criteria in the 24 hours before death. Of the 100 patients who were designated NFR at the time of death, 35 received a MET call during their admission. Of the 35 MET calls, 10 occurred on the same day as the patient's death, and 12 on the same day as the NFR designation. Documentation of NFR status occurred later in the admission for patients who received a MET call than for those who did not receive a MET call (mean ± SD, 13.3 ± 16.1 versus 5.3 ± 10.8 days after admission; $P = 0.003$). Hypotension, hypoxia and tachypnoea were the most common MET triggers, and pulmonary oedema, pneumonia and acute coronary syndromes were the most common reasons for the deterioration in the patient's condition. Following the MET review, patients were admitted to the ICU and newly classified as NFR in 15 and nine of the 35 MET calls, respectively.

Conclusions: Most patients who died in our hospital were designated NFR at the time of death. A third of these patients were seen by the MET before death. In about 10% of cases, the MET participated in the decision to designate the patient NFR.

Crit Care Resusc 2007; 9: 151–156

Patients admitted to hospital wards have increasingly complex conditions and a growing number of comorbidities.[1] Medical emergency teams (METs) have been introduced into hospitals to identify, review and treat acutely unwell ward patients in an attempt to reduce cardiac arrests, serious adverse events and unplanned admissions to the intensive care unit.[2-12]

The introduction of a MET service into the Austin Hospital, Melbourne, Australia, has been associated with a reduction in cardiac arrests over a sustained period.[13] It is possible that assessment of the epidemiology of patients dying in our hospital will reveal information needed to develop further strategies to prevent in-hospital deaths. An additional role of the MET service involves decisions and discussions about end-of-life care and "not for resuscitation" (NFR) status.[14] The role of the MET service in end-of-life care planning at our hospital is not known.

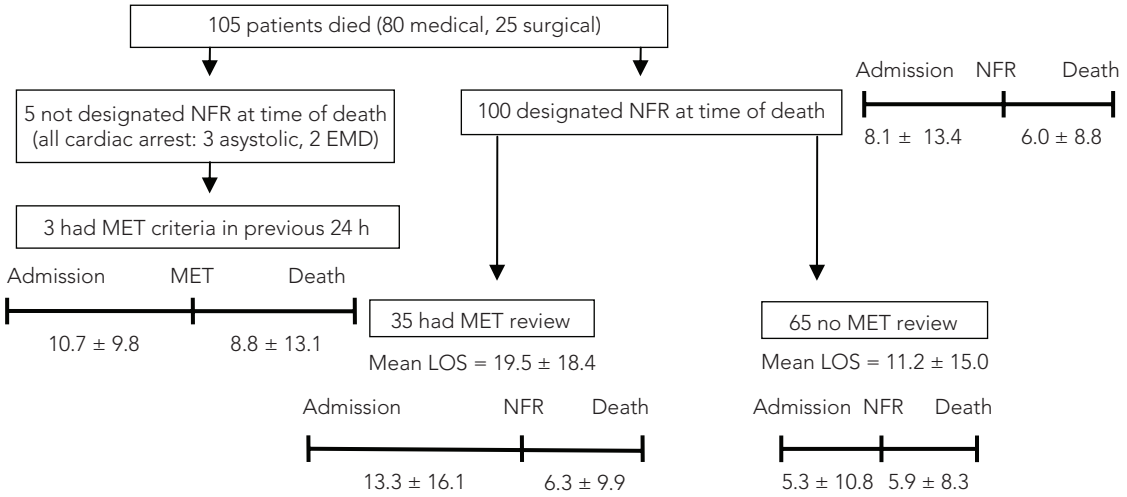
We undertook a retrospective study to assess the epidemiology of 105 patient deaths over a 1-month period in our hospital. In addition, we described the frequency and timing of NFR documentation, as an objective marker of end-of-life care. Finally, we determined the frequency and timing of MET calls in patients who died with an NFR status, and analysed differences in timing of NFR documentation between patients who received a MET call and those who did not receive such a call.

Methods

Hospital rapid response teams

The characteristics of the rapid response teams at our hospital have been described previously.[2,7,13,15] Briefly, the acute care campus of Austin Health operates two levels of team. The first is a traditional cardiac arrest ("code blue") team composed of a cardiology registrar and coronary care nurse, an intensive care registrar and nurse, and the receiving medical unit registrar of the day. In September 2000, a MET service was introduced into the acute campus following an extensive preparation and education process. The MET comprises an intensive care registrar and nurse, and the receiving medical unit registrar of the day. The MET can be activated by any member of the hospital staff according to preset criteria of physiological instability. A detailed log of all code blue and MET calls is maintained by the hospital switchboard operators.

Figure 1. Flow diagram showing NFR designation and MET review characteristics of 105 patients who died in May 2005



Line diagrams show timelines in days (mean ±SD) for not-for-resuscitation (NFR) documentation and medical emergency team (MET) review in relation to hospital admission and patient death. EMD = electromechanical dissociation. LOS = length of stay.

Criteria for MET activation and NFR designation

The calling criteria for our MET service are based on acute changes in heart rate (< 40 or > 120 beats per min), systolic blood pressure (< 90 mmHg), respiratory rate (< 8 or > 25 breaths per min), conscious state, urine output (< 50 mL over 4 hours) and oxygen saturation derived from pulse oximetry (Sao_2 < 90%, despite oxygen administration). Additional criteria include noisy breathing, difficulty with breathing, and problems with a tracheostomy tube. Finally, the calling criteria contain a "staff member is worried" category to allow staff to summon senior assistance to manage any possible emergency situation. The MET service is an integral aspect of hospital policy. During education of new staff, it is emphasised that no staff member should be criticised for activating the MET, including for patients designated NFR. At present there is no formal written NFR policy in the hospital, and NFR designation is performed by the treating clinicians in conjunction with the patient and/or their next of kin.

Study design, patient cohort, and data collection

Patients who died during May 2005 were identified from the hospital's electronic database. The patient files were analysed by an ICU nurse (T M) who was blinded to the study objectives, using a prospectively developed case report form. Information on dates of admission and death were derived from the hospital's electronic database. Information on the number of MET calls for the study period was obtained from the hospital switchboard log as previously described.[15]

We collected information on patient age and parent unit (medical versus surgical), as well as the prevalence of 16 pre-defined comorbidities, based on clinical diagnoses in the medical and nursing clinical notes. In addition, we recorded the dates of patient admission and patient death, and the date of completion of an NFR form. Finally, we documented the date of the first recorded MET call, as an indicator of the time when ward medical and nursing staff first became concerned about the patient's clinical status. Information on the characteristics and management of the MET calls was obtained from case report forms completed by MET members at the conclusion of each call. This included the physiological trigger and presumed clinical cause for the MET call, treatment instituted by the MET, and whether the patient was admitted to the ICU following the MET review. Finally, we recorded whether MET members recommended limitation of medical treatment, including whether they considered the patient should be designated NFR, not for subsequent MET calls, or for palliation.

For patients who did not have an NFR form completed (presumed unexpected death), further patient file analysis was undertaken by two investigators (R B and D A J) to assess the following prospectively defined questions:

- Was there evidence of palliation or care de-escalation despite the absence of an NFR form?
- Did the patient have MET criteria in the 24 hours before death?
- Who was the most senior doctor to review the patient in the 24 hours before death?

Table 1. Number and nature of comorbidities in 105 patients who died during a 1-month period

	Overall ($n=105$)	Medical ($n=80$)	Surgical ($n=25$)
Mean age (SD)	75.5 (13.9)	75.7 (14.1)	74.8 (13.6)
Number of comorbidities (no. of patients)*			
0	3	3	0
1	31	25	6
2	25	17	8
3	26	18	8
4	10	7	3
⩾ 5	10	10	0†
Mean no. of comorbidities	2.4	2.5	2.3‡
Nature of comorbidities (%)*			
Rhythm disturbance	34%	39%§	20%
Ischaemic heart disease	30%	26%	40%
Solid organ cancer	29%	29%	28%
Diabetes	29%	29%	28%
Dementia	24%	25%	20%
Heart failure	24%	26%	16%
Renal failure	18%	20%	12%
COAD	15%	14%	20%
Peripheral vascular disease	11%	9%	16%
Valvular heart disease	7%	8%	4%
Asthma	7%	8%	4%
Current smoker	6%	3%	16%
Chronic liver disease	6%	5%	8%
Haematological cancer	5%	6%	0
Dialysis-dependent	2%	3%	0
Intellectual disability	1%	1%	0

* $P > 0.18$ for all comparisons except the following: † $P = 0.11$; § OR, 3.33 (95% CI, 1.04–10.62; $P = 0.05$). ‡ $P = 0.87$.
COAD = chronic obstructive airways disease. ◆

- What was the patient's admission diagnosis and/or presumed cause of death?

Data analysis and comparisons

We assessed the number of comorbidities in the cohort overall, for surgical versus medical patients, and for patients with an NFR status who received a MET call during their admission versus those who did not.

In patients who had an NFR form completed, the timing of NFR status was compared with the date of admission and date of death. Comparison of the timing of NFR documentation was then performed separately for patients who did versus those who did not have a MET call during their admission.

Furthermore, in patients who did receive a MET call, we assessed the timing of the first MET call in relation to the date of death. Histograms were constructed to describe the timing of the first MET call in relation to patient death, and the timing of the first MET call in relation to the documentation of NFR status.

Descriptive data are presented as raw numbers and percentages of overall cases. Distributed data are presented as mean ± standard deviation (SD). Differences in numerical data were assessed using the Mann–Whitney test, and differences in proportions, using the χ^2 or Fisher's exact test, as appropriate. In cases where comparators were greater than zero, analyses of comparisons are also presented as odds ratios (ORs) and 95% confidence intervals (CIs). A P value < 0.05 was taken to indicate statistical significance.

Results

Of the 105 patients who died during May 2005, 80 had been admitted under a medical unit, and 25 under a surgical unit. The mean age ± SD was 75.5 ± 13.9 years. Patient NFR designation and MET review characteristics are summarised in Figure 1.

Prevalence of pre-existing comorbidities

Comorbidities of the 105 patients are shown in Table 1. There were a mean of 2.4 comorbidities per patient, and medical patients had a similar number of comorbidities to surgical patients (mean, 2.5 versus 2.3; $P = 0.87$). Ten patients (10%) had five or more comorbidities.

Rhythm disturbance, ischaemic heart disease, diabetes mellitus and solid organ malignancy were the most common pre-existing comorbidities, each present in about a third of patients. Dementia and heart failure were each documented in about a quarter of patients. Medical patients showed trends toward more rhythm disturbances (OR, 3.33; 95% CI, 1.04–10.62; $P = 0.05$) and multiple (> 5) comorbidities ($P = 0.11$) compared with surgical patients.

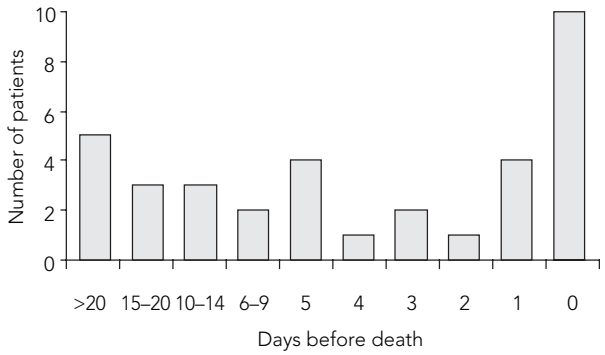
Patients not designated NFR at time of death

Five of the 105 patients did not have a completed NFR form at the time of death (Figure 1). Of these five, three had a code blue call and two a MET call during their admission. The maximum interval between the emergency call and death was 3 days (same day, 2 patients; previous day, 2 patients; and 3 days prior, 1 patient). There was no statistically significant difference in number of comorbidities between patients who did versus those who did not have an NFR order at the time of death (mean comorbidities, 1.8 versus 2.5; $P = 0.13$).

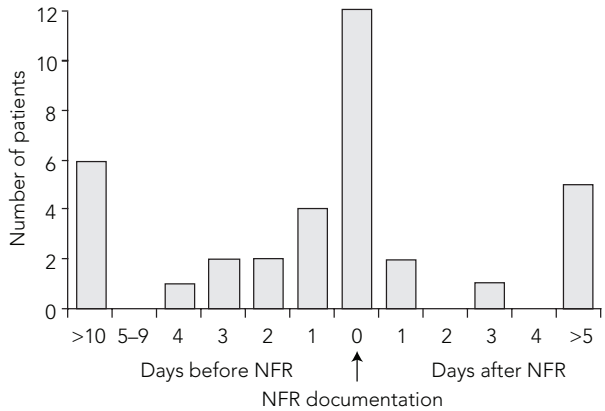
Four of the five patients without completed NFR forms were admitted to the general ward. Of these four patients,

Figure 2. Timing of first MET call in 35 patients who received a MET call and were designated not-for-resuscitation (NFR) at time of death

A. First MET call in relation to death



B. First MET call in relation to NFR designation



In 10 of 35 patients, the first MET call was made on the same day as the patient's death, and in 12 of the 35 it was made on the same day as the documentation of NFR status. ◆

two had moderate dementia, one had carcinoma of the lung, and the other had severe right heart failure and pulmonary hypertension secondary to recurrent pulmonary emboli. Three of these four patients were admitted with infections, and the fourth was admitted with severe dehydration in the context of gastroenteritis. The fifth patient died in the coronary care unit from refractory cardiogenic shock following a large anterior myocardial infarct.

Two of the five patients had no MET criteria at any stage during their admission. The remaining three had MET criteria for longer than 24 hours before death, but only one received a MET call in the 24 hours before death. There was no evidence of de-escalation of care on the ward or documentation of discussions regarding NFR status in any of the five patients. For two of the five, there was documented consultant review in the 24 hours before death. For the remaining three, a registrar was the most senior person to see the patient in this period. All patients suffered a cardiac arrest (three asystolic, two electromechanical dissociation) and received attempts at advanced cardiac life support. One patient was successfully resuscitated, but therapy was withdrawn the following day in the ICU.

Patients designated NFR at time of death

Timing of first MET call

Thirty-five of the 100 patients with a completed NFR form at the time of death received a MET call during their admission (Figure 1). As there were 93 MET calls in May 2005, 38% (35/93) of MET calls involved a patient who subsequently died with an NFR status. The time between admission and the first MET call (mean ± SD) was 10.7 ± 9.8 days, and between MET call and death was 8.8 ± 13.1 days (Figure 1). In 10 patients, the first MET call was made on the same day as the patient's death (Figure 2A). Thus, in 10% (10/100) of deaths and 29% (10/35) of MET calls for patients dying with an NFR form, the first MET call was made on the same day as the patient's death.

The first MET call was most frequently made on the same day as the NFR documentation (Figure 2B). Thus, in 12% (12/100) of patients with a completed NFR form, and in 35% (12/35) of MET calls in NFR patients, the first MET call was made on the same day as completion of the NFR form. In 15 of the 35 MET calls, the first MET call preceded the day of NFR documentation, and, in eight of the 35, the call occurred after the patient was documented as NFR (Figure

Table 2. Comparison of NFR timing and comorbidities between patients who received a MET call during their admission and those who did not

	MET call ($n = 35$)	No MET call ($n = 65$)
Mean age (years) (SD)	74.8 (12.4)	75.8 (15.2)
Mean length of stay (days) (SD)	19.5 (18.4)	11.2 (15.0)
Timing of NFR in admission		
Mean days from admission to NFR (SD)	13.3 (16.1)	5.3 (10.8)
Mean days from NFR to death (SD)	6.3 (9.9)	5.9 (8.3)
Number of comorbidities*		
0	0	3
1	5†	22
2	10	15
3	12	14
4	3	7
⩾5	5	4
Mean no. of comorbidities	2.9	2.2

* Proportions compared using Fisher's exact test. $P > 0.23$ for all comparisons except: † Odds ratio, 0.33 (95% CI, 0.11–0.96; $P = 0.06$). NFR = not for resuscitation. MET = medical emergency team.

Table 3. Aetiology and management of patients receiving medical emergency team (MET) review*

MET criteria triggering call
Hypotension (13), low SaO_2 (10), high respiratory rate (7), altered Glasgow Coma Score (6), arrhythmia (4), abnormal breathing (3), low urine output (1), worried criteria only (1)

Presumed cause of deterioration
Pulmonary oedema or cardiogenic shock (14), pneumonia (6), acute coronary syndrome (4), hypovolaemia or bleeding (4), primary arrhythmia (4), sepsis not pneumonia (3), exacerbation of chronic obstructive airways disease (2), respiratory arrest (1), intracranial haemorrhage (1), narcosis (1)

Investigations performed
Electrocardiogram (11), radiological test (10), arterial blood gas analysis (8), blood tests (5)

Treatments performed
Increased oxygen therapy (10), fluid bolus (8), frusemide (7), intravenous insertion (4), arterial line (3), indwelling catheter (3), non-invasive ventilation (3), bag-mask ventilation (3), glyceryl trinitate (3), electrolyte replacement (2), vasoactive agent (2), central venous catheter (2), antibiotics (2), amiodarone (1), hydrocortisone (1), endotracheal intubation (1), acute coronary angioplasty (1)

Outcome from MET
Admitted to ICU (15), classified "not for resuscitation" (9), recommendation for palliation (6), classified "not for further MET calls" (5)

* Patients may have satisfied more than one category.

2B). Thus, at least 8.6% of the 93 MET reviews in May 2005 occurred in patients with a pre-existing NFR order.

Differences between patients receiving and not receiving a MET call

In the 100 patients with NFR documentation at the time of death, the timing of the NFR documentation differed according to whether the patient received a MET call (Figure 1 and Table 2). Thus, in the 35 patients who received a MET call, NFR documentation was completed a mean ± SD of 13.3 ± 16.1 days after admission, compared with 5.3 ± 10.8 days after admission for the 65 patients who did not receive a MET call ($P = 0.003$). The interval between NFR documentation and death was similar in the two groups (6.3 ± 9.9 versus 5.9 ± 8.3 days). The mean hospital stay for the patients who received a MET call was correspondingly longer than for those who did not (19.5 ± 18.4 versus 11.2 ± 15.0 days; $P = 0.002$).

Characteristics, management and outcome of 35 MET calls

Case report forms completed at the time of the original MET review were available for 31 of the 35 MET reviews. The most common physiological triggers for the MET call were hypotension, hypoxia and tachypnoea (Table 3). Pulmonary oedema, pneumonia and acute coronary syndromes were the most commonly diagnosed causes of the deterioration. The most common therapies instituted were oxygen therapy (increased or commenced), administration of a fluid bolus, and frusemide (Table 3). Following the MET review, 15 of the 35 patients were admitted to the ICU. Nine patients with no prior NFR order were newly documented as NFR by members of the MET.

Discussion

We conducted a retrospective analysis of 105 deaths occurring over a 1-month period in our hospital to assess the epidemiology of in-hospital deaths and the role of the MET in planning end-of-life care in such deaths. We found that patients who died in our hospital (especially medical patients) were elderly, had multiple pre-existing comorbidities, and were mostly designated NFR at the time of death. We also found evidence that the MET participated in NFR documentation in about 10% of deaths, typically when advanced care planning was delayed.

Only five of the 105 deaths were not associated with formal NFR documentation, suggesting that the vast majority of deaths in our hospital are expected. Furthermore, of these five patients, two had advanced dementia, one solid organ cancer, and the other advanced right heart failure. Finally, only three of the five patients designated "for resuscitation" at the time of death exhibited MET criteria before death. Combined, these findings suggest that the MET may have a limited capacity to further reduce unexpected deaths in our hospital.

More than a third of the 100 patients who had an NFR order at the time of death received a MET call during their stay. In these patients, the MET was most likely to be called on the day of the patient's death, as well as on the day of NFR documentation. In addition, the time interval between admission and NFR documentation for patients who did receive a MET call was longer than for those who did not receive a MET call. Combined, these findings may suggest that the MET was called to assist in NFR decision-making in patients in whom advanced care planning was delayed or suboptimal. Alternatively, our findings may suggest that NFR status was documented after a period of attempted active treatment, which was later considered to have failed. If this were true, at least 10% of NFR orders might be made in patients who were initially for active treatment. We also found that the MET newly designated the patient as NFR following MET review in nine of the 35 MET calls. However, 15 of the 35 patients were admitted to the ICU, and most received treatment during the MET review. This suggests that the MET was not merely adjudicating NFR status in the patients reviewed, but also providing treatment.

A number of previous studies have attempted to assess the role of the MET in end-of-life care. In the original description of the MET system, Lee and colleagues[16] reported that 36 of the 522 calls between February 1992 and March 1993 were "inappropriate", in part because the patient was terminally ill and/or designated NFR. In a subsequent 12-month study in 1998, members of the MET felt that an NFR order would have been appropriate in 130 of the 713 cases (23%).[17]

In a 1999 study, Buist and colleagues reported that 13 of the 152 MET calls (8.6%) led to the allocation of NFR orders during the visit.[3] Finally, 8.3% of the calls in hospitals randomised to the MET in the recently completed MERIT (Medical Early Response Intervention and Therapy) study[18] resulted in an NFR order. All these studies differed from our study, as they assessed the proportion of MET calls that were associated with documentation of NFR status, rather than the proportion of patients dying with an NFR status who received a MET call during their admission. In our current study, we found that 35% of patient who died with an NFR status had a MET call during their admission.

Our study has a number of strengths. To our knowledge, it is the first to assess in detail the role of the MET in the care of patients who died within a hospital. This assessment has provided important information about the potential capacity of the MET to further reduce unexpected in-hospital deaths.

Despite this, our study has limitations. It assessed the deaths of only 105 patients in a single centre, and was retrospective in design. However, the case report form was designed to assess prospectively defined objectives and questions, and was completed by an investigator blinded to the study objectives. Confirmation of our findings will require a larger study, possibly multicentre in nature. A further limitation of our study was that it did not assess the frequency of NFR documentation in patients who did not subsequently die during their admission.

Conclusions

Our pilot study suggests that most patients who die in our hospital do so with a documented NFR order, and that few deaths are unexpected. These findings suggest that the capacity of the MET service to further reduce unexpected deaths at our hospital is limited. The MET appears to participate in NFR discussions in about 10% of hospital deaths, often when advanced care planning is delayed or active management has been unsuccessful.

Author details

Daryl A Jones, Senior Research Fellow,[1] and Senior Intensive Care Registrar[2]
Tammy McIntyre, Intensive Care Nurse[3]
Ian Baldwin, Nursing Educator, Intensive Care Unit[3]
Inga Mercer, Intensive Care Nurse[3]
Andrea Kattula, Medical Director[4]
Rinaldo Bellomo, Intensive Care Specialist, and Director of Intensive Care Research[3]
1 Australian and New Zealand Intensive Care Research Centre, Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, VIC.
2 Alfred Hospital, Melbourne, VIC.
3 Austin Hospital, Melbourne, VIC.
4 Department of Strategy Risk and Clinical Governance, Austin Hospital, Melbourne, VIC.
Correspondence: Daryl.Jones@med.monash.edu.au

References

1 Hillman K. The changing role of acute-care hospitals. *Med J Aust* 1999; 170: 325-8.
2 Bellomo R, Goldsmith D, Uchino S, et al. A prospective before-and-after trial of a medical emergency team. *Med J Aust* 2003; 179: 283-8.
3 Buist MD, Moore GE, Bernard SA, et al. Effects of a medical emergency team on reduction in incidence of and mortality from unexpected cardiac arrests in hospital: a preliminary study. *BMJ* 2002; 324: 387-90.
4 DeVita MA, Braithwaite RS, Mahidhara R, et al. Medical Emergency Response Improvement Team (MERIT). Use of medical emergency team responses to reduce hospital cardiopulmonary arrests. *Qual Saf Health Care* 2004; 13: 251-4.
5 Goldhill DR, Worthington L, Mulcahy A, et al. The patient-at-risk team: identifying and managing seriously ill ward patients. *Anaesthesia* 1999; 54: 853-60.
6 Ball C, Kirkby M, Williams S. Effect of the critical care outreach team on patient survival to discharge from hospital and readmission to critical care: a non-randomized population based study. *BMJ* 2003; 327: 1014-6.
7 Bellomo R, Goldsmith D, Uchino S, et al. Prospective controlled trial of effect of medical emergency team on postoperative morbidity and mortality rates. *Crit Care Med* 2004; 32: 916-21.
8 Garcea G, Thomasset S, McClelland L, et al. Impact of a critical care outreach team on critical care readmissions and mortality. *Acta Anaesth Scand* 2004; 48: 1096-100.
9 Pittard AJ. Out of our reach? Assessing the impact of introducing a critical care outreach service. *Anaesthesia* 2003; 58: 882-5.
10 Priestley G, Watson W, Rashidian A, et al. Introducing critical care outreach: a ward randomized trial of phased introduction in a general hospital. *Intensive Care Med* 2004; 30: 1398-404.
11 Bristow PJ, Hillman KM, Chey T, et al. Rates of in-hospital arrests, deaths and intensive care admissions: the effect of a medical emergency team. *Med J Aust* 2000; 173: 236-40.
12 Salamonson Y, Kariyawasam A, van Heere B, et al. The evolutionary process of Medical Emergency Team (MET) implementation: reduction in unanticipated ICU transfers. *Resuscitation* 2001; 49: 135-41.
13 Jones D, Bellomo R, Bates S, et al. Long term effect of a medical emergency team on cardiac arrests in a teaching hospital. *Crit Care* 2005; 9: R808-15.
14 Hillman K, Chen J, Cretikos M, et al; MERIT study investigators. Introduction of the medical emergency team (MET) system: a cluster-randomised controlled trial. *Lancet* 2005; 365: 2091-7.
15 Jones D, Bates S, Warrillow S, et al. Effect of an education programme on the utilization of a medical emergency team in a teaching hospital. *Intern Med J* 2006; 36: 231-6.
16 Lee A, Bishop G, Hillman KM, Daffurn K. The medical emergency team. *Anaesth Intensive Care* 1995; 23: 183-6.
17 Parr MJA, Hadfield JH, Flabouris A, et al. The medical emergency team: 12 month analysis of reasons for activation, immediate outcome and not-for-resuscitation orders. *Resuscitation* 2001; 50: 39-44.
18 Hillman K, Chen J, Cretikos M, et al; MERIT study investigators. Introduction of the medical emergency team (MET) system: a cluster-randomised controlled trial. *Lancet* 2005; 365: 2091-7. ❑