

Rapid Response Teams in Metropolitan Hospitals: Why We Need Better Monitoring in Hospital Wards

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Background

Hospitals are dangerous places !!

30,121 records in USA (Harvard Medical Practice Study; NEJM 1991) : 3.7% had adverse events (AEs) with 27.6% due to negligence and 13.6% mortality.

Estimated AEs involving negligence in N.Y.: 27,179 (13,392 deaths)

How about outside the USA?

Australia is just as dangerous !!

The Quality in Australian Health Care

Study (MJA 1995) : 14,000 admissions in 28 hospitals with 16.6% showing adverse events of which 51% deemed preventable and 4.9% (116) causing death and 13.7% (318) permanent disability. **A silent epidemic**

Do we have reason to believe that adverse events can be prevented?

Definitely !!

Night discharge from ICU increases mortality (Lancet 2000; 355: 1138-1142)

More than 50% of ICU emergency admissions receive inadequate pre-ICU care (BMJ 1998; 316: 1853-1858)

Decreased nurse-patient ratio increases complications after esophagectomy (Intensive Care med 2000; 26: 1857-1862)

Can we identify patients at risk?

Another Melbourne study (MJA 1999; 171: 22-25) showed that all critical events were preceded by warning signs for an average of **6.5 hours**

A study of hospital cardiac arrests in **Miami** showed that **84% had physiological instability for 8 hours** (Chest 1990; 98: 1388-92)

Can we identify patients?

A study of 150 cardiac arrests in **Chicago**. In **99 (66%)** cases there was documented instability for **8 hours** (Crit Care Med 1994; 22: 244-247)

Resuscitating dead people is harder than resuscitating sick people!!

Waiting for cardiac arrest does not make sense.....**but that's what happens in most hospitals in the world!!**

Why does this happen?

- Structure of medical practice in hospital
- “Silos” of specialty
- Patient “ownership”
- Ridiculous notion that an orthopedic resident knows how to recognize or handle pulmonary edema
- Crises happen randomly in random units and doctors can’t see the “big picture”

Why does this happen?

- Hospital doctors (esp. surgical doctors) are not immediately available
- Non ICU/Anesthesiology doctors have limited skills in dealing with acute illness
- Acute illness is often missed
- At 3 am if you are sick you get to see the night resident !

Is there a possible solution?

- Develop a systematic approach
- Get nurses/doctors to call for help the way people do at home
- Deliver to patients the equivalent of an “hospital ambulance” (**a rapid response team - RRT**) whenever they get really sick
- Do that and see what happens

The Medical Emergency Team

ICU fellow and ICU nurse + emergency pack - ICU specialist available 24 hours a day

Any member of hospital staff can trigger the MET - Call switchboard to call MET

Use criteria on red poster to trigger MET

Let's do it and compare the hospital before and after the MET!

Austin Hospital
**MEDICAL EMERGENCY TEAM
(MET)**

**CALL 7777 and state
"MET CALL WARD ____"**

**IF YOU ARE WORRIED ABOUT ANY PATIENT
OR IF YOU NOTICE ANY ACUTE CHANGES IN**

AIRWAY



- Obstructed airway
 - Noisy breathing / stridor
 - Problem with a tracheostomy tube

BREATHING



- Any difficulty breathing
- Breathing less than 8 breaths a minute
- Breathing greater than 25 breaths a minute
- Oxygen Saturation \leq 90%, despite high flow oxygen

IF PATIENT IS NOT BREATHING, CALL A CODE BLUE

CIRCULATION



- Heartbeat less than 40 beats a minute
- Heartbeat greater than 120 beats a minute
- Low Blood Pressure (Systolic less than 90 mmHg)
- Urine output $<$ 50 ml over 4 hours

IF PATIENT HAS NO PULSE, CALL A CODE BLUE

**CONSCIOUS
STATE**



- Acute change in conscious state
- Unroutable patient

A prospective before-and-after trial of a medical emergency team

Rinaldo Bellomo, Donna Goldsmith, Shigehiko Uchino, Jonathan Buckmaster, Graeme K Hart, Helen Opdam, William Silvester, Laurie Doolan and Geoffrey Gutteridge

MOST HOSPITALS have cardiac arrest teams that respond to in-hospital cardiac arrests using modern technology and standardised protocols. However, survival to hospital discharge in patients with in-hospital cardiac arrests has remained stable at between 14.7% (United States) and 16.7% (United Kingdom) for 30 years.¹ As several studies of in-hospital cardiac arrests suggest that signs of clinical and physiological instability may precede the arrest,²⁻⁴ introducing an intensive care-based hospital-wide preventive approach (a medical emergency team [MET]) might decrease the incidence of cardiac arrests and, consequently, hospital mortality. We tested this hypothesis by conducting a prospective trial comparing these outcome measures before and after introducing a MET.

METHODS

Hospital

ABSTRACT

Objective: To determine the effect on cardiac arrests and overall hospital mortality of an intensive care-based medical emergency team.

Design and setting: Prospective before-and-after trial in a tertiary referral hospital.

Patients: Consecutive patients admitted to hospital during a 4-month "before" period (May–August 1999) ($n = 21\,090$) and a 4-month intervention period (November 2000 – February 2001) ($n = 20\,921$).

Main outcome measures: Number of cardiac arrests, number of patients dying after cardiac arrest, number of postcardiac-arrest bed-days and overall number of in-hospital deaths.

Results: There were 63 cardiac arrests in the "before" period and 22 in the intervention period (relative risk reduction, RRR: 65%; $P < 0.001$). Thirty-seven deaths were attributed to cardiac arrests in the "before" period and 16 in the intervention period (RRR: 56%; $P = 0.005$). Survivors of cardiac arrest in the "before" period required 163 ICU bed-days versus 33 in the intervention period (RRR: 80%; $P < 0.001$), and 1353 hospital bed-days versus 159 in the intervention period (RRR: 88%; $P < 0.001$). There were 302 deaths in the "before" period and 222 in the intervention period (RRR: 26%; $P = 0.004$).

Conclusions: The incidence of in-hospital cardiac arrest and death following cardiac arrest, bed occupancy related to cardiac arrest, and overall in-hospital mortality decreased after introducing an intensive care-based medical emergency team.

MJA Rapid Online 18 August 2000

Prospective controlled trial of effect of medical emergency team on postoperative morbidity and mortality rates*

Rinaldo Bellomo, MD; Donna Goldsmith, RN; Shigehiko Uchino, MD; Jonathan Buckmaster, MD; Graeme Hart, MD; Helen Opdam, MD; William Silvester, MD; Laurie Doolan, MD; Geoffrey Gutteridge, MD

Objective: To determine whether the introduction of an intensive care unit-based medical emergency team, responding to hospital-wide preset criteria of physiologic instability, would decrease the rate of predefined adverse outcomes in patients having major surgery.

Design: Prospective, controlled before-and-after trial.

Setting: University-affiliated hospital.

Patients: Consecutive patients admitted to hospital for major surgery during a 4-month control phase and during a 4-month intervention phase.

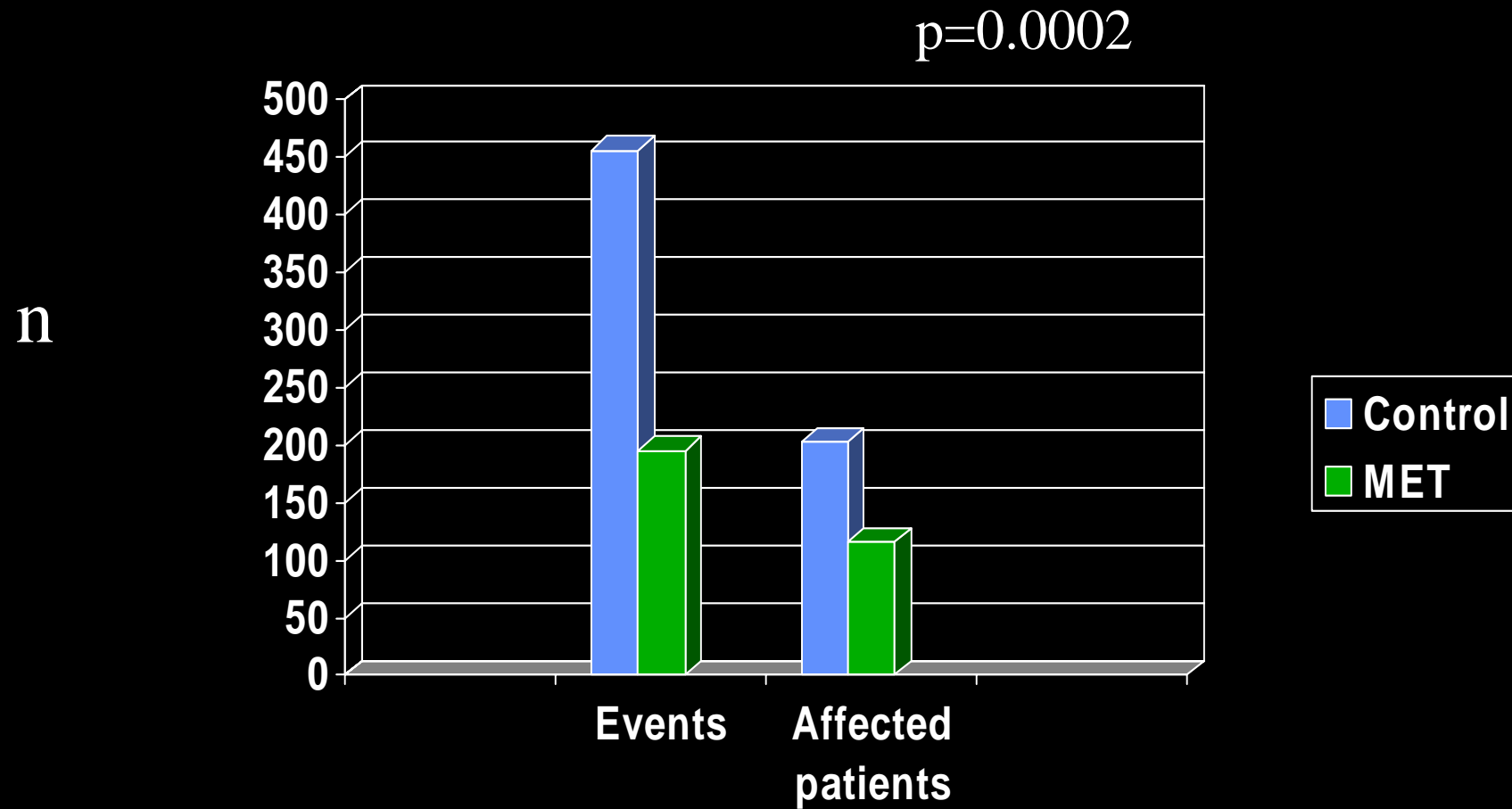
Interventions: Introduction of a hospital-wide intensive care unit-based medical emergency team to evaluate and treat inpatients deemed at risk of developing an adverse outcome by nursing, paramedical, and/or medical staff.

Measurements and Main Results: We measured incidence of serious adverse events, mortality after major surgery, and mean duration of hospital stay. There were 1,369 operations in 1,116 patients during the control period and 1,313 in 1,067 patients during the medical emergency team intervention period. In the control period, there were 336 adverse outcomes in 190 patients

(301 outcomes/1,000 surgical admissions), which decreased to 136 in 105 patients (127 outcomes/1,000 surgical admissions) during the intervention period (relative risk reduction, 57.8%; $p < .0001$). These changes were due to significant decreases in the number of cases of respiratory failure (relative risk reduction, 79.1%; $p < .0001$), stroke (relative risk reduction, 78.2%; $p = .0026$), severe sepsis (relative risk reduction, 74.3%; $p = .0044$), and acute renal failure requiring renal replacement therapy (relative risk reduction, 88.5%; $p < .0001$). Emergency intensive care unit admissions were also reduced (relative risk reduction, 44.4%; $p = .001$). The introduction of the medical emergency team was also associated with a significant decrease in the number of postoperative deaths (relative risk reduction, 36.6%; $p = .0178$). Duration of hospital stay after major surgery decreased from a mean of 23.8 days to 19.8 days ($p = .0092$).

Conclusions: The introduction of an intensive care unit-based medical emergency team in a teaching hospital was associated with a reduced incidence of postoperative adverse outcomes, postoperative mortality rate, and mean duration of hospital stay. (Crit Care Med 2004; 32:916–921)

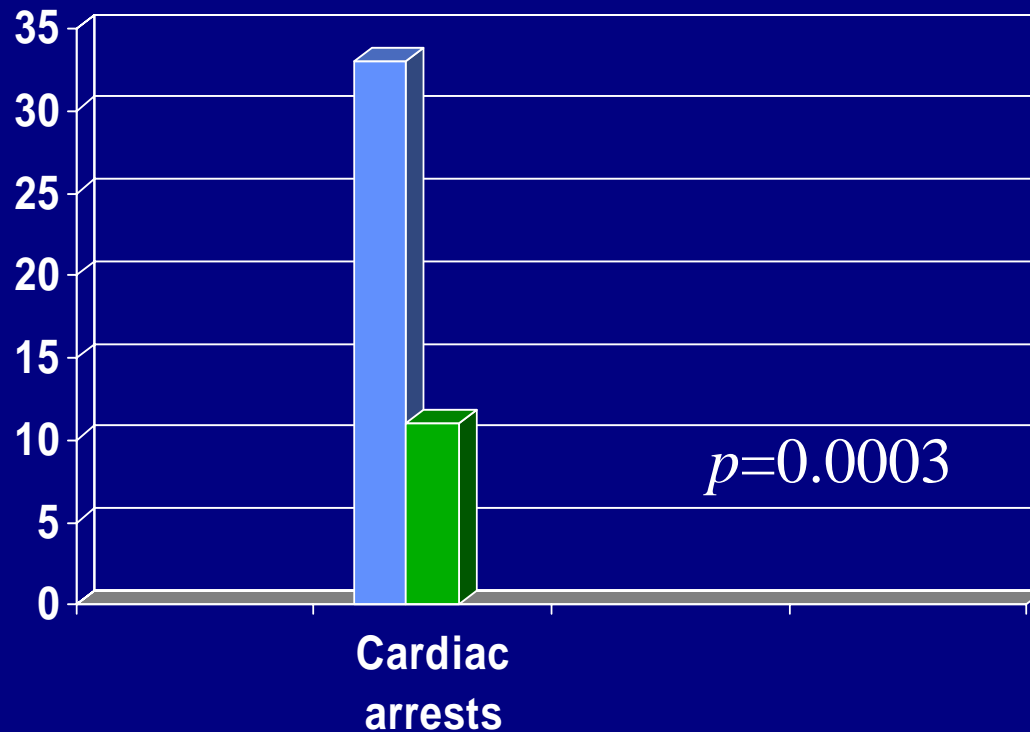
Overall adverse events



Effect of MET on Cardiac Arrests in Surgical Patients

Percentage reduction: 66.6%

n

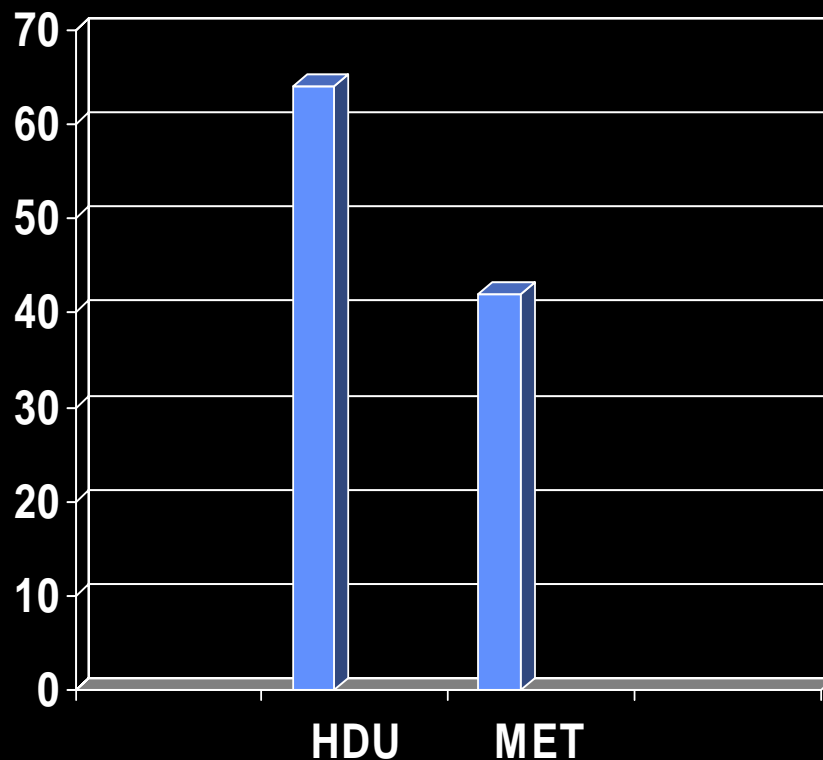


Effect of MET on in-hospital Surgical Mortality

37.5% relative reduction in mortality

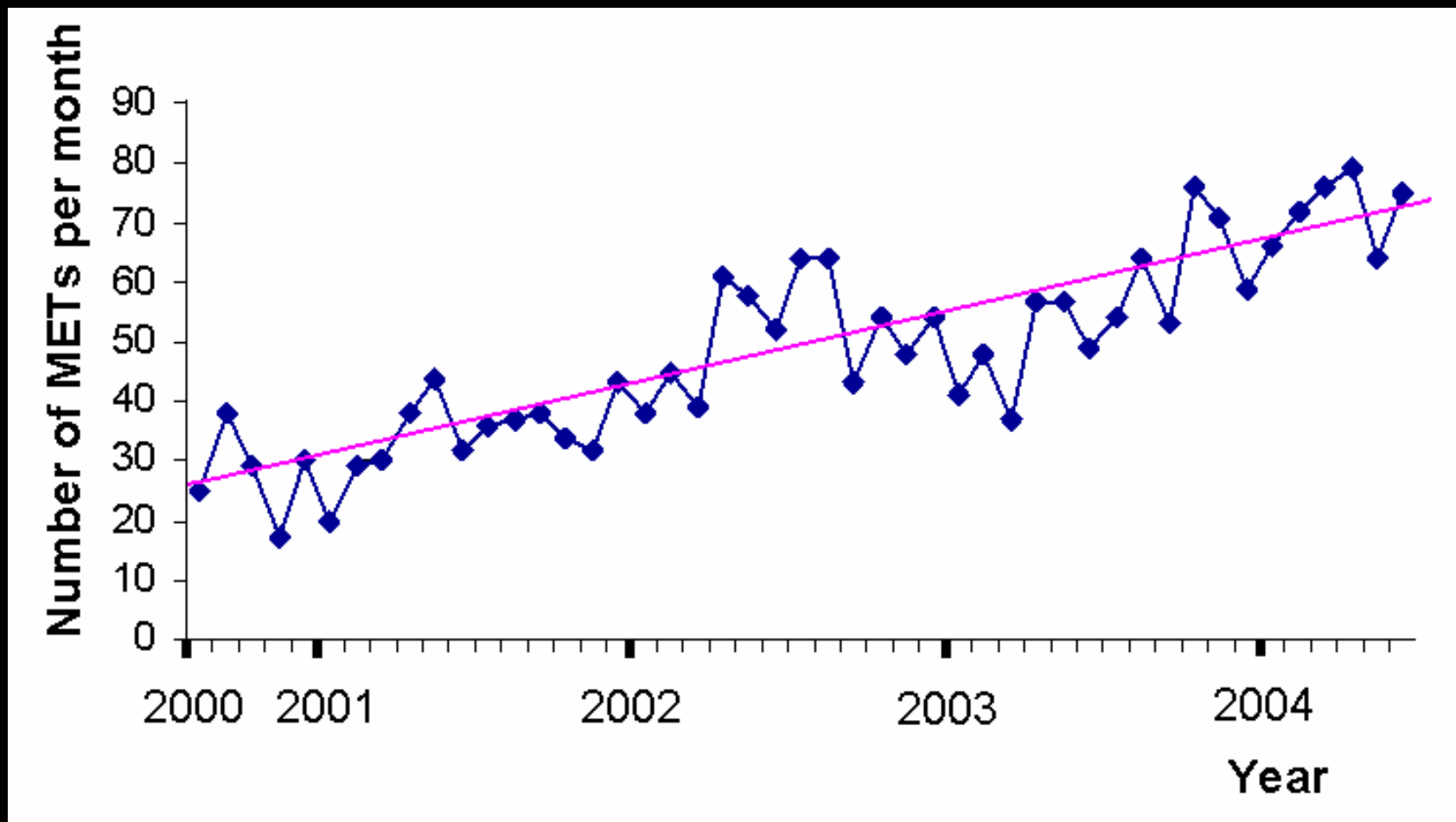
$p=0.022$

n



In-Hospital Mortality

Change in MET use over time at Austin



MET calls in 2008: 157/month

The relationship between early emergency team calls and serious adverse events*

Jack Chen, MBBS, PhD, MBA (Exec); Rinaldo Bellomo, FRACP, FJFICM, MD;
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Ken Hillman, MBBS, FRCA, FACA, FJFICM, MD; Simon Finfer, MBBS, FRCA, FRCP, FJFICM;
the MERIT Study Investigators for the Simpson Centre and the ANZICS Clinical Trials Group

Objective: To examine the relationship between early emergency team calls and the incidence of serious adverse events—cardiac arrests, deaths, and unplanned admissions to an intensive care unit—in a cluster randomized controlled trial of medical emergency team implementation (the MERIT study).

Design: *Post hoc* analysis of data from cluster randomized controlled trial.

Setting and Participants: Twenty-three public hospitals in Australia and 741,744 patients admitted during the conduct of the study.

Interventions: Attendance by a rapid response system team or cardiac arrest team.

Main Outcome Measures: The relationship between the proportion of rapid response system team calls that were early emergency team calls (defined as calls not associated with cardiac arrest or death) and the rate (events/1000 admissions) of the adverse events.

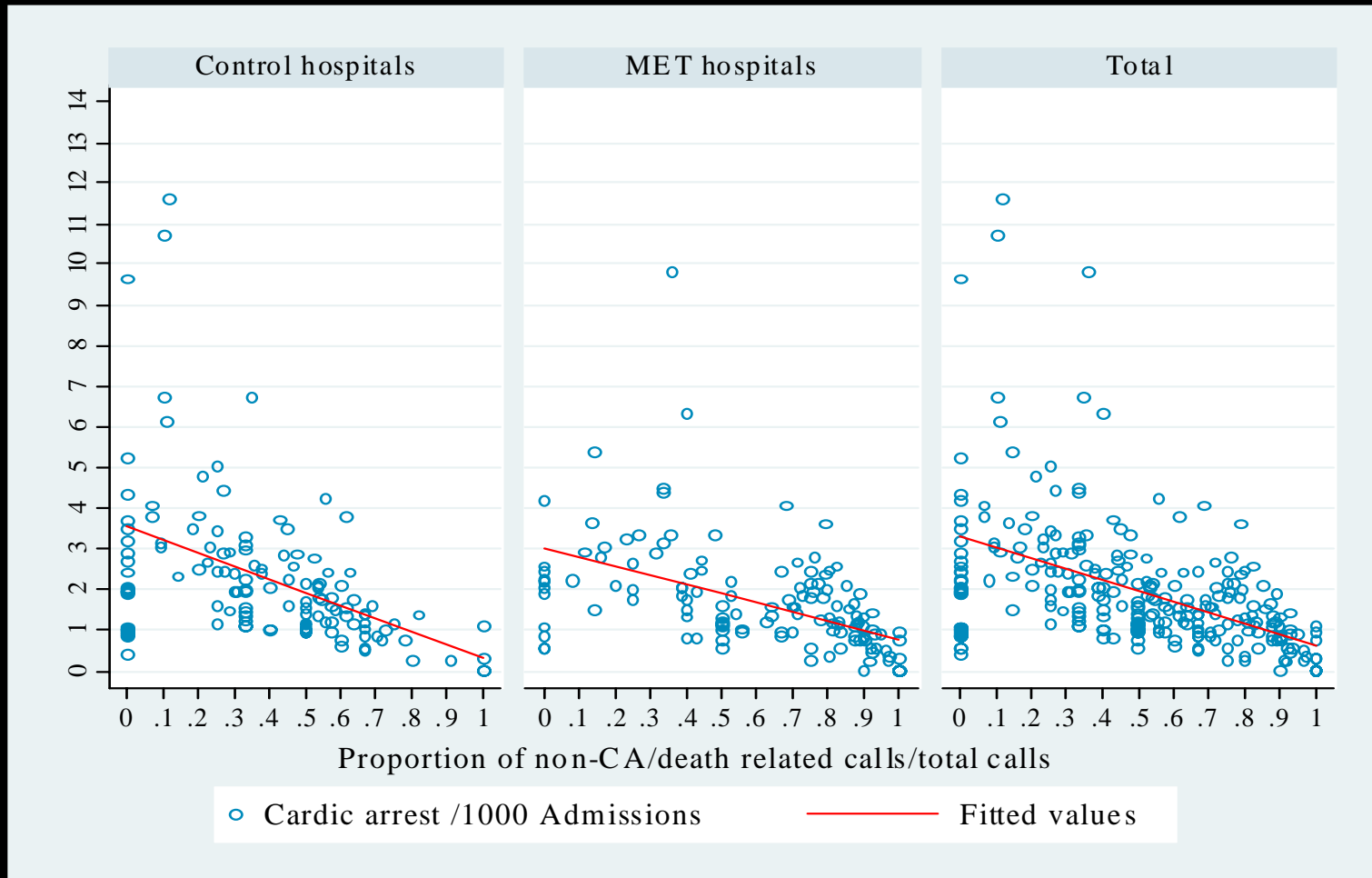
Results: We analyzed 11,242 serious adverse events and 3700 emergency team calls. For every 10% of increase in the

proportion of early emergency team calls there was a 2.0 reduction per 10,000 admissions in unexpected cardiac arrests (95% confidence interval [CI] -2.6 to -1.4), a 2.2 reduction in overall cardiac arrests (95% CI -2.9 to -1.6), and a 0.94 reduction in unexpected deaths (95% CI -1.4 to -0.5). We found no such relationship for unplanned intensive care unit admissions or for the aggregate of unexpected cardiac arrests, unplanned intensive care unit admissions, and unexpected deaths.

Conclusions: As the proportion of early emergency team calls increases, the rate of cardiac arrests and unexpected deaths decreases. This inverse relationship provides support for the notion that early review of acutely ill ward patients by an emergency team is desirable. (*Crit Care Med* 2009; 37:148–153)

KEY WORDS: medical emergency team; rapid response team; health services research; cluster randomized controlled trial; dose–response

Dose of MET-like activity in cardiac arrests in MERIT



Circadian pattern of activation of the medical emergency team in a teaching hospital

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Abstract

Introduction Hospital medical emergency teams (METs) have been implemented to reduce cardiac arrests and hospital mortality. The timing and system factors associated with their activation are poorly understood. We sought to determine the circadian pattern of MET activation and to relate it to nursing and medical activities.

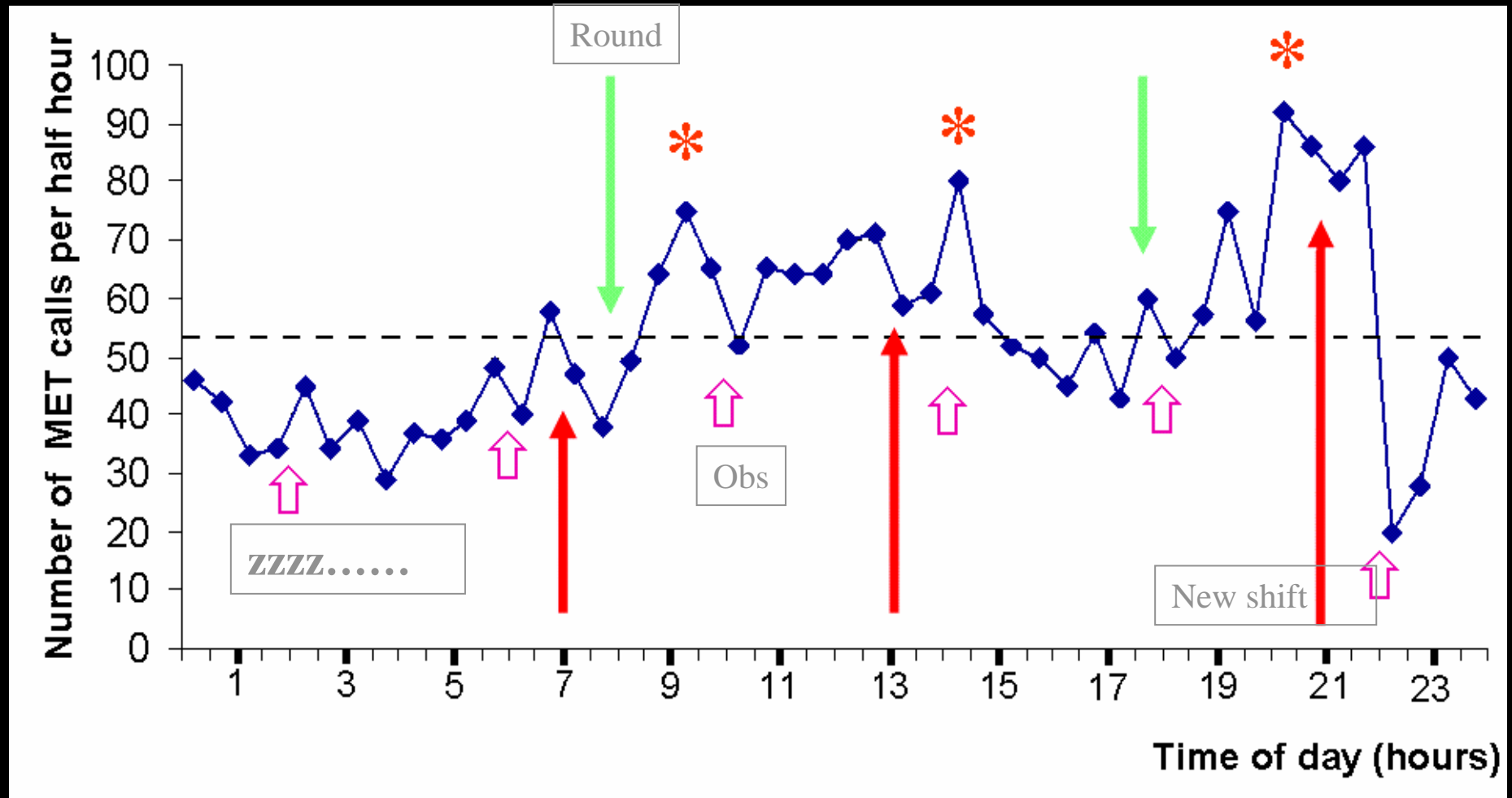
Method We conducted a retrospective observational study of the time of activation for 2568 incidents of MET attendance. Each attendance was allocated to one of 48 half-hour intervals over the 24-hour daily cycle. Activation was related nursing and medical activities.

Results During the study period there were 120,000 consecutive overnight medical and surgical admissions. The hourly rate of MET calls was greater during the day (47% of calls in the 10 hours between 08:00 and 18:00), but 53% of the 2568 calls occurred between 18:00 and 08:00 hours. MET calls increased in the half-hour after routine nursing observation, and in the half-hour before each nursing handover. MET service utilization was 1.25 (95% confidence interval [CI] = 1.11–1.52)

times more likely in the three 1-hour periods spanning routine nursing handover ($P = 0.001$). The greatest level of half-hourly utilization was seen between 20:00 and 20:30 (odds ratio [OR] = 1.76, 95% CI = 1.25–2.48; $P = 0.001$), before the evening nursing handover. Additional peaks were seen following routine nursing observations between 14:00 and 14:30 (OR = 1.53, 95% CI = 1.07–2.17; $P = 0.022$) and after the commencement of the daily medical shift (09:00–09:30; OR = 1.43, 95% CI = 1.00–2.04; $P = 0.049$).

Conclusion Peak levels of MET service activation occur around the time of routine observations and nursing handover. Our findings raise questions about the appropriate frequency and methods of observation in at-risk hospital patients, reinforce the need for adequately trained medical staff to be available 24 hours per day, and provide useful information for allocation of resources and personnel for a MET service.

Medical and nursing activities (**monitoring**) dictate whether you are “sick” almost as much as pathophysiology



Austin data over 4 years

(Jones D, Goldsmith D, Bellomo R et al. Critical Care 2005; 9: R303-R306)

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Patient monitoring and the timing of cardiac arrests and medical emergency team calls in a teaching hospital

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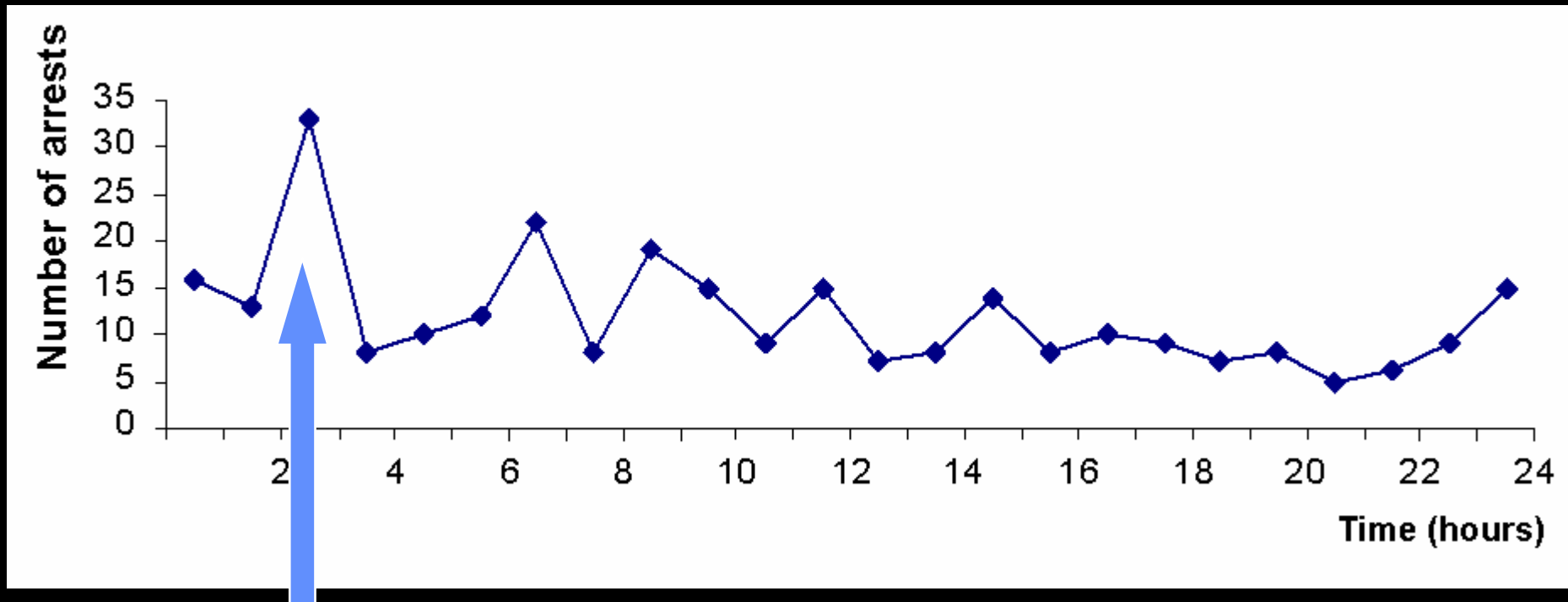
© Springer-Verlag 2006

Abstract *Objective:* To describe the timing of cardiac arrest detection in relation to episodes of Medical Emergency Team (MET) review and routine nursing observations. *Design and setting:* Retrospective observational study in a university-affiliated hospital. *Patients:* 279 cardiac arrests involving ward patients *Measure-*

introduction of the MET there were 162 cardiac arrests, 28% of which occurred shortly after an initial MET call. The odds ratio for risk of cardiac arrest during periods of lowest MET activation (24:00–08:00) when compared with periods of highest MET activation (16:00–24:00) was 2.26. *Conclusions:* Cardiac arrest

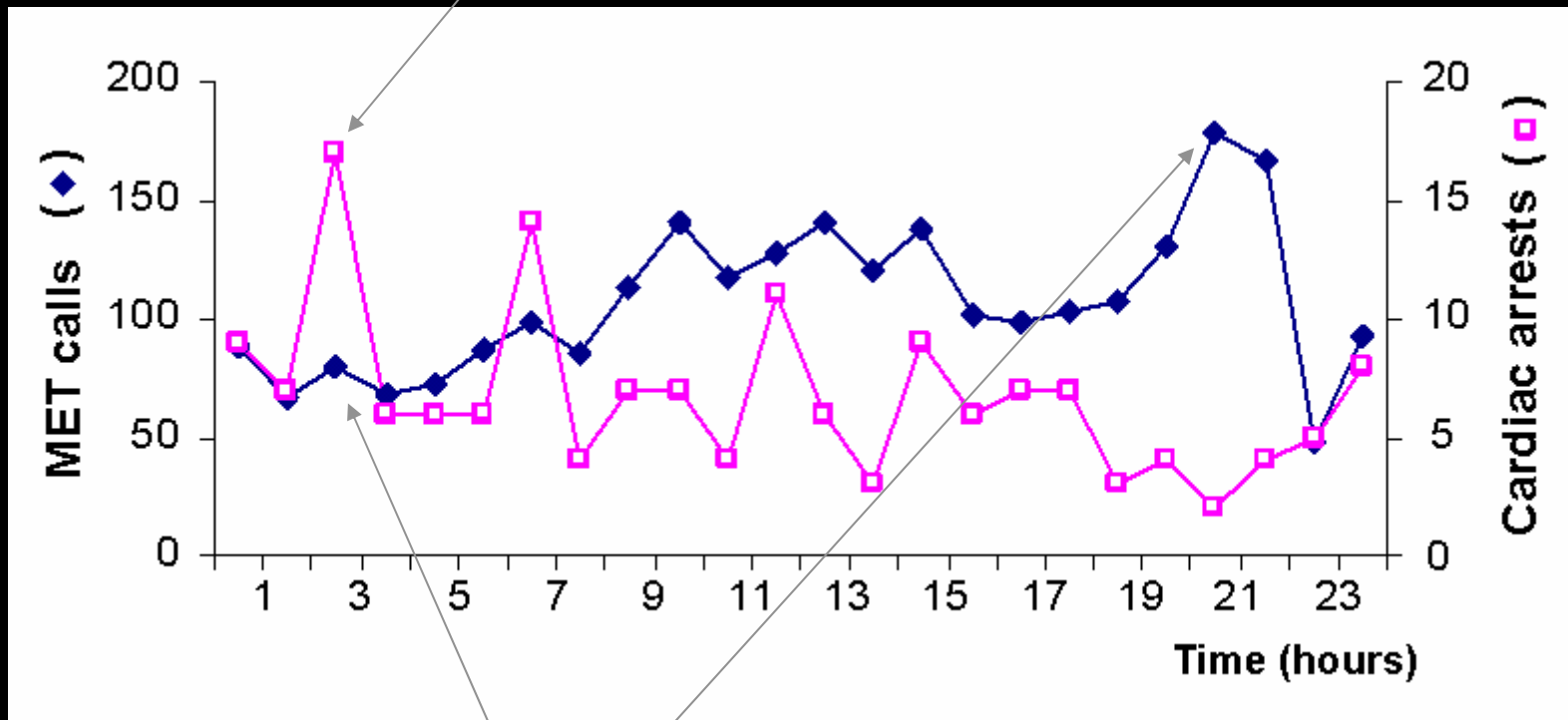
Why can't we make these damn cardiac arrests disappear completely??

So much is about vigilance & monitoring



Less monitoring = More cardiac arrests

The “afferent arm” “sleeps on the job”
(no monitoring)



As MET calls go up cardiac arrests go down and vice-versa

However...as we learn more about RRTs...the recurrent problem is the afferent (call) arm....

- Weakest link in the chain
- Nurses do not reliably monitor vital signs
- When they do, they (and doctors) do not understand their significance
- When they do, they (and doctors) still do not understand the need to act immediately
- The focus turns to **monitoring**.....

What is monitoring in the wards

Outside of specific areas (ICU, CCU, CT HDU, Neuro HDU) monitoring is **intermittent**

Intermittent Monitoring = **vital signs**

Are intermittent vital signs of any use in identifying “at risk” patients?

Is such monitoring important/useful?

A multicenter study (MERIT) provided a unique opportunity

Resuscitation (2007) xxx, xxx–xxx



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RESUSCITATION



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The objective medical emergency team activation criteria: A case–control study[☆]

Michelle Cretikos^{a,*}, Jack Chen^a, Ken Hillman^a, Rinaldo Bellomo^b,
Simon Finfer^c, Arthas Flabouris^d,

the MERIT study investigators¹

Monitoring and call criteria

Patients: all patients with an event over a 6-month period. Obtain data for 24 hr period before the event

Controls: chosen from patients admitted to same ward in 4 week period before the case event using age and sex matching. Obtain data during a random 24 hour period

Study Patients

Patients: 450

Age: 68; sex: 58.7%

Events: 297 admit to ICU;
135 arrests; 18 unexpected
death

Missing data in last 24 hr:

RR: 78; HR 5; BP: 6

Controls: 520

Age: 68; sex: 57.5%

Events: None

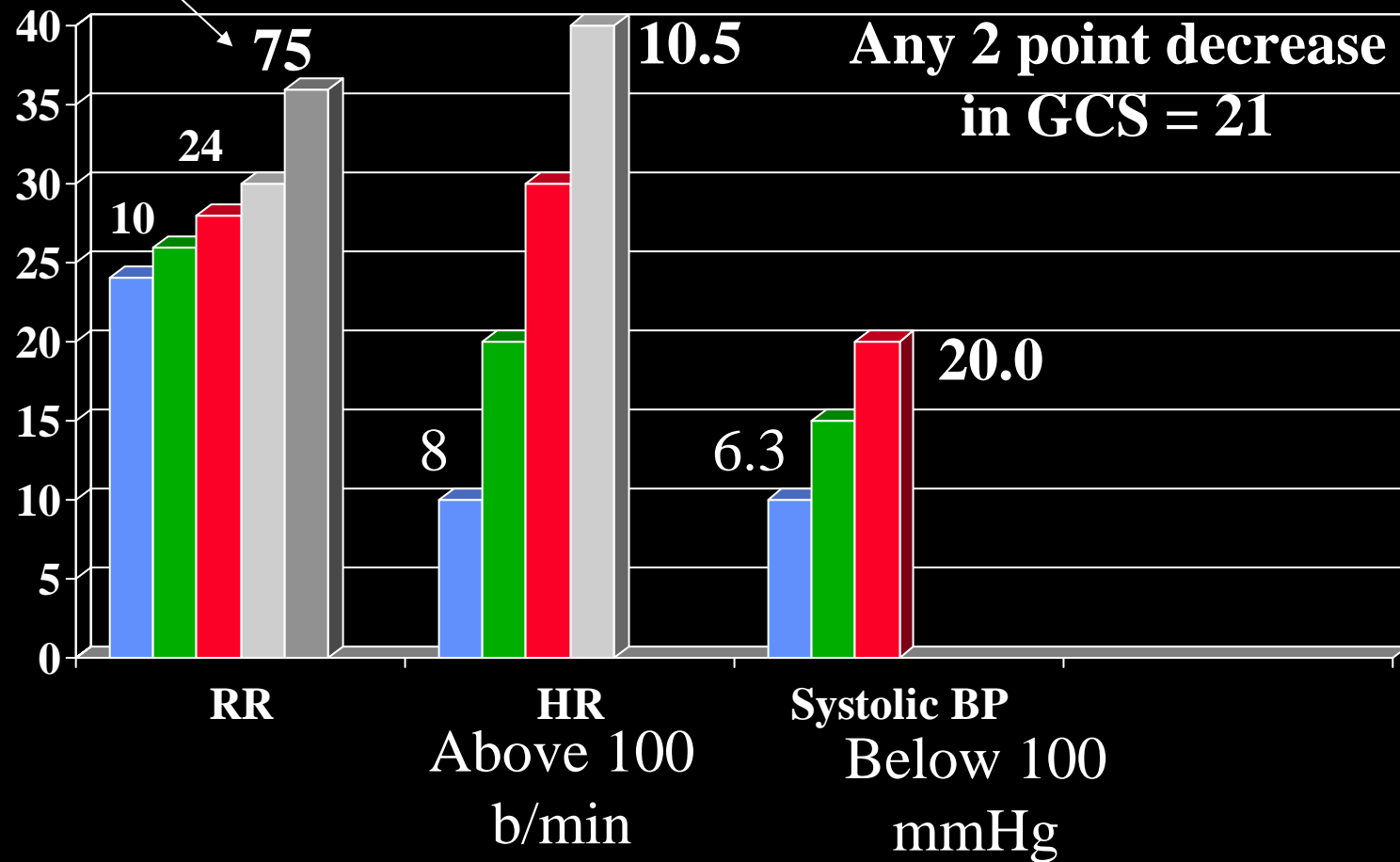
Missing data in last 24

hr: RR 123; HR: 1;

BP: 6

Vital signs and **odds ratio** of CA/death/ICU admission

RR is king



Monitoring vital signs is important !

Continuous non-invasive monitoring for all would be wonderful

However, even good ol' intermittent monitoring (1853 Nightingale style) is not bad **(If people only used it!)**

Using something as simple as vital signs, we can identify the majority of at risk patients

Monitoring in Sweden

Resuscitation (2006) xxx, xxx–xxx



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RESUSCITATION



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Prevalence and sensitivity of MET-criteria in a Scandinavian University Hospital[☆]

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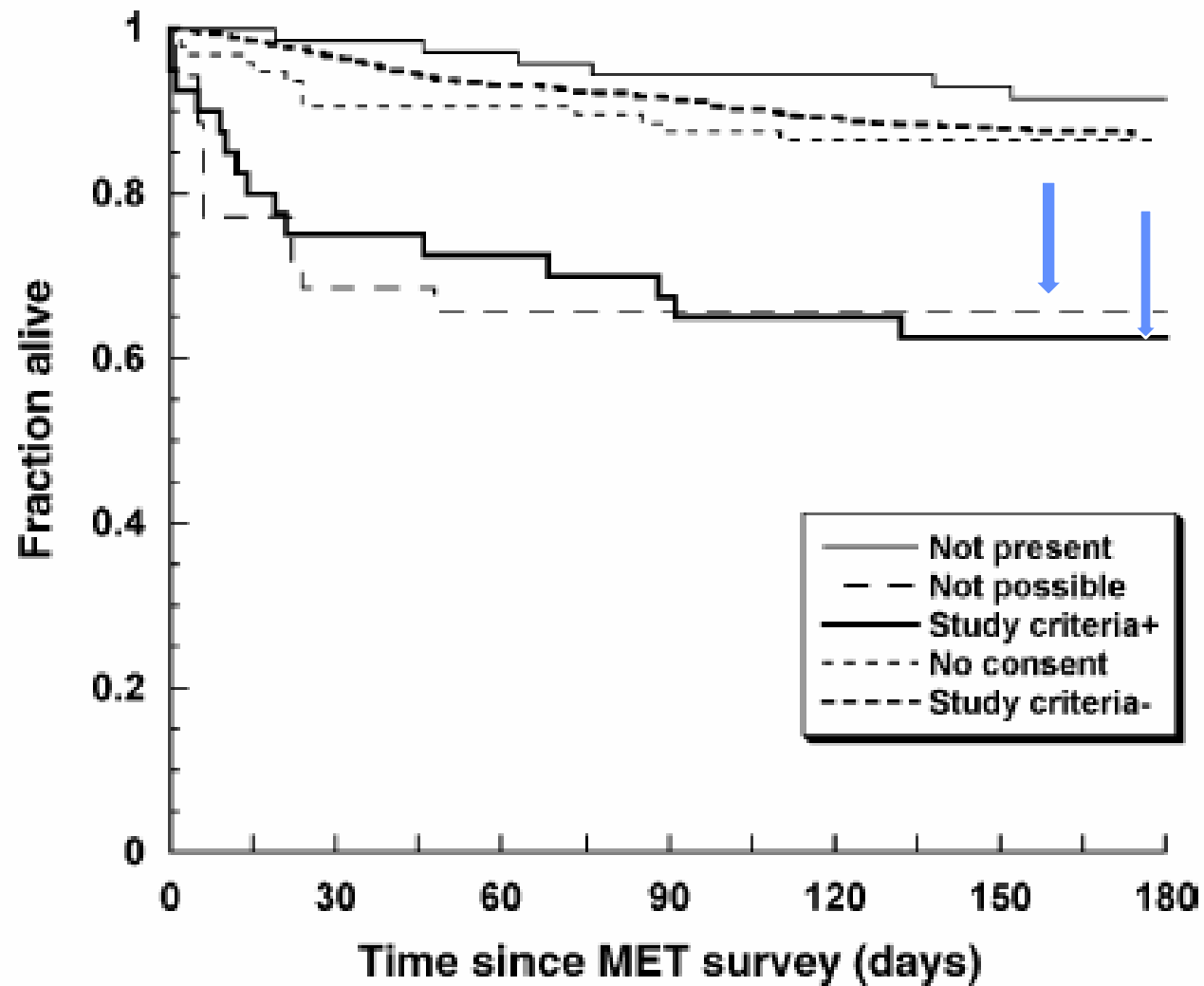


Figure 2 Kaplan–Meier curve stratified by patient category.

How do we fail?

We do not reliably monitor patients by intermittent measurements (**lack of monitoring**)

When we do, there is frequently no call for suitably trained and equipped help (**lack of advice**)

When there is a call for such help, it is often dangerously late (**lack of response**)

Consequently...people die

The hospital guarantee

Question: could a hospital put a giant billboard at its entrance that says this?
“We guarantee that, for a week, if you have major surgery 1. we will monitor your vital signs at least once every 8 hours and document them, 2. a nurse will see you every 8 hours and document that and 3. a doctor will see you at least once a day and document that”

ABSTRACT

Objective: To describe the quality of postoperative documentation of vital signs and of medical and nursing review and to identify the patient and hospital factors associated with incomplete documentation.

Design, setting and participants: Retrospective audit of medical records of 211 adult patients following major surgery in five Australian hospitals, August 2003 – July 2005.

Main outcome measures: Proportion of patients with complete documentation of medical review (each day) and nursing review and vital signs (heart rate, blood pressure, respiratory rate, temperature and oxygen saturation) (each nursing shift), and the proportion of available opportunities for medical and nursing review where documentation was incomplete. Univariate and multivariate odds ratios for the association between incomplete documentation and hospital and patient factors.

Results: During the first 3 postoperative ward days, 17% of medical records had complete documentation of vital signs and medical and nursing review. During the first 7 postoperative ward days, nursing review was undocumented for 5.6% of available shifts and medical review for 14.9% of available days. Respiratory rate was the most commonly undocumented observation (15.4% undocumented). Certain hospitals were significantly associated with incomplete documentation. Vital signs were more commonly undocumented in patients without epidural or patient-controlled (PC) analgesia, during evening nursing shifts, and during successive postoperative ward days. Nursing review was more commonly undocumented in the evening and for patients without epidural or PC analgesia. Medical review was more commonly undocumented on weekends.

Conclusion: Hospital and patient factors are associated with incomplete documentation of clinical review and vital signs after major surgery.

The hospital guarantee

Let's find out what happens

Four teaching hospitals (Sydney & Melbourne) + One major metropolitan hospital

14 major operations (cardiac, GI, thoracic, vascular Sx)

Three patients for each operation for one week in each hospitals

Findings of hospital guarantee study

RR missing in 15.4%

HR missing in 4.2%

BP missing in 5.5%

Sat missing in 6.7%

Nurse notes missing in 5.5%

Only 15% of patients got the “full package”
each day for the first 3 days

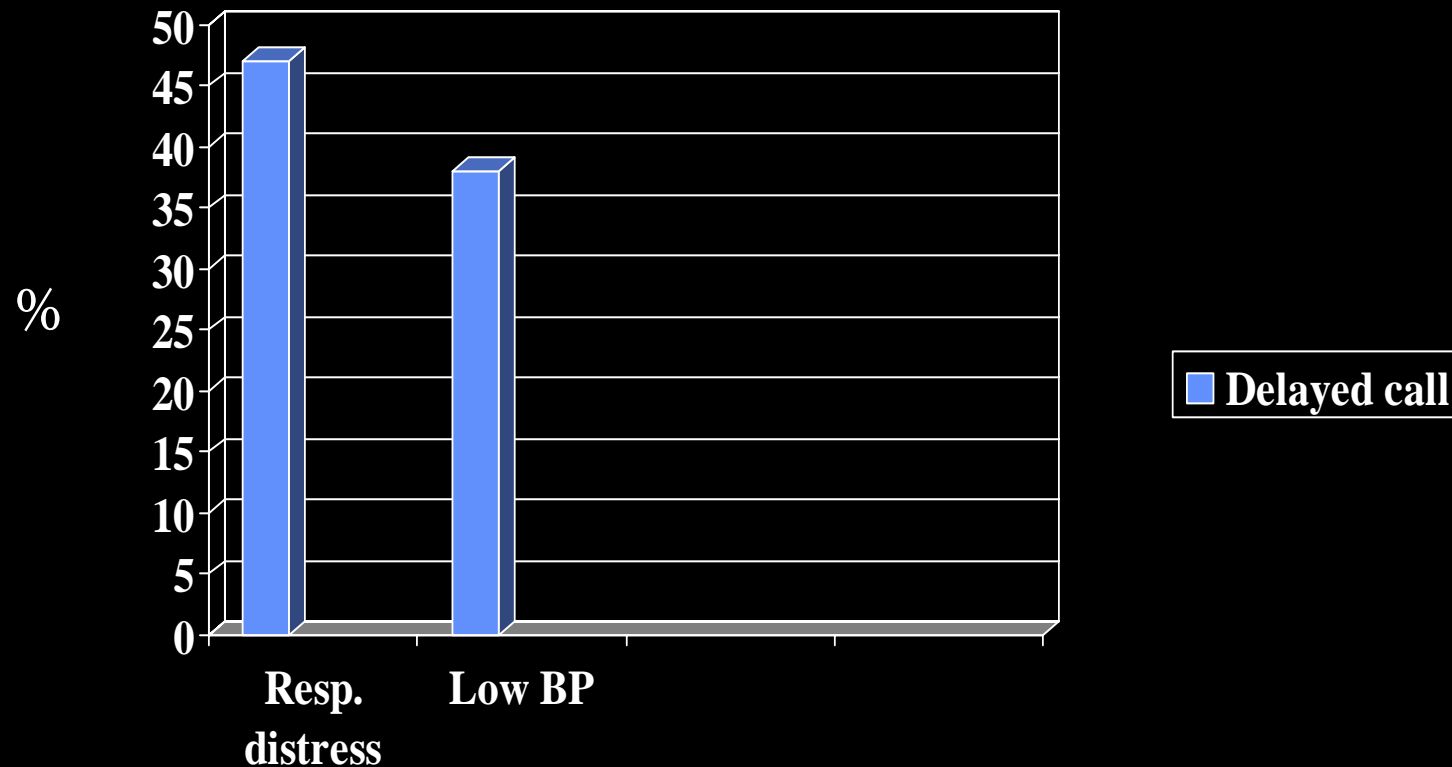


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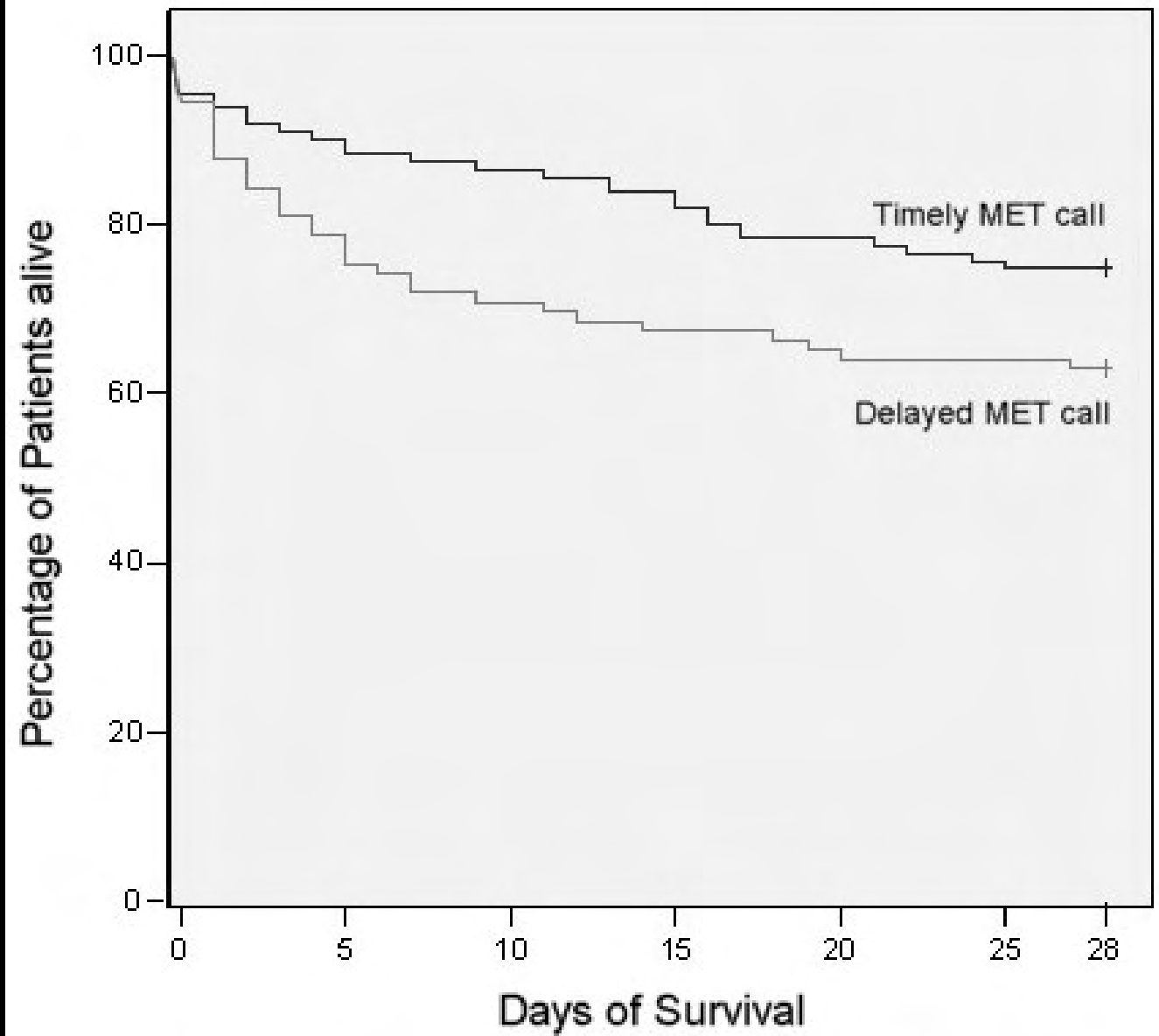
Characteristics and outcomes of patients receiving a medical emergency team review for respiratory distress or hypotension[☆]

Jon L. Quach BSci (Hons), Andrew W. Downey BSci (Hons), Michael Haase MD, Anja Haase-Fielitz BPharm, Daryl Jones MD, Rinaldo Bellomo MD, FRACP, FJFICM*

Review of 200 MET calls at Austin



Delay = >30 min after documentation of MET criteria



Respiratory distress and low BP

Characteristics and outcomes of patients receiving a medical emergency team review for acute change in conscious state or arrhythmias*

Andrew W. Downey, BSci (Hons); Jon L. Quach, BSci (Hons); Michael Haase, MD; Anja Haase-Fielitz, BPharm; Daryl Jones, MD; Rinaldo Bellomo, MD, FRACP, FJFICM

Objective: To describe the characteristics and outcomes of patients receiving a medical emergency team (MET) review for the MET syndromes of acute change in conscious state or arrhythmia and to assess the effect of delayed MET activation on their outcomes.

Design: Retrospective analysis of medical records.

Setting: University teaching hospital.

Patients: Two cohorts of 100 patients for each of the MET syndromes of acute change in conscious state or arrhythmia.

Interventions: None.

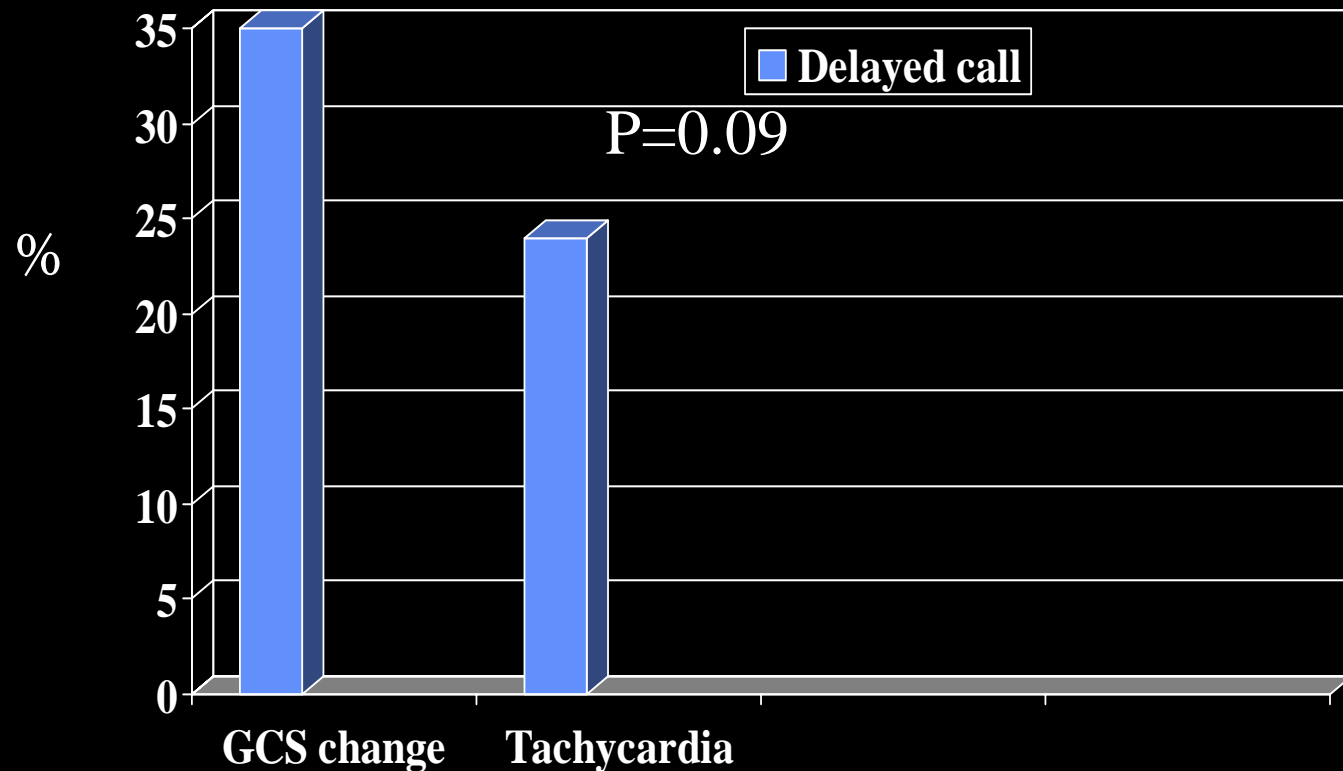
Measurements and Main Results: We collected information on patient demographics, comorbidities, and presence of sepsis, hypovolemia, cardiogenic shock, and patient outcome. We also documented the presence and duration of delayed MET activation. The median age for both syndromes was >70 yrs, and major comorbidities were present in >10% of patients. A history of ischemic heart disease ($p < .001$) and congestive cardiac failure ($p = .007$) was more common in patients with arrhythmias.

Cardiogenic shock and sepsis were common underlying causes of the MET calls for the two groups. However, cardiogenic shock was more common in patients with arrhythmias ($p < .001$). Hospital mortality was 35% for patients with an acute change in conscious state, compared with 18% for patients with arrhythmias ($p = .01$). Delayed MET activation occurred in 35% of acute change in conscious state patients and in 24% of arrhythmia patients ($p = .09$) with a median duration of delay of 16 and 13 hrs, respectively. Delayed MET activation was associated with increased mortality (odds ratio 3.1, 95% confidence interval 1.4–6.6, $p = .005$).

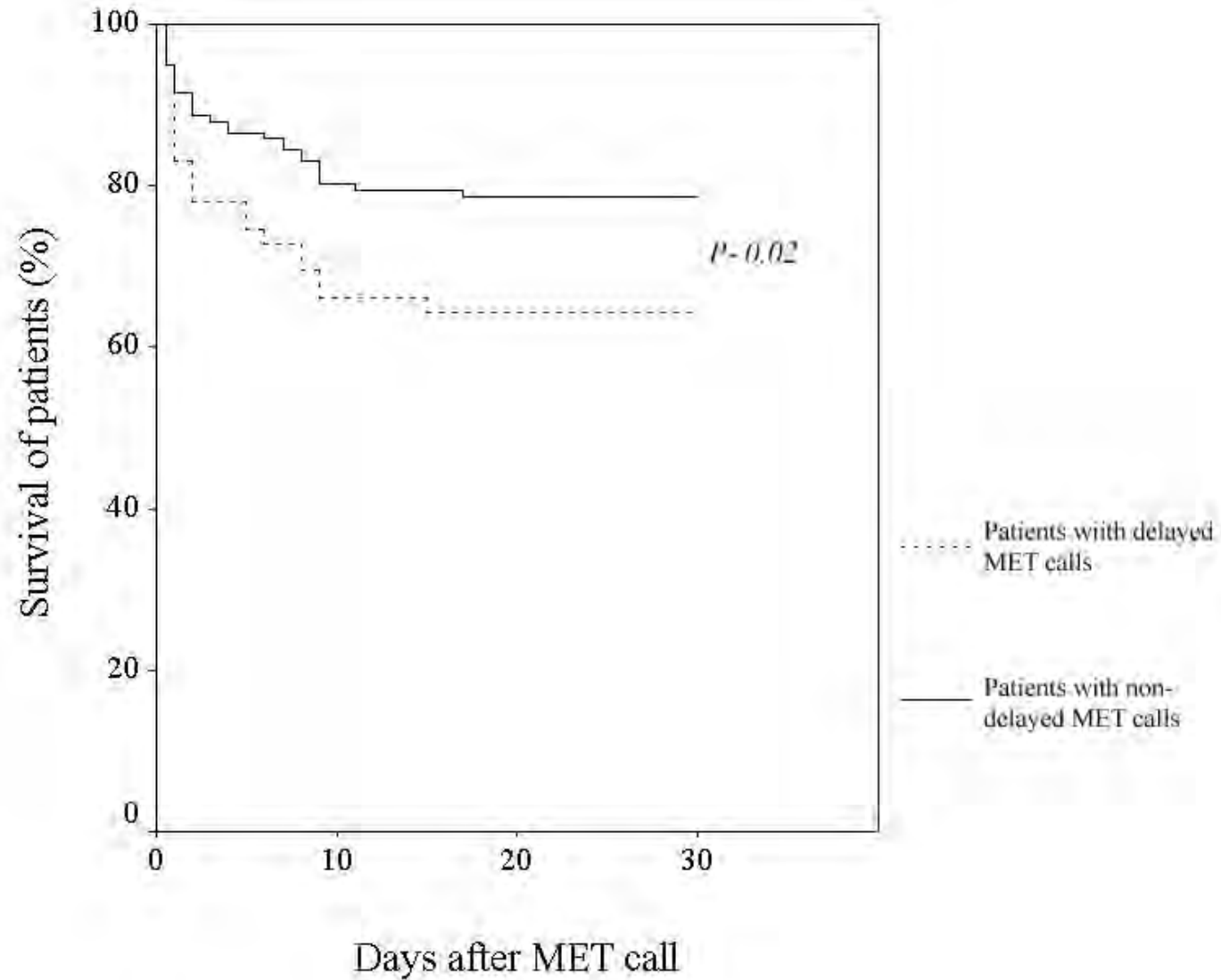
Conclusions: An acute change in conscious state leading to a MET call carried a greater risk of death than activation due to arrhythmias. Delayed activation was common for both syndromes and was independently associated with an increased risk of death. (Crit Care Med 2008; 36:●●●–●●●)

KEY WORDS: medical emergency team; conscious state; arrhythmia; delay; outcome; critical illness

Review of 200 MET calls at Austin

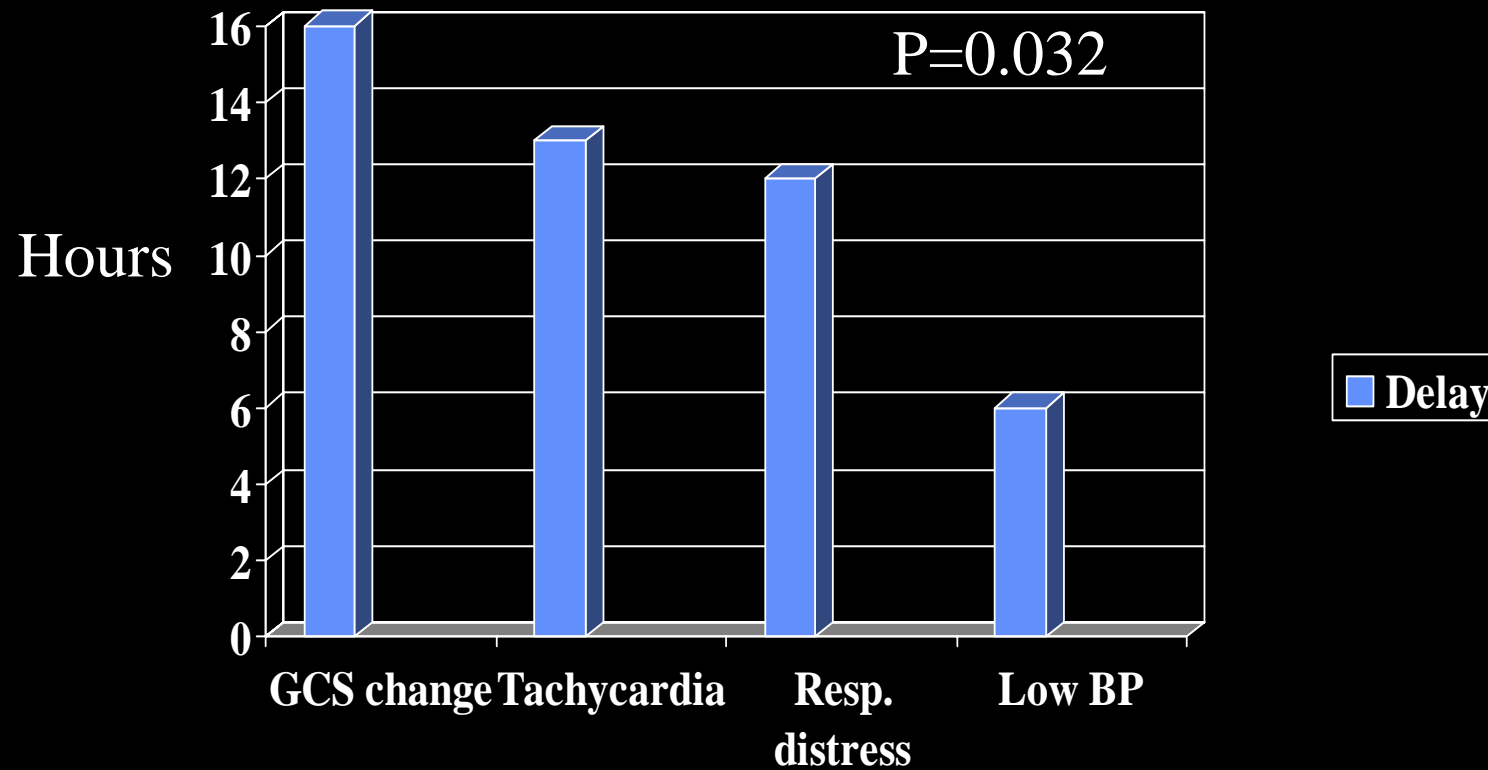


Delay = >30 min after documentation of MET criteria



Low GCS and Tachycardia

Duration of delay



Conclusions

Monitoring (even intermittent) is important

Like everything else in hospitals (hand washing, ACLS, Trauma care) it is **highly imperfect**

We fail by not doing it, not understanding it, not calling for help or calling for help too late

Conclusions

- There is an enormous need to educate doctors and nurses to the need for and importance of monitoring
- We need to educate them to the consequences of not calling for help or delays
- We need to develop “smart” monitoring technology
- If we can't identify sick patients how can we help them?