



# Effect of ambulance diversion on patient mortality: how access block can save your life

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Emergency department (ED) overcrowding is the most serious issue confronting EDs in the Western world.<sup>1</sup> As a result, diversion of ambulances to another hospital has become commonplace. This is primarily due to access block — patients in the ED requiring inpatient care are unable to gain access to appropriate hospital beds within a reasonable time frame.<sup>2</sup> A reasonable time frame is defined as up to 8 hours spent in the ED by an admitted patient.<sup>2</sup>

Adverse events associated with ED overcrowding and ambulance diversion have been reported. These include impaired access to emergency care, compromised clinical care, prolonged pain and suffering, and prolonged inpatient length of stay. These adverse events have also been linked to fatalities.<sup>3,4</sup>

To date, no studies have examined the mortality rate associated with ambulance diversion. I hypothesised that, during periods

### Episodes of ambulance diversion and patient mortality rates

Period	Number of patients	Number of deaths	P	Incidence rate ratio (95% CI)
Pre-diversion period (1 h)	8679	137 (1.58%)		
Comparative period (1 h)	7175	100 (1.39%)	0.34	1.13 (0.88–1.46)
Diversion period	5445	73 (1.34%)		
Comparative period (not on diversion)	8245	154 (1.87%)	0.018	0.72 (0.61–0.95)

of ambulance diversion, patients in the ED would have a higher eventual mortality rate, because ED staff, stretched beyond their capacity, may not be able to provide safe care.

### METHODS

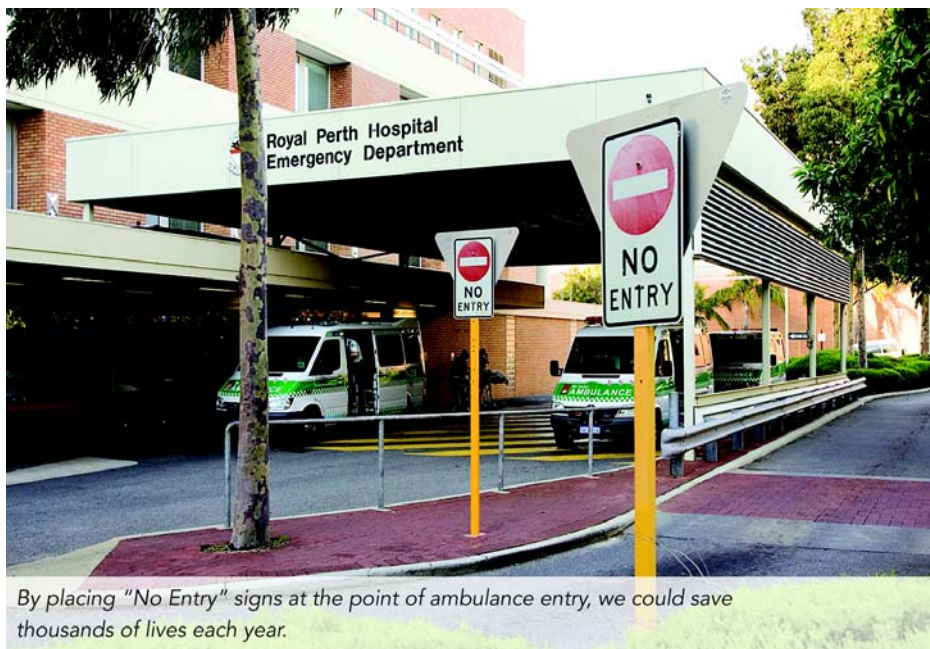
All periods of ambulance diversion at Royal Perth Hospital ED for the calendar year 2003 were studied. That year's ED attendances numbered 51 885, with an admission rate of 43%. Of all attendances, 38.3%

arrived by ambulance. The rate of access block during the study period was 30.7%.

Each episode of ambulance diversion was recorded as day, date, start time, and end time. From this, the 1-hour period before ambulance diversion (pre-diversion) was determined. (This was considered to represent the period of greatest risk for patients). For comparative purposes, an identical time series was constructed for when the ED was not on ambulance diversion. For example, if the ED was on ambulance diversion on a Wednesday from 11:00–14:00, then the pre-diversion period was 10:00–11:00 and the comparative period becomes the Wednesday 1 week later, assuming that the ED was not on diversion during that period. If it was, then the preceding Wednesday was chosen as the comparative period. If that period was on diversion, then the Wednesday 2 weeks later was used, and so on. This was to allow for valid day-to-day comparisons, and to avoid seasonal variations.

The record of each patient episode refers to the period (pre-diversion, diversion or the respective comparison periods) during which the patient arrived at the ED. To avoid duplication of patient episodes, once patients attended the ED, they remained in that defined episode. For example, if a patient arrived at the ED in the pre-diversion period and subsequently died, that death was attributed to the pre-diversion period (even though this patient may have still been in the ED during the diversion period).

These data were linked with EDIS (Emergency Department Information System) and TOPAS (The Open Patient Administration System) for each patient attendance. TOPAS is an administrative computer system that,



By placing "No Entry" signs at the point of ambulance entry, we could save thousands of lives each year.

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among other things, records patient outcomes, such as discharge or death.

The outcome measure used was death. (Deaths were those deaths that occurred at any stage while the patient was in hospital, from the ED to the wards.)

In this retrospective data-linkage study, data were analysed using SAS version 9.1 (SAS Institute, Cary, NC, USA). A negative binomial model was used because it is equivalent to the Poisson model. However, the Poisson model assumes that the variance and means are the same, whereas the negative binomial model does not make that assumption. Fit was assessed using deviance and  $\chi^2$  tests.

### RESULTS

There were 297 episodes of ambulance diversion in 2003. Paradoxically, the results show a statistically significant 28% reduction in patient mortality for patients attending the ED during periods of ambulance diversion (Box).

### DISCUSSION

Patient safety, as measured by eventual mortality, appears to be positively enhanced by

ambulance diversion. That clinical staff are able to meet the clinical and safety needs of their patients during ambulance diversion has profound implications.

From my data, it is possible to calculate the number of lives saved by ambulance diversion. The difference in mortality (1.87% minus 1.34%) is 0.53%, which is equivalent to 29 of the 5445 patients; extrapolating this to an annual figure (0.53% of the 43% admissions of 51 885 annual attendances) means about 118 lives saved per year at our hospital alone. Nationally, there are about 4 million ED attendances per year. Assuming a national admission rate of 30%, there is potential for ambulance diversion to save 6360 lives a year in Australia.

It is recommended that, to realise these safety gains, health authorities should steadily increase the prevalence of ambulance diversion. Further research is needed to examine the effect on mortality of increasing access block. As there is an almost linear correlation between access block and ambulance diversion,<sup>3</sup> it is likely that increasing access block to 100% might result in three times as many lives saved.

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### COMPETING INTERESTS

I have prayed to St Jude, the patron saint of lost causes, for more hospital beds.

### REFERENCES

- 1 Fatovich DM. Emergency medicine. *BMJ* 2002; 324: 958-962.
- 2 Australasian College for Emergency Medicine. Standard Terminology, 2001. Available at: <http://www.acem.org.au/open/documents/policy.htm> (accessed Nov 2005).
- 3 Fatovich DM, Nagree Y, Sprivilis P. Access block causes emergency department overcrowding and ambulance diversion in Perth, Western Australia. *Emerg Med J* 2005; 22: 351-354.
- 4 Derlet RW, Richards JR. Overcrowding in the nation's emergency departments: complex causes and disturbing effects. *Ann Emerg Med* 2000; 35: 63-68.

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