Myths versus facts in emergency department overcrowding and hospital access block

Drew B Richardson and David Mountain

> The great enemy of the truth is very often not the lie; deliberate, contrived and dishonest, but the myth — persistent, persuasive and unrealistic. — John F Kennedy, 35th President of the United States

ABSTRACT

- Overcrowding occurs when emergency department (ED) function is impeded, primarily by overwhelming of ED staff resources and physical capacity by excessive numbers of patients needing or receiving care. Access block occurs when there is excessive delay in access to appropriate inpatient beds (> 8 hours total time in the ED).
- Access block for admitted patients is the principal cause of overcrowding, and is mainly the result of a systemic lack of capacity throughout health systems, and not of inappropriate presentations by patients who should have attended a general practitioner. Overcrowding is most strongly associated with excessive numbers of admitted patients being kept in the ED.
- Excessive numbers of admitted patients in the ED are associated with diminished quality of care and poor patient outcomes. These include (but are not limited to) adverse events, errors, delayed time-critical care, increased morbidity and excess deaths (estimated as at least 1500 per annum in Australia).
- There is no evidence that telephone advice lines or collocated after-hours GP services assist in reducing ED workloads.
- Changes to ED structure and function do not address the underlying causes or major adverse effects of overcrowding. They are also rapidly overwhelmed by increasing access block.
- The causes of overcrowding, and hence the solutions, lie outside the ED. Solutions will mainly be found in managing hospital bedstock and systemic capacity (including the use of step-down and community resources) so that appropriate inpatient beds remain available for acutely sick patients.

MJA 2009; 190: 369–374

Overcrowding has been described as the most serious problem and most avoidable cause of harm facing our hospital systems.[1] Yet, given the severity of the problem, myths are still rife about causes, effects and possible solutions for emergency department (ED) overcrowding. Finding real solutions and formulating policy cannot progress without a true understanding of the underlying issues, and this is actively hindered when myths are propagated or left unanswered by research and the facts.

Wherever human beings gather, there are fluctuations in their numbers and, if uncontrolled, these occasionally exceed the efficient maximum for a given purpose. EDs are designed largely for a continuous flow of patients, with some diagnosis and treatment provided, rather than for gathering or storage. However, even in systems designed purely for flow (such as roads) there are peaks and troughs of activity, and occupancy sometimes exceeds the number able to move safely and smoothly, leading to traffic jams.

Overcrowding to the point of dysfunction has gradually become the norm in Australasian EDs since the mid 1990s. The greatest contributing factor has been access block. This is the inability of patients who need to be admitted to the hospital to be allocated appropriate beds in a timely fashion. Additionally, there has been an increase in patient numbers, the complexity of their conditions, and the need for their admission. Demand growth has resulted from an enlarging, ageing population, expansion of diagnostic and therapeutic choices and improved survival with severe diseases. This has not been properly matched by growth in other services, especially outside working hours, further increasing the burden on EDs.

Theoretical basis of overcrowding

Queuing theory indicates that the length of a queue, and hence the waiting time to treatment, is determined by the arrival rate, the treatment and discharge (either home or admitted) rate, and the baulk rate (did-not-wait-to-be-seen rate, which is usually dependent on the length of the queue). An individual patient's access to emergency care is dependent, first, on urgency (assuming triage to the correct queue), second, on the number of similar patients already waiting ahead, and third, on the rate and strategy of treatment. Treatment rate is dependent on staffing and on the number of patients already being treated (occupancy), which determines physical availability of resources (space and equipment) and the competing demands on staff. On a daily basis, patient flow is significantly dependent on occupancy, because even a small decrease in treatment rate is cumulative — it causes further increases in the number waiting ahead of new arrivals.

EDs can be considered as overcrowded when treatment becomes dysfunctional; that is, when the treatment rate is reduced or the quality of treatment suffers, even with optimal staffing and space. This has been termed the "cardiac analogy" model,[2] where ED functional efficiency is regarded as a Starling curve (Starling's law of the heart states that the greater the end-diastolic volume [input], the greater the stroke volume [output] up to a limit corresponding to maximum muscle stretch). In this analogy, ED functional efficiency increases to a peak, but then starts to decrease with overwhelming workload (corresponding to congestion, as in cardiac failure).

Definition of overcrowding

The Australasian College for Emergency Medicine (ACEM) defines ED overcrowding as the situation where ED function is impeded primarily because the number of patients waiting to be seen, undergoing assessment and treatment, or waiting to leave exceeds the physical and/or staffing capacity of the ED.[3] Access block is quantified as the proportion of patients admitted, transferred to

other hospitals, or who die in the ED who have a total ED time (arrival at triage to discharge from the ED) of more than 8 hours.[3]

The American College of Emergency Physicians defines crowding as the situation when the identified need for emergency services exceeds available resources for patient care in the ED, hospital, or both[4] — a definition deliberately closer in spirit to that of "disaster medicine". Most research on the subject, however, is concerned with the balance between daily fluctuations and ED occupancy, rather than the response to mass-casualty surges. However, some see overcrowding as a recurrent, common and foreseeable internal disaster. Many EDs have declared internal disasters purely because of severe overcrowding, unrelated to an external disaster.

"Crowding" might be the more descriptive term, but "overcrowding" is in common use, and researchers have used multiple definitions in attempts to quantify the phenomenon. All major recognised definitions incorporate occupancy with patients under treatment, either as an absolute figure or as a proportion of a resource, such as cubicles occupied by treated patients.[5,6] Many also include subjective factors (eg, when a department "feels" overcrowded) and/or outcomes such as ambulance bypass/diversion (where ambulances are diverted away from an overcrowded ED) that are not always applicable and are modifiable by administrative, rather than actual, changes to system function.

Retrospectively identified episodes of overcrowding tend to be reliable and useful for research, but are of only limited significance in day-to-day management of EDs. However, it is clear that certain seasonal patterns (overcrowding is worse in winter than in summer) and weekly patterns (overcrowding tends to be worst on Mondays because of increased admissions for elective procedures, inadequate numbers of patients discharged over the weekend, and more urgent attendances) are fairly predictably associated with worse overcrowding. These can be used to help change hospital practice and capacity planning. Real-time assessments may be correlated with patient service (number of patients waiting correlates well with waiting time for new arrivals), but are only useful if there is a managerial commitment and capacity to intervene. Predictive algorithms based on the number being treated suffer from false positives and, again, are only justified if there are interventions available to prevent deterioration in flow.

There are multiple scales proposed and used to define overcrowding,[5,6] but validation studies are difficult and many rely on ambulance diversion as an outcome measure, which is only suitable for urban centres with multiple EDs. In addition, even in areas where diversion is possible, it is used less frequently over time, as severe overcrowding at all sites makes diversion less useful. The few Australasian studies that exist have not shown these scales to be clinically useful in real time.[7]

Myths and facts

1. Causes of overcrowding

The single most important factor affecting ED overcrowding is the availability of sufficient inpatient beds.[1,8] The number of acute-care public hospital beds in Australia per head of population decreased by 18% between the financial years 1995–96 and 2005–06,[9] after even larger reductions in the preceding two decades. Although these large decreases were initially ameliorated by more efficient hospital function and shorter admissions, it is clear that in most major hospitals, occupancy levels have been driven up routinely to over 90%. These levels are known to be associated with poor hospital and system function, inefficient care and increased episodes of hospital and ED overcrowding.[8] In fact, it is a universal finding that operating at full capacity for prolonged periods is inefficient and unsustainable. ED overcrowding is best seen as a marker of whole-of-hospital dysfunction that requires a whole-of-hospital or whole-of-system response.[10,11] Bed availability depends not only on the physical number of beds, but also on the way the bedstock is managed (appropriate use, good flow practices),[11] competing uses for beds (eg, elective versus acute care), the availability of step-down units, and appropriate community care.

Importantly, there is no evidence for the often-proposed myth of "general-practice-type" or "inappropriate" patients leading to ED overcrowding.[12-14] Discretionary presentations by patients with low-complexity conditions, who might reasonably be managed elsewhere, constitute an insignificant workload in most EDs. These patients are uncommon in major EDs, and the most frequent reason for them to attend an ED is because they were referred by a GP. They rarely require admission or even use of trolleys, they use minimal ED resources (less than 3% of all costs or resources in most EDs), are easy to deal with, and do not impose on the key functions of the ED (assessment of sick patients, complex treatments and resuscitation).[15,16] They may attend an ED because no other options are available and, importantly, they often feel their medical needs are urgent. They may spend a lot of time in waiting rooms, but this does not affect overall ED function. This myth is particularly problematic in that, if allowed to continue to be given credence, it continually diverts attention to solutions that cannot deal with the key issue causing dysfunction in the ED — that is, excessive numbers of admitted patients.

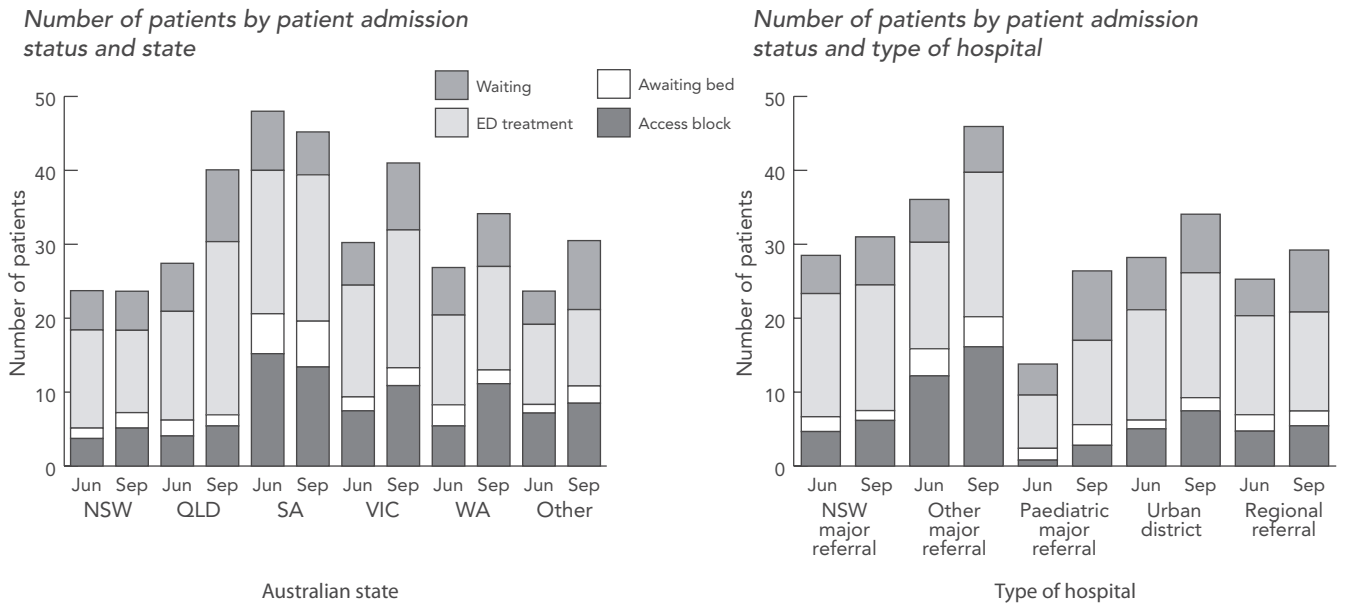
2. Attendances and waiting time to see a doctor

At 10:00 on 2 June and 1 September 2008, two national studies funded by the ACEM examined the point prevalence of overcrowding and access block in accredited Australian EDs. As shown in Box 1, over half the patients under treatment in non-New South Wales tertiary hospitals were waiting for beds, and 75% of those had been in the ED for more than 8 hours. Despite variation between states and hospital types (partly reflecting the size of different EDs), on average, the number of people waiting to be seen was less than the number who were under treatment and experiencing access block. If the patients experiencing access block were moved to appropriate inpatient beds, there would be more than enough staff and physical resources to treat all those waiting to be seen. The 2008 point prevalence study confirms data from previous similar studies and hospital time series[17,18] showing that the problem is ubiquitous, sustained, and getting worse.

3. Emergency department staff time spent assessing patients

Development of new diagnostic approaches and therapies has contributed to increases in the "assessment" time in some groups of patients. Chest pain "rule-out" protocols using delayed marker measurements, and increased use of computed tomography (CT) scans for conditions such as abdominal pain are two examples. These are partly balanced by shorter, protocol-driven care in other conditions; for example, routine CT for minor head injury with immediate discharge if the result is normal, rather than observation. However, both effects are small compared with access block, as highlighted by data showing that during the time ED over-

1 Mean number of patients in 72 Australian emergency departments* at 10:00 on 2 June and 1 September 2008



Waiting = not yet started medical assessment and treatment. ED treatment = undergoing emergency department (ED) medical assessment and treatment. Awaiting bed = decision made to admit and admission process started, less than 8 hours total ED time. Access block = awaiting bed, but more than 8 hours total ED time.
NSW = New South Wales. QLD = Queensland. SA = South Australia. VIC = Victoria. WA = Western Australia. Other = Australian Capital Territory, Northern Territory, Tasmania.
* The 72 hospitals that responded to Australasian College for Emergency Medicine point prevalence surveys for both 2 June and 1 September 2008. ◆

crowding has become persistent and prolonged with dramatic increases in ED stays, assessment times have increased only minimally (Box 2).

4. Telephone advice lines and general practitioner collocation

Telephone advice services are popular with patients and may decrease the demand for after-hours GP consultations in some settings,[19,20] but have not been shown to reduce ED workload in Australasia.[21,22] Establishment of additional GP services, even bulk-billing services near hospitals, does not significantly decrease ED workload either in theory[12] or in practice.[23]

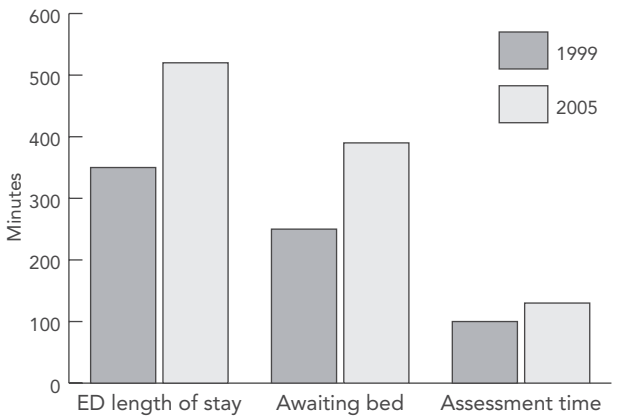
5. Size of emergency departments

Hospitals that provide a local service in areas in which the population is undergoing significant demographic change, such as a large ageing cohort or rapid population growth, may experience ED overcrowding simply because the numbers of patients presenting exceed appropriate ED changes and resources. However, this is rarely the major issue and is rarely reported as the main cause of ED overcrowding. Indeed, studies[24] and local experiences have shown that even with very large increases in ED size (eg, doubling cubicle numbers) or function, there is more access block and overcrowding. The most plausible explanation for this is that the extra capacity in the ED allows more patients to be accommodated there awaiting inpatient beds while bed capacity in the rest of the hospital (which has not been addressed) remains unchanged.

6. Solutions in the emergency department

EDs have an obligation to minimise the effects of overcrowding, but any reduction will be largely achieved through whole-of-hospital changes. Long time series show that, in the absence of hospital-wide changes, access block tends to continue to increase even after mitigation efforts within EDs.[17,18]

2 Changes over 5 years in patients' lengths of stay* in Western Australian tertiary hospital emergency departments (EDs)



* Comprising assessment time and time spent awaiting a bed. ◆

Increases in the number and seniority of ED staff are associated with improvements in process measures and analysis of flow, and system redesign can allow better use of existing resources — for example, through dedicated "fast-track" areas for patients with low-complexity conditions. Such areas improve flow, but make only a small contribution to reducing occupancy by patients under treatment, and hence their effect on overcrowding is also small. Observation medicine within the ED is a useful adjunct or

3 Adverse outcomes associated with overcrowding and access block in peer-reviewed international literature

Type	Outcome	Definition of overcrowding	Reference
Process measures	Increased ambulance bypass	Emergency department access block	30
	Ambulance delay in chest pain	Divert status (time series)	31
	Increased "left without being seen" rate	National Emergency Department Overcrowding Scale	32
		Staff subjective opinion	33
	Worse waiting time performance	Emergency department access block	34
	Emergency department flow (multiple measures)	Total emergency department boarding* time	35
Quality measures	Decreased patient satisfaction	Staff subjective opinion	33
	Missed myocardial infarction	Emergency department volume	36
	Delay to reperfusion	Ambulance network diversion ("bypass")	37
	Reduced adherence to myocardial protocols	Simultaneous trauma cases	38
		Patient length of stay in the emergency department	39
	Delay to antibiotics in pneumonia	Administrative cycle time and performance data	40
		Emergency department occupancy and number needing admission	41
		Multiple measures at triage	42
	Inadequate analgesia (hip fracture)	Emergency department census (occupancy) > 120%	43
	Lower-quality pain management	Multiple measures at triage	44
	Worse process of pain care measures	Emergency department occupancy Emergency department boarders*	45
	Reduced satisfaction (admitted patients)	Individual patient boarding* times	46
Outcome measures	Increased reinfarction rate	Patient length of stay in the emergency department	39
	Increased incidence of pneumonia in patients who had been artificially ventilated	Patient length of stay in the emergency department	47
	Increased admission length of stay	Patient access block	48,49
		⩾ 6 h in emergency department (intensive care unit survivors)	27
	Increased short-term mortality	⩾ 6 h in emergency department (intensive care unit patients)	27
		Emergency department occupancy	29
		Emergency department and hospital occupancy	28

* "Boarding" is the situation in which patients are kept in the emergency department awaiting inpatient beds. ◆

alternative to formal inpatient admission, and multidisciplinary assessment and discharge is effective at reducing representation, at least among older people. However, none of these responses can be used indefinitely if access block keeps increasing.

7. Consequences of overcrowding

Adverse effects of hospital overcrowding have been described since the birth of modern medicine. In Australasia, access block was first shown to be associated with decreased ED function in 2000,[25] and was defined by the ACEM in 2002.[3] Worldwide, rigorously conducted studies in different centres have found an association between overcrowding and reduced access to care, decreased quality measures, and poor outcomes.[26]

Most important are studies, including a number from Australia, that show an increased mortality rate with increasing overcrowding.[27-29] Two independent studies from different centres found about a 30% increase in overall early mortality if patients are admitted through overcrowded EDs to overcrowded hospitals.[27,28] Annual excess deaths amounted to 13 in one of two hospitals in the Australian Capital Territory[29] (13/(0.5 × 320 000 [population of ACT]) = ~ 8/100 000) and 120 among the three major hospitals in Perth[28] (120/1.4 million [population of greater Perth] = ~ 8/100 000). Thus, a rate of 8/100 000 is conservatively estimated to correspond to 1500 additional deaths a year in Australia (similar to the road toll[29]), based on 2003 data. Access block has worsened since.[10]

Other serious problems associated with ED overcrowding include: delayed time-critical interventions and increased complications (eg, more recurrent myocardial infarctions or episodes of congestive cardiac failure); increased medical error; less frequent and less adequate pain control; prolonged hospital length of stay, further worsening the underlying cause and increased costs per stay; more legal actions and complaints; and severe problems with staff turnover and burnout. ED overcrowding causes ambulance diversion and delays to offloading ambulance patients,[30,31] with both financial and service impact on prehospital care. The opportunity cost of lost ambulance resources has not been quantified but is also likely to be high.

Associations between overcrowding and outcomes demonstrated in peer-reviewed studies are shown in Box 3. While there may be some publication bias, there remain no published studies associating overcrowding with improvements in care and very few

4 Summary of the myths and facts about emergency department (ED) overcrowding

The myths	The facts
• "Inappropriate" or "general-practice-type" patients cause overcrowding	• Overcrowding is largely the result of patients being admitted but remaining in the ED awaiting suitable inpatient beds
• Overcrowding is the result of an excess number of patients arriving and waiting to be seen by a doctor	• Patient attendances at EDs have increased, but the number of patients waiting to see a doctor in Australasian EDs remains smaller than the number waiting for an inpatient bed
• The time patients spend in the ED is now excessive because staff take too long in investigating and treating them	• There has been little change in the time taken to assess and treat ED patients, but some increase in waiting time because ED staff and resources are being used to care for inpatients, and a large increase in waiting time for inpatient beds
• Telephone advice lines and collocated general practitioner services reduce ED attendances	• Telephone advice lines and collocated GP services have little or no effect on ED attendances
• Overcrowding can be reduced by building larger EDs	• Increasing ED size is associated with increased overcrowding
• The causes of overcrowding lie within the ED	• The causes and the solutions to overcrowding lie outside the ED
• Overcrowding does not influence patient outcomes	• Overcrowding has serious adverse effects on hospital processes, quality of care, and patient outcomes, including mortality ◆

where it has no effect on care. The association between overcrowding and poor outcomes is accepted to be causative by most medical authorities and all emergency medicine colleges.

It is important to realise that ED overcrowding has serious adverse effects, because there is little incentive to fix a problem if it is not shown to have serious consequences. Routine denials in the media by politicians and bureaucrats that overcrowding has major adverse effects on patient care or outcomes shows that they do not see overcrowding as having serious consequences.

Conclusions

Overcrowding has changed the nature of the practice of emergency medicine. The fundamental issue is the availability of inpatient beds. There is sufficient evidence to convince reasonable authorities that the relationship between overcrowding and poorer patient outcomes is causal. Emergency physicians have a role to play in maintaining the standard of patient care in the face of overcrowding, but most of the solutions to overcrowding and resultant poor outcomes will lie outside the ED. It is vital to know what really does and does not cause access block in order to decide which solutions will work and should be concentrated on, and to avoid perpetuating the myths that abound in this area of policy debate. A summary of the myths and the corresponding facts is provided in Box 4.

Competing interests

Drew Richardson's unit has received funding from the Australasian College for Emergency Medicine to study access block and overcrowding, and both authors have received travel assistance to speak at meetings about access block and overcrowding.

Author details

Drew B Richardson, MB BS(Hons), FACEM, GradCertHE, Chair of Road Trauma and Emergency Medicine[1]
David Mountain, FACEM, Associate Professor[2]
1 Emergency Department, Australian National University Medical School, Canberra, ACT.
2 Department of Emergency Medicine, Sir Charles Gairdner Hospital, University of Western Australia, Perth, WA.
Correspondence: drew.richardson@act.gov.au

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(Received 12 Dec 2008, accepted 27 Jan 2009) ❑