

QUALITY IMPROVEMENT REPORT

Six year audit of cardiac arrests and medical emergency team calls in an Australian outer metropolitan teaching hospital

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EDITORIAL by Rowan and Harrison

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Problem

In our hospital, the occurrence of cardiac arrest often indicates delayed or suboptimal clinical management of the patient.¹ The outcome from in-hospital cardiac arrest is universally poor.²⁻⁶ Our hospital implemented a medical emergency team in 1996, and within three years the incidence of cardiac arrests dropped by 50%.⁷ Three other studies have since reported similar findings,⁸⁻¹⁰ but they have been criticised because they used a historical control, before-after methodology.^{11,12}

Recently in the MERIT study, a large randomised prospective study of medical emergency team implementation,¹³ a composite outcome of cardiac arrest, unexpected death, and unplanned admission to the intensive care unit was not significantly reduced. However, in both the intervention and control hospitals the overall calls for an emergency team increased, and cardiac arrests and unexpected deaths reduced.

Despite the results of the MERIT study, more and more hospitals have set up medical emergency or rapid response teams. Recent initiatives in the US and Australia have implemented rapid response teams in hospitals nationally. In June 2005 the first consensus

conference on medical emergency teams found that hospitals should implement such systems.¹⁴

Inspections of data from the MERIT study and single centre studies using historical controls⁷⁻¹⁰ show that in a large number of instances where the composite outcome occurred, although the patient had had the criteria for calling the medical emergency team, the staff had not called the team. Thus, the MERIT study could not measure the effectiveness of the medical emergency team because the randomised intervention was often not received by the patient.

In our hospital the importance of ensuring that patients with calling criteria are responded to arose through the unexpected in-hospital death of a previously well 47 year old man after a thoracotomy in 2001. A coronial inquiry found that part of the cause of death was the failure to call the medical emergency team during the 14 hours immediately after the operation, when the patient was tachycardic and hypotensive.¹⁵

We identified several important barriers to staff calling for higher order assistance. Firstly, nursing staff were reluctant to breach the traditional hierarchical referral model of care. Secondly, over the 14 hour postoperative period, the four different junior doctors

Abstract

Problem In-hospital cardiac arrest often represents failure of optimal clinical care. The use of medical emergency teams to prevent such events is controversial. In-hospital cardiac arrests have been reduced in several single centre historical control studies, but the only randomised prospective study showed no such benefit. In our hospital an important problem was failure to call the medical emergency team or cardiac arrest team when, before in-hospital cardiac arrest, patients had fulfilled the criteria for calling the team.

Design Single centre, prospective audit of cardiac arrests and data on use of the medical emergency team during 2000 to 2005.

Setting 400 bed general outer suburban metropolitan teaching hospital.

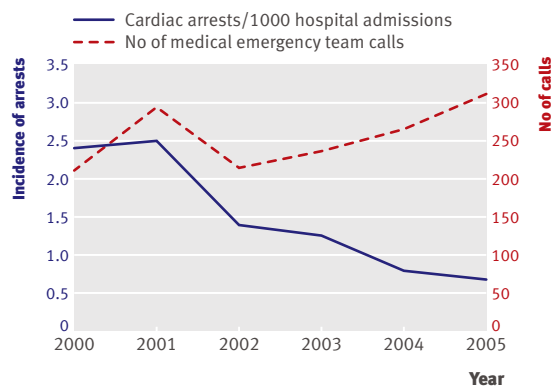
Strategies for change Three initiatives in the hospital to improve use of the medical emergency team: orientation programme for first year doctors, professional development course for medical registrars, and the evolving role of liaison intensive care unit nurses.

Key measures for improvement Incidence of cardiac arrests.

Effects of the change Incidence of cardiac arrests reduced 24% per year, from 2.4/1000 admissions in 2000 to 0.66/1000 admissions in 2005.

Lessons learnt Medical emergency teams can be efficacious when supported with a multidisciplinary, multifaceted education system for clinical staff.

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Incidence of medical emergency team and cardiac arrest calls, 2000-5

who had responsibility for the patient opted to hand the problem either to the next shift or up the hierarchy to the registrar.

This case highlighted that having a medical emergency team based in the intensive care unit, along with telling ward staff about the team and in-service education, was not sufficient.

Design and setting

Dandenong Hospital is a 400 bed outer metropolitan teaching hospital serving a population of 500 000. In our single centre, prospective audit of cardiac arrest in hospital and use of the medical emergency team data, the attending staff collected information from all hospital cardiac arrest calls and medical emergency team calls in 2000-5, making a standardised record at the time of the event. The patient's age and sex, reason for call, treatments given, and outcome were entered into the intensive care unit's audit database. Hospital data were downloaded from the hospital's patient administration system. If a member of staff assessed a patient and then called a cardiac arrest, this was documented as a cardiac arrest.

Strategies for change

The medical emergency team consists of a senior intensive care nurse, one of two intensive care registrars (variable seniority from postgraduate year 3 to preconsultant), and a ward medical registrar (typically postgraduate year 3 or 4). Airway equipment, resuscitation drugs, and fluids are taken in a single roller bag. The criteria for calling the team are shown in the box.

The cardiac arrest team consists of the medical emergency team plus an anaesthetic registrar and a senior coronary care nurse. In our audit, if a medical emergency team call progresses to a cardiac arrest call, either before the team arrives or at the bedside, the event is classified as a cardiac arrest.

Orientation programme for interns

All first year doctors participate in a one week orientation course.

Professional development programme for medical registrars

The six day course for medical registrars aims to develop communication, teamwork, and leadership skills. Thirteen hours of this programme are devoted to medical emergency team training. Registrars learn and practise a generic systematic approach to ward emergencies individually and as part of a realistic team in a simulator along with intensive care and ward nursing staff.

Intensive care liaison nurses

The role of intensive care liaison nurse evolved out of the leaving intensive care non-stressfully and collaboratively programme developed in 2000. It establishes a continuum of care to reduce the patient's and family's anxiety during transition to the wards, combining this with a coordinated approach to planning discharge from the intensive care unit.^{9,16,17} The liaison nurse follows up 90% of patients discharged from intensive care.

Key measures for improvement

We assessed the effects of the orientation and professional development programmes, and the evolving role of the liaison nurse, on the incidence of in-hospital cardiac arrests, and monitored the participation of medical registrars in professional development.

Effects of the change

In 2000 we had 2.4 in-hospital cardiac arrests per 1000 hospital admissions; six years later this had decreased to 0.66 cardiac arrests per 1000 admissions (table). The number of medical emergency team calls increased by 46%, from 213 in 2000 to 311 in 2005 (figure). Over the six year audit period the in-hospital cardiac arrests reduced by 24% a year (95% confidence interval 19% to 29%, $P < 0.001$). A Poisson regression model shows an

Calls for medical emergency team and cardiac arrest calls in an outer metropolitan teaching hospital

	2000	2001	2002	2003	2004	2005
Medical emergency team calls:	n=213	n=294	n=215	n=236	n=265	n=311
No (%) of patients died in hospital	76 (35)	80 (27)	65 (30)	70 (29)	67 (25)	69 (22)
Cardiac arrest calls:	n=69	n=70	n=41	n=41	n=26	n=24
No (%) invalid	22 (31)	18 (25)	7 (17)	5 (12)	1 (3)	5 (20)
Hospital admissions:	n=28 539	n=27 517	n=29 715	n=32 299	n=32 356	n=35 644
Cardiac arrests per 1000 hospital admissions	2.4	2.5	1.38	1.26	0.8	0.66

Criteria or triggers for calling the medical emergency team**Airway**

Respiratory distress
Threatened airway

Breathing

Respiratory rate >30 breaths per minute
Respiratory rate <6 breaths per minute
Oxygen saturation <90% on oxygen
Difficulty speaking

Circulation

Blood pressure <90 mm Hg despite treatment
Pulse rate >130 beats per minute

Neurology

Decreased level of consciousness
Fitting

Other

Concerned
Need of treatment and prompt help

estimated rate of decline of 0.76 (0.71 to 0.82) per year ($P < 0.001$).

Since 2005, 53 medical registrars have completed the professional development programme. In 2004 and 2005 the proportion of medical registrars covering medical emergency team calls at Dandenong Hospital who have participated in the programme increased from 48% to 76%.

Lessons learnt

Our audit data show that with appropriate ongoing educational support a medical emergency team system can significantly reduce the incidence of cardiac arrests. The major limitation of this audit is that we have not measured other factors that may have influenced this decline in the incidence of cardiac arrests. Firstly, all our educational initiatives emphasise making appropriate “not for resuscitation” orders, and the decreased incidence of cardiac arrests could simply reflect this change in practice. Secondly, the number of hospital admissions has increased over the audit period, which will influence the denominator used for incidence of cardiac arrests. We have been unable to obtain similar audit data from comparable hospitals in the region to determine if the decline in cardiac arrests reflects a general change in in-hospital mortality.

Discussion of the benefits of the medical emergency team needs to consider the discrepancy between the data presented in this and previous single centre studies⁷⁻¹⁰ and the data from the MERIT study.¹³ Comparing the efficacy of such teams in different hospitals is always going to be complicated by differences in composition of the team and type of hospital.

In our experience the hospital staff's acceptance of medical emergency team concepts is just as important as the actual actions of the team. The main hurdle in our experience is the creation of a supportive environment

for general ward nurses to call the team and that provides support for junior medical officers. We have strong support from our senior medical staff for the medical emergency team.

The Hawthorne effect is important: it drives the efficacy of the medical emergency team. In our experience the medical emergency team's performance is determined by timely feedback to all team members: audit of activity and feedback of missed call opportunities.

Conclusion

Our last six years' experience with the medical emergency team shows a continued sustained decline in in-hospital cardiac arrests. The team's actual intervention is only one aspect of this: educational initiatives have created a culture and permanent Hawthorne effect to drive these outcomes.

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- Buist MD, Jarmolowski E, Burton PR, Bernard SA, Waxman BP, Anderson J. Recognising clinical instability in hospital patients before cardiac arrest or unplanned admission to intensive care: a pilot study in a tertiary-care hospital. *Med J Aust* 1999;171:22-5.
- Peatfield RC, Sillett RW, Taylor D, McNicol MW. Survival after cardiac arrest in hospital. *Lancet* 1977;i:1223-5.
- Bedell SE, Delbanco TL, Cook EF, Epstein FH. Survival after cardiopulmonary resuscitation in the hospital. *N Engl J Med* 1983;309:569-76.
- Schein RM, Hazday N, Pena M, Rubens BH, Sprung CL. Clinical antecedents to in-hospital-cardiopulmonary arrest. *Chest* 1990;98:1388-92.
- Franklin C, Mathew J. Developing strategies to prevent in-hospital cardiac arrest: analyzing responses of physicians and nurses in the hours before the event. *Crit Care Med* 1994;22:244-7.
- Hillman KM, Bristow PJ, Chey T, Daffum K, Jacques T, Norman S, et al. Antecedents to hospital deaths. *Intern Med J* 2001;31:343-8.
- Buist MD, Moore GE, Bernard SA, Waxman BP, Anderson JN, Nguyen TV. Effects of a medical emergency team on reduction of incidence of and mortality from unexpected cardiac arrests in hospital: preliminary study. *BMJ* 2002;324:387-90.
- Bellomo R, Goldsmith D, Uchino S, Buckmaster J, Hart G, Opdam H, et al. A prospective before and after trial of a medical emergency team. *Med J Aust* 2003;179:283-7.
- DeVita MA, Braithwaite RS, Mahidhara R, Stuart S, Foriada M, Simmons RL. Use of the medical emergency team responses to reduce hospital cardiopulmonary arrests. *Qual Safety Health Care* 2004;13:251-4.
- Tiballs J, Kinney S, Duke T, Oakley E, Hennessy M. Reduction of paediatric in-patient cardiac arrest and death with a medical emergency team: preliminary results. *Arch Dis Child* 2005;90:1148-52.
- Esmonde L, McDonnell A, Ball C, Waskett C, Morgan R, Rashidian A, et al. Investigating the effectiveness of critical care outreach services: a systematic review. *Intens Care Med* 2006;32:1713-21.
- Winters W, Pham J, Hunt E, Guallar E, Berenholtz S, Pronovost P. Rapid response systems: a review. *Crit Care Med* 2007;35:1238-43.
- MERIT Study Investigators. Introduction of the medical emergency team (MET) system: a cluster randomised controlled study. *Lancet* 2005;365:2091-7.
- DeVita MA, Bellomo R, Hillman K, Kellum J, Rotondi A, Teres D, et al. Findings of the First Consensus Conference on Medical Emergency Teams. *Crit Care Med* 2006;34:2463-78.
- Buist M, Bellomo R. MET: the medical emergency team or the medical education team? *Crit Care Resus* 2004;6:83-91.
- Russell S. Reducing readmissions to ICU. *Heart Lung* 1999;28:365-72.
- Russell S. Improving the continuity of care after discharge from an ICU. *Prof Nurse* 2000;15:497-500.

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