

# Intensive care unit occupancy after introduction of the emergency department 4-hour discharge rule at a tertiary referral hospital in Western Australia

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A recent study reported on some benefits of the introduction of the 4-hour rule in metropolitan hospitals in Western Australia.<sup>1</sup> This rule means that patients in the emergency department (ED) must be admitted to hospital or discharged from the ED within 4 hours of presentation. Geelhoed and de Klerk showed less ED crowding and a reduction in overall hospital mortality after introduction of the 4-hour rule.<sup>1</sup> The 4-hour rule was implemented by the WA government in April 2009 to reduce ED overcrowding.<sup>1,2</sup>

Implementation of this policy means that eventually 98% of patients in the ED would be discharged home or admitted to a ward within 4 hours of presentation to the ED. So far, the implementation of the 4-hour rule has been very successful by these measures in WA metropolitan hospitals. Compliance has improved, ED overcrowding has been reduced and overall hospital mortality has reportedly been reduced.<sup>1</sup>

In a hospital system which runs at high capacity (over 85% occupancy), the changing of a policy in one area may affect other acute care areas. In particular, prioritising movement of patients from the ED into ward beds (for patients admitted to hospital) might limit or impede the discharge of patients from the intensive care unit to the wards. Also, early transfer of patients from the ED to general wards may result in placement of acutely unwell patients to less well staffed areas and put them at risk. This could increase the need for medical emergency team (MET) interventions,<sup>3-8</sup> even when new observation charts have been implemented or early warning systems are in place in the ED, or ICU liaison services are provided.<sup>9-11</sup>

To assess whether the introduction of the 4-hour rule was associated with changes in exit block from the ICU, overall hospital mortality and the number of MET calls, we conducted a retrospective observational study using hospital-wide databases.

## Methods

Data were collected from existing hospital databases in a tertiary referral hospital in Perth, WA. Ethics committee approval was waived due to the use of de-identified patient data only. The study was registered as an institutional quality improvement initiative. The study hospital is a metropolitan hospital of about 600 beds and provides all services except paediatrics, obstetrics and burns.

## ABSTRACT

**Background:** The 4-hour rule has been introduced in Western Australia, requiring that emergency department (ED) patients be admitted to hospital or discharged from the ED within 4 hours of presentation. We hypothesised that this rule might have been associated with changes in medical emergency team (MET) calls and intensive care unit exit bed block.

**Methods:** Hospital databases were examined to determine compliance with the 4-hour rule, the effect on ICU exit bed block, and the number of MET calls, in 2008 (before introduction of the 4-hour rule) and 2011 (after introduction of the 4-hour rule). We also measured background ICU and hospital activity in 2008 and 2011.

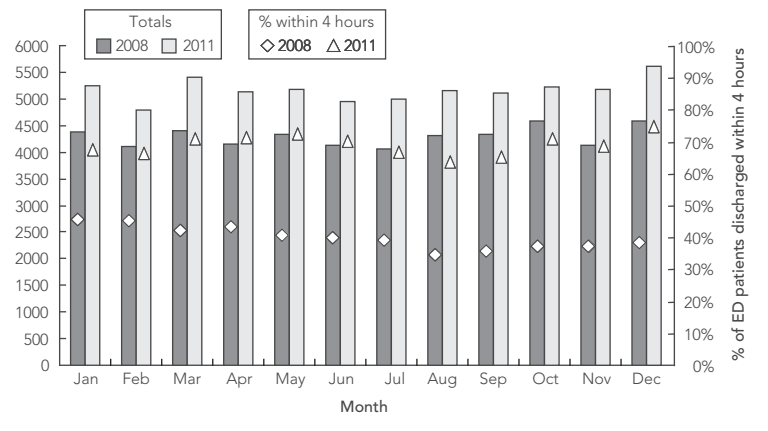
**Results:** Monthly compliance with the 4-hour rule ranged from 35%–46% in 2008 to 64%–75% in 2011 ( $P < 0.0001$ ). There was a marked increase in bed block-days for patients in the ICU between 2008 (before introduction of the 4-hour rule) and 2011 (after introduction of the 4-hour rule) ( $P = 0.05$ ). The increase in ICU bed block-days could not be explained by a difference in ICU occupancy, as there was a reduction in ICU bed-days between 2008 and 2011 ( $P = 0.014$ ). There was a reduction in hospital mortality rate between 2008 and 2011 ( $P < 0.001$ ). There was no significant increase in the number of MET calls from 2008 to 2011 ( $P = 0.221$ ). Hospital activity (separations) increased from 2008 to 2011 ( $P < 0.0001$ ).

**Discussion:** The introduction of the 4-hour rule was associated with increased exit block from the ICU, but not with increased MET calls to attend to unstable or deteriorating ward patients. Introduction of the 4-hour rule was associated with a small reduction in hospital mortality.

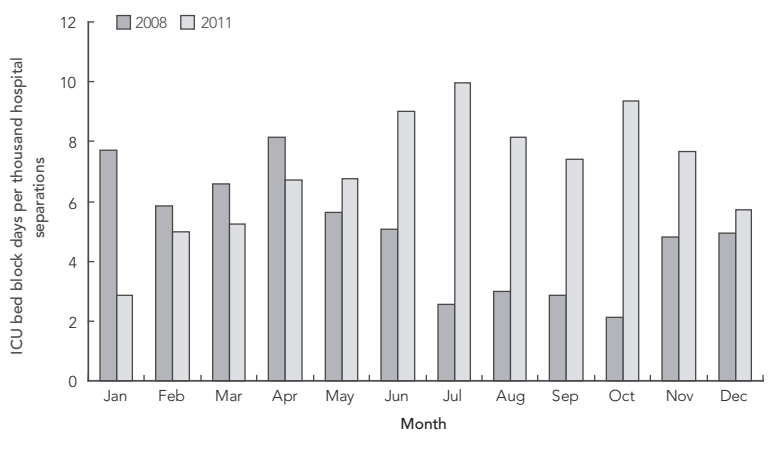
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Exit block from the ICU was defined as bed-days of patients in the ICU who were deemed ready (by the attending intensivist) for discharge from the ICU, but for whom there was no ward bed available. This was decided and documented at each morning ICU handover round. Data were collected prospectively each day by the consult-

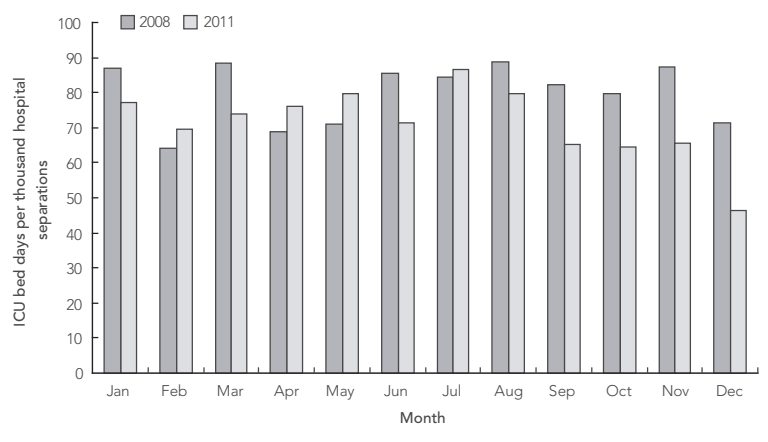
**Figure 1. Total patients admitted to a ward or discharged from the emergency department (ED), and percentages admitted to a ward or discharged from the ED within 4 hours, 2008 and 2011**



**Figure 2. Intensive care unit bed block-days, 2008 and 2011**



**Figure 3. Intensive care unit bed-days, 2008 and 2011**



ant on duty, verified by the ICU data manager and entered into the unit database. The ICU has 23 beds and handles about 1400 admissions per year.

Overall hospital mortality rate was defined as the number of deaths per year in 2008 (before implementation of the 4-hour rule) and 2011 (after implementation of the 4-hour rule), divided by total inpatient separations during the same period. The number of MET calls was monitored monthly during the same two study periods (calls per month in 2008 and 2011) as a surrogate marker for urgent attendances to ward patients before and after introduction of the 4-hour rule.

The data collected were data routinely recorded in standard electronic hospital databases. Comparisons were made using *t* tests and  $\chi^2$  tests as appropriate.

The 2 years chosen for comparison were 2008, the year immediately before the introduction of the 4-hour rule, and 2011, the most recent year for which hospital data were complete.

**Results**

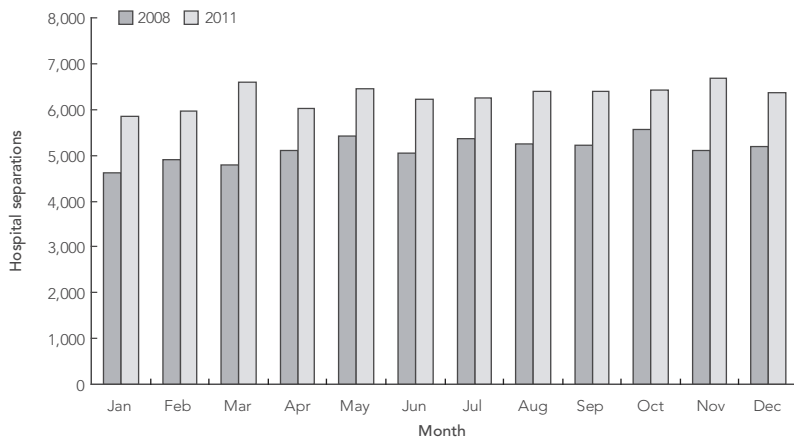
Figure 1 shows compliance with the 4-hour rule, ie, the percentage of ED patients admitted or discharged from the ED within 4 hours. The improved compliance is evident from the ranges of compliance in 2008 (35%–46%) and 2011 (64%–75%) ( $P < 0.0001$ ).

Figure 2 shows the ICU bed block-days per 1000 hospital separations per month, in which there was a statistically significant increase between 2008 (mean, 4.94 bed block-days/month) and 2011 (mean, 6.98 bed block-days/month) ( $P < 0.05$ ).

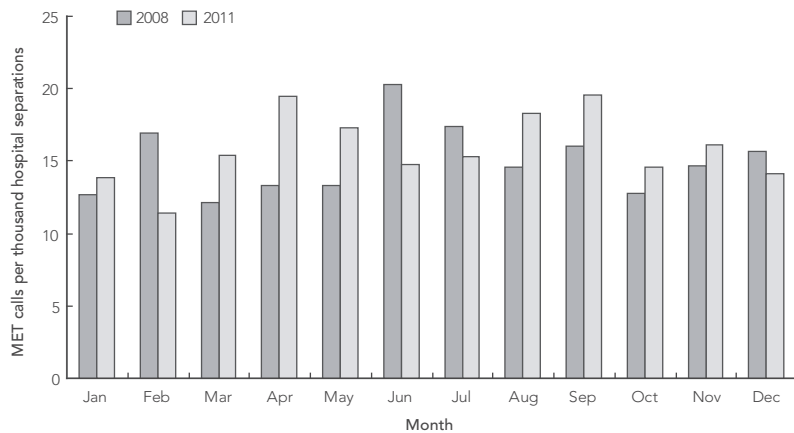
There was a small decrease in ICU occupancy between 2008 (mean, 79.86 ICU bed-days/month) and 2011 (mean, 77.26 ICU bed-days/month), as measured by bed-days per 1000 hospital separations (Figure 3) ( $P = 0.01$ ). There was an increase between 2008 and 2011 in overall hospital activity (number of separations) (Figure 4),  $P < 0.0001$ .

Overall hospital mortality is shown in Figure 5; there was a decrease between 2008 (1.37%) and 2011 (1.19%),  $P < 0.001$ . Figure 6 shows annual MET calls from 1999 to 2011; there was no significant increase in calls from 2008 to 2011 ( $P = 0.221$ ), Figure 7.

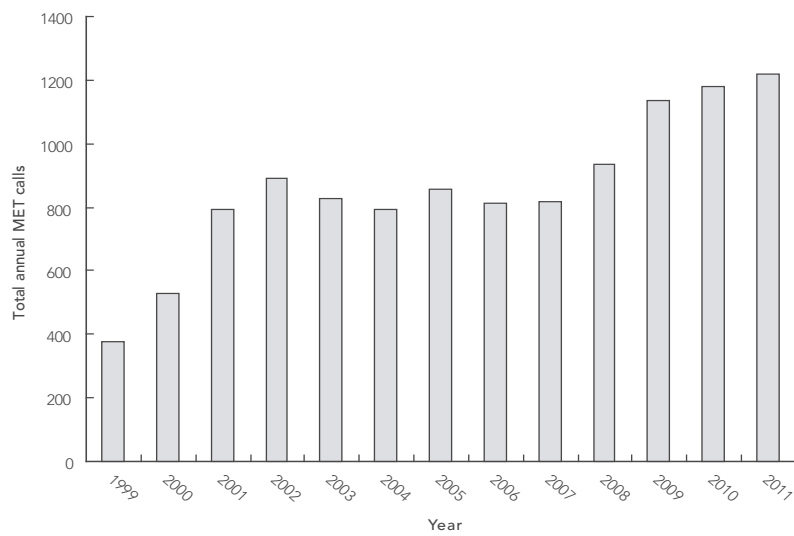
**Figure 4. Hospital activity (separations), 2008 and 2011**



**Figure 5. Hospital mortality, 2008 and 2011**



**Figure 6. Medical emergency team (MET) calls, 1999–2011**



**Discussion**

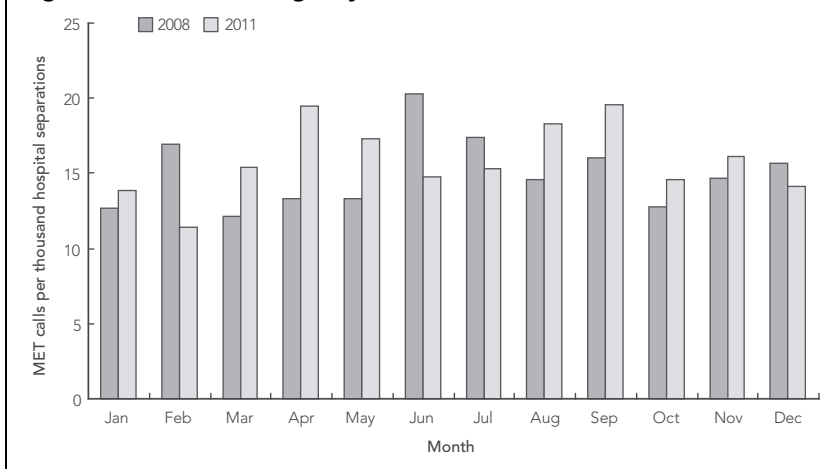
Our data show that introduction of the 4-hour rule, previously shown to reduce ED occupancy and overall hospital mortality,<sup>1,2</sup> was associated with increased exit block from the ICU. This is not unexpected, as the hospital we studied has a finite capacity and runs at high occupancy rates. Therefore, preferentially discharging patients from the ED to regular wards must necessarily result in strain in the system elsewhere. This is reflected in the reduced ability to discharge patients from the ICU to the general wards. The cost of caring for these dischargeable patients in the ICU should be a consideration when assessing the benefits to the institution that can be attributed to the 4-hour rule.

The increase in ICU exit block was not reflected by an increase in total ICU bed-days. There was a decrease in ICU activity (defined by ICU bed-days per thousand hospital separations) between the two years studied. The number of ICU refusals during the two time periods studied was not available.

It seems logical that ED patients admitted sooner to wards, and therefore separated from the greater staffing, monitoring and diagnostic capacity of the ED, may be at higher risk. However, admitting patients to the general wards more rapidly did not have an effect on the number of observed MET calls to attend unstable or deteriorating patients, nor did it increase hospital mortality.

Expedient assessment, treatment and disposition of patients in the ED are all desirable goals. However, in a system running at high capacity, improving efficiency in one area may have the unintended consequence of affecting another. In the case of the 4-hour rule, we have shown that an increased exit block from the ICU is a possible unintended and undesirable outcome, associated with increased ICU length of stay and its potential attendant extra costs and morbidity (eg, nosocomial infections and deep vein thrombosis). Generally, ICUs are not set up for care of patients undergoing rehabilitation; there are limited bathroom facilities for ambulant patients and the units are noisy, disrupting rest and sleep.

Health care systems are complex, and system changes in one area should be carefully considered, as there may be unintended consequences in another area. Our data indicate

**Figure 7. Medical emergency team (MET) calls, 2008 and 2011****Author details**Peter V van Heerden, Intensivist<sup>1,2,3</sup>John A Blott, Intensivist<sup>2</sup>Mary Pinder, Intensivist<sup>2</sup>Peter D Cameron, Intensivist<sup>2</sup>Brigit L Roberts, Research Nurse<sup>2</sup>Anne Brinkworth, Clinical Nurse Specialist<sup>2</sup>Ilana Stav, Data Manager<sup>1</sup>Sigal Sviri, Intensivist<sup>1</sup>

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that the 4-hour rule may have resulted in increased ICU exit block, but not in increased MET call activity or hospital mortality. It should be noted that there was also an increase in overall hospital activity during the same period, but all comparisons between 2008 and 2011 were corrected for hospital activity.

Of interest is the fact that as the 4-hour rule was being implemented in WA, there were already changes being made in the system in the United Kingdom, such as reducing the target (the percentage compliance with the 4-hour rule) and adding quality indicators.<sup>12,13</sup> There have even been calls for the abolition of the policy in the UK, on the grounds that the policy may improve patient flow through the ED, but not necessarily improve the quality of patient care.<sup>14</sup> Anstey and colleagues<sup>13</sup> state that the principal cause of ED overcrowding is the lack of available inpatient beds; this is our contention too. Pushing patients through the ED into an already crowded inpatient environment must have consequences. We have tried to assess some of these consequences (the effects on MET calls, hospital mortality and ICU exit block). While not conclusive, our results do show an associated effect on ICU exit block, with no measurable change in hospital mortality.

Study limitations include that our data were derived from existing databases, not collected in a dedicated way to test a hypothesis.

We conclude that carefully directed prospective data should be captured and analysed to measure the effect of a fundamental change such as the 4-hour rule. It may improve patient flow greatly in the ED, a worthy goal, but may also affect other acute care areas. A visible, politically advantageous improvement in one area of the health care system may be a hidden burden elsewhere.

**Competing interests**

None declared.