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SHORT REPORT

Access block and ED overcrowding

Roberto Forero,[1] Kenneth M Hillman,[1] Sally McCarthy,[2] Daniel M Fatovich,[3] Anthony P Joseph[4] and Drew B Richardson[5]

[1]Simpson Centre for Health Services Research Affiliated with The Australian Institute of Health Innovation, University of New South Wales, Kensington, New South Wales, [2]Department of Emergency Medicine, Prince of Wales Hospital, Randwick, New South Wales, [4]Royal North Shore Hospital and University of Sydney, Sydney, New South Wales, [3]Department of Emergency Medicine, Royal Perth Hospital and University of Western Australia, Perth, Western Australia, [5]Australian National University Medical School, Canberra, ACT, Australia

Abstract

Prospective and retrospective access block hospital intervention studies from 1998 to 2008 were reviewed to assess the evidence for interventions around access block and ED overcrowding, including over 220 documents reported in Medline and data extracted from *The State of our Public Hospitals Reports*. There is an estimated 20–30% increased mortality rate due to access block and ED overcrowding. The main causes are major increases in hospital admissions and ED presentations, with almost no increase in the capacity of hospitals to meet this demand. The rate of available beds in Australia reduced from 2.6 beds per 1000 (1998–1999) to 2.4 beds per 1000 (2002–2007) in 2002, and has remained steady at between 2.5–2.6 beds per 1000. In the same period, the number of ED visits increased over 77% from 3.8 million to 6.74 million. Similarly, the number of public hospital admissions increased at an average rate of 3.4% per year from 3.7 to 4.7 million. Compared with 1998–1999 rates, the number of available beds in 2006–2007 is thus similar (2.65 *vs* 2.6 beds per 1000), but the number of ED presentations has almost doubled. All patient groups are affected by access block. Access block interventions may temporarily reduce some of the symptoms of access block, but many measures are not sustainable. The root cause of the problem will remain unless hospital capacity is addressed in an integrated approach at both national and state levels.

Key words: *access block, emergency department, overcrowding.*

Introduction

In the last decade, access block and ED overcrowding have been defined, investigated and managed through different initiatives across the Australian States, Territories and internationally. However, the problem of access block is far from being resolved with bed occupancy rates over 90% in most Australian public

Correspondence: Dr Roberto Forero, Simpson Centre for Health Services Research, University of New South Wales, Locked Bag 7103, Liverpool Hospital, Liverpool BC, NSW 1871, Australia. Email: r.forero@unsw.edu.au

Roberto Forero, MA, MPH, PhD, Senior Research Fellow; Kenneth M Hillman, MB BS, FRCAnes, FFICANZCA, Professor, Director; Sally McCarthy, MB BS, FACEM, MBA, Director; Daniel M Fatovich, MB BS, FACEM, Professor; Drew B Richardson, MB BS(Hons), FACEM, Director, Associate Professor; Anthony P Joseph, MB BS, FACEM, MRCP, Senior Staff Specialist, Director, Clinical Senior Lecturer.

hospitals,[1] increases in ED presentations[2] and despite major policy changes proposed and or implemented in the last few years across Australia.[3,4]

Access block is defined by the ACEM as 'the situation where patients are unable to gain access to appropriate hospital beds within a reasonable amount of time, no greater than 8 hours'. ED Overcrowding is defined as 'the situation where ED function is impeded by the number of patients waiting to be seen, undergoing assessment and treatment, or waiting for departure, exceeding the physical or staffing capacity of the department'.[5]

The purpose of this report is to update, summarize and integrate the evidence concerning access block and ED overcrowding by looking at trends in hospital admissions and bed availability, the contribution of access block and ED overcrowding to patient mortality and the quality of the studies conducted to date. Other literature reviews have also been conducted in recent years.[2,6–9]

This report provides an overview of access block studies, and explores hospital, patient or medical interventions to reduce its impact in terms of ambulance diversion, impaired access to emergency care, compromised clinical care, prolonged pain and suffering, comorbidity and mortality associated with prolonged ED length of stay.

Methods

Studies were appraised according to the following characteristics: type of intervention to reduce access block, quality of the study design, the level of evidence according to National Health and Medical Research Council (NHMRC) grades of recommendation,[10] methods and outcomes.[6–9]

Peer reviewed literature was sourced from Medline for the published literature and Google for unpublished papers and websites. Table 1 describes the methods used for searching and selecting research papers, including the inclusion and exclusion criteria, keyword and MeSH terms strategy and online databases accessed.

Results

The search in Medline using the keyword 'Access Block' identified 47 articles and using the keyword 'Overcrowding' identified 1208 articles. A second search using keywords 'Access Block' or 'Crowding' or 'Overcrowding and ED' identified 533 articles. This demonstrates rapid growth in the published literature as an identical Medline search published in the *Medical Journal of Australia* in 2007 reported 163 articles.[11] We compiled and reviewed 220 documents including policy reports, research papers, press releases, opinion documents (letters and editorials) and other relevant professional associations' website information.

Decline in numbers of inpatient beds

There has been a decline of 15–30% in the number of inpatient beds since the early 1990s across all major hospitals in Australia.[2,12–14] The last 5 years of available data from *State of Our Public Hospitals*[15–17] show that the rate of available beds per 1000 population nationally has remained steady, whereas the average number of ED presentations and admissions per year has increased dramatically. Public hospital admissions increased from 3.7 million in 1998–1999 to 4.7 million in 2006–2007, an increase of 3.4% per year. The trend of ED presentations and bed availability are summarized in Figures 1 and 2.[15–17]

The number of available beds in 2006–2007 is similar to 1998–1999, yet the number of ED presentations has almost doubled from 3.5 to 6.7 million (see Fig. 2).[15–17] It is also important to note that the 2006, 2007 and 2008 reports present a different baseline 1998–1999 rate compared with the same data reported in the 2005 report (2.9 *vs* 2.65 beds per 1000). Some inconsistencies may be as a result of differences in the way weighted populations were calculated.[15,17]

ED presentations

The rate of ED presentations per 1000 population in Australia has increased from 202 in 2003–2004 to 208 in 2004–2005, 223 in 2005–2006 and to 311 in 2006–2007, according to the *State of Our Public Hospitals Reports*. This represents 1.98 million more presentations to Australian ED in 2006–2007 compared with the 2005–2006 financial year.[15–17] Bed occupancy rates in most hospitals exceed 85% as a result of the increased demand and bed shortages, a level which is considered the maximum for efficient care and surge capacity.[2,6,7,14,18–24]

Increased patient mortality associated with access block and overcrowding

Access block and overcrowding are associated with increased patient mortality. Different authors have estimated that there is a 20–30% excess mortality rate

Table 1. Medline search (July 2008; update July 2009)

Databases searched	Medline (OVID); Google Scholar; Google.
Search keywords	Broad searches were performed including MeSH headings: Access Block OR Crowding OR Overcrowding.
Search date	July 2008; updated July 2009.
Other information sources checked	Reference lists of included studies searched from websites to identify additional sources of information.
Inclusion/exclusion criteria for study eligibility	Interventions classified according to type and level of evidence:

Type of intervention (Bagust *et al.*)[18]	**NHMRC grade of recommendation[10]**	**Effect level**
1. Avoiding admissions	1. Body of evidence can be trusted to guide practice (A).	1. Positive effect
2. Alternatives to admission	2. Body of evidence can be trusted to guide practice in most situations (B).	2. Negative effect
3. Management of existing resources	3. Body of evidence provides some support for recommendation(s) but care should be taken in its application (C).	3. No demonstrable effect/nil effect
4. Early discharge	4. Body of evidence is weak and recommendation must be applied with caution (D).	
5. Health outcomes		

Results	220 records retrieved initially. 51 studies met the inclusion criteria.
Categories of studies retrieved	• 6% analytical studies (case–control, quasi experimental designs, cohort or RCT) • 21% large multicentre studies or data-linkage studies • 26% large descriptive studies or before–after studies from single hospitals • 9% professional association documents or commissioned reports • 8% cross-sectional surveys of health professionals or patients • 30% editorials, letters, policy reports, reviews, commentaries or abstracts
Methods used to assess and interpret the evidence	Subject inclusion criteria, measured outcomes, study validity, study conclusions, opportunity for bias, weakness and strength

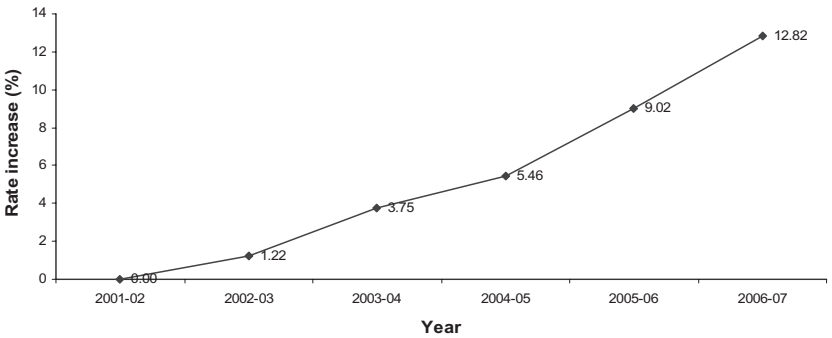

Figure 1. Relative increase of acute hospital overnight separations by 32.2% over the 5 years (2001–2007).

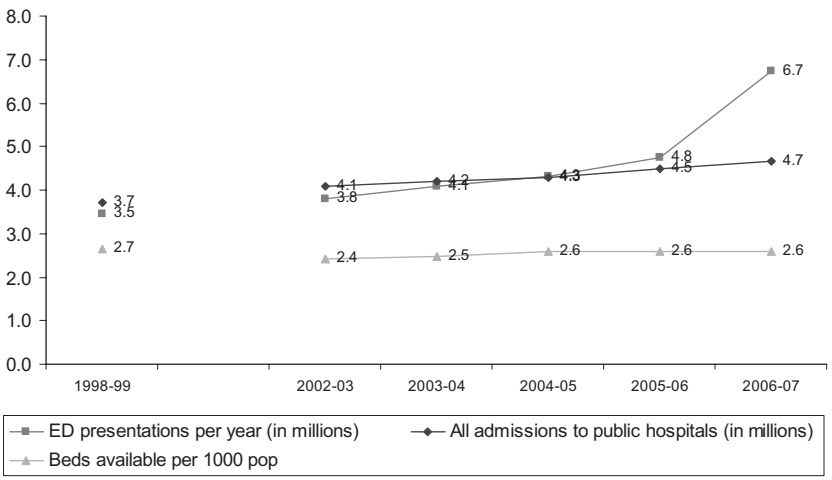

Figure 2. Trends in Australian ED utilization, hospital admissions and bed availability (2002–2007).

annually attributable to access block and ED overcrowding in Australia.[25–27] This equates to approximately 1500 deaths per year, which is similar to the 2006–2007 Australian road toll.[28]

Quality of interventions

Bagust *et al.*[18] have suggested that interventions to avoid or alleviate the effects of rising emergency admissions may be grouped into four categories: avoiding admissions, alternatives to admission, better management of existing resources and early discharge (see Table 2). Of the 220 papers examined in the present study, 70% provided data from NHMRC grades of recommendation levels of evidence A-CI-IV (See Table 1) and 30% were opinion documents from editorials, letters, policy reports, reviews, commentaries or abstracts (Type D). Results by journal showed *Medical Journal of Australia* and *Annals of Emergency Medicine* had published 52 papers each; *Emergency Medicine Journal* and *Emergency Medicine Australasia* 12 papers each; and the *Journal of Emergency Medicine* had published 5 papers.

Multifaceted, multidisciplinary and hospital interventions are believed more likely to improve health outcomes than single-faceted and single hospital interventions.[13,14] However, 89% of the evidence reported in Table 2 derives from single hospital interventions[19–23,25–26,29–44,46,49–63,65,67–71] and only 11% from multicentre interventions.[27,45,47–48,64]

Summary of the evidence on access block and ED overcrowding

Table 2 provides a summary of publications of the evidence on access block and ED overcrowding

Table 2. Summary of the evidence on access block and ED overcrowding in five classification groups

Author, reference number, country	Type of publication	Study design	NHMRC Grade	Effect level	Methods/outcomes
Group 1: Initiatives to avoid admission					
Caplan *et al.* (2004)[29] USA	Peer reviewed article	RCT of unplanned admissions in the elderly. Single hospital study.	1	1	739 patients aged 75 years and over. Multidisciplinary intervention improved health outcomes and reduced unplanned admissions.
Dunn (2003)[30] Australia	Peer reviewed article	Comparative observational study of occupancy rates with historical control. Single hospital study.	2	1	1133 ED presentations during study period and 2332 historical control group. Occupancy rates decreased from 95% to 89%. ED mean occupancy rate decreased from 19 to 15 patients. ED waiting time decreased from 59 min to 37 min ($P < 0.001$).
Williams *et al.* (2000)[19] Australia	Peer reviewed article	Retrospective analysis of establishing an OW. Single hospital study.	3	1	Increased admission to OW reduced admission to inpatient wards for selected DRG. Total number of patients increased by 19% over 4 years, but total number of bed days fell by 23%.
Mace *et al.* (2003)[39] USA	Peer reviewed article	Cross-sectional survey of 522 hospitals with OU. Single hospital study.	3	1	Random sample of all hospitals in the USA (33% response rate). OU assist OC ED and reduce ambulance diversion. Significant increases in patient flow detected.
Donald *et al.* (2005)[31] Australia	Peer reviewed article	Retrospective case–control study of the effect of an additional ED physician. Single hospital study.	3	1	Group A (doctor present at night) = 125; Group B (no doctor at night) = 117. ED LOS reduced by 50%. Pathology tests per patient reduced from 5 to 3 ($P < 0.001$). Admission rate also reduced.
Han *et al.* (2007)[32] USA	Peer reviewed article	Retrospective before–after study of the effects of ED expansion. Single hospital study.	3	3	Effect of ED expansion from 28 to 53 beds on ambulance diversion. Daily ED volume increased, but ED occupancy decreased. No change in ambulance diversion time. ED expansion by itself appeared to be insufficient to improve diversion without addressing other factors.

Table 2
Continued

Author, reference number, country	Type of publication	Study design	NHMRC Grade	Effect level	Methods/outcomes
Levin *et al.* (2008)[33] USA	Peer reviewed article	Retrospective cohort study of cardiac patients using a stochastic discrete event simulation of patient flow. Single hospital study.	2	1	Simulation based analysis showed rescheduling elective catheterization resulted in 20 min reduction in average access block time compared to 9 min reduction by increasing capacity of one additional telemetry bed.
Group 2: Interventions to provide alternatives to admission					
Combs *et al.* (2007)[34] Australia	Peer reviewed article	Time series study 12-month study of a fast track intervention. Single hospital study.	2	1	Assessment of introduction of Fast Track in an ED. DNW rates decreased from 10% to 5.4%. Most patients with minor injuries treated within 2 h of presentation.
Van Uden *et al.* (2003)[35] Netherlands	Peer reviewed article	Quasi-experimental study of two after-hours GP services in two Dutch cities. Single hospital study.	2	1	Explored rates of self-referral to ED by patients receiving GP services. Both services similar in size and volume. The free access service located at the hospital. Self-referrals to ED were statistically different (51% *vs* 16%, $P < 0.001$)
Sprivulis *et al.* (2004)[36] Australia	Peer reviewed article	Data-linkage project. Single hospital study.	2	3	Implementation of 'Health Direct', a telephone triage service. 6.5% of 13 019 ED presentations used this service. No differences were detected between users and non-users of the service.
Geller *et al.* (1999)[37] Australia	Peer reviewed article	Implementation of a new model of psychiatric service in ED. Single hospital study.	3	1	New service attended over 72 000 presentations per year, serving a population of 260 000.
Simon *et al.* (1997)[40] USA	Peer reviewed article	Case–control study of fast track intervention in a paediatric ED. Single hospital study.	3	1	4060 fast track cases and 5199 controls from overall sample of 35 308 paediatric patients. Estimated savings US$100 000 per year.
Van Uden *et al.* (2004)[41] Netherlands	Peer reviewed article	Before–after study GP service versus ED after hours. Single hospital study.	3	1	10% increase in GP contacts and 9% decrease to ED attendances. Self-referral was reduced by 4%.
Graber *et al.* (2003)[42] New Zealand	Peer reviewed article	Prospective clinical records review for 6 months. Single hospital study.	3	3	Evaluation of a 6-month health line service. Small increase in ED attendance during the study period. Health Line had little effect on the overall ED census.

Group 3: Interventions to produce better management of existing resources					
Finn *et al.* (2006)[43] Australia	Peer reviewed article	Retrospective cohort study of residential care facility patients. Single hospital study.	2	1	541 patients aged 65+ years transferred by ambulance. Most were appropriately admitted (87%).
Carr *et al.* (2007)[44] USA	Peer reviewed article	Retrospective case–control study of patients with pneumonia. Single hospital study.	2	2	509 ED patients and controls. ED LOS was longer than for controls. Delays in transfer from ED to ICU had deleterious effect on trauma patients with pneumonia.
Chalfin *et al.* (2007)[45] USA	Peer reviewed article	Cross-sectional analytical study of the critically ill. Multicentre study.	2	2	Delayed = 1036; non-delayed = 49 286. Delays in transfer from ED to ICU had deleterious effect on critically ill patients.
Cordell *et al.* (2002)[46] USA	Peer reviewed article	Retrospective cross-sectional study of pain prevalence. Single hospital study.	2	2	Chart review of 1665 consecutive ED visits. 61% reported pain and for 52% it was the main reason for presentation.
Diercks *et al.* (2007)[47] USA	Peer reviewed article	Secondary analysis of registry date of angina patients. Multicentre study.	2	3	42 780 patients. 15% access block (>8 h). No difference in mortality rates. Rate of recurrent myocardial infarction increased among patients with access block (OR = 1.23).
Schull *et al.* (2001)[48] Canada	Peer reviewed article	Systematic times series analysis. Multicentre study.	2	1	n = 20 hospitals, 120 months. Severe overcrowding rate before restructuring was 0.5–9%; during restructuring was 6–23%, after controlling for ED utilization.
Burns *et al.* (2005)[20] Australia	Peer reviewed article	24 months comparative analysis of patient flow. Single hospital study.	3	2	CuSum analysis revealed important trend changes in patient flow following changes in bed use. Over 9500 bed days reduced. Results not sustainable, as a result of excessive bed closures following intervention.
Cameron *et al.* (2002)[21] Australia	Peer reviewed article	Observational study using a complex organizational change intervention in multiple hospitals. Single hospital study.	3	1	Implementation of task force for all hospitals in Victoria in 2001. 10 million dollars allocated to 3-month implementation program. Results: Ambulance bypass reduced by 50%. No evidence changes have been sustained since 2001.

Table 2
Continued

Author, reference number, country	Type of publication	Study design	NHMRC Grade	Effect level	Methods/outcomes
Green *et al.* (2006)[22] USA	Peer reviewed article	Controlled trial with a before/after design of Staff allocation using QT. Single hospital study.	3	1	Using QT to increase the effectiveness of ED provider staffing. An average increase of 12 working hours resulted in 23% decrease in DNW patient rate. QT useful for identifying most effective allocation of staff.
Epstein *et al.* (2006)[49] USA	Peer reviewed article	Retrospective observational study of ambulance diversion. Single hospital study.	3	1	Development of an ED Work score to predict ambulance diversion. Score significantly different during no diversion status (3.45) and diversion status (6.13). Receiver operator curve = 0.89; Sensitivity 86%, Specificity 80%.
Sprivulis and Gerrard (2005)[50] Australia	Peer reviewed article	Retrospective before–after study using administrative ED data. Single hospital study.	3	2	Implementation of pre-emptive ambulance distribution using internet-accessible ED information. Ambulance diversion fell from 1788 h in 2002 to 1138 h in 2003 ($P < 0.001$). Strategy alone not sustainable.
Falvo *et al.* (2007)[51] USA	Peer reviewed article	Retrospective descriptive analysis of waiting time. Single hospital study.	3	1	12 months historical review of ED visits in a 450 bed hospital between July 2004 and June 2005. Estimated savings US$4 million and 10 397 h treatment capacity.
O'Connor *et al.* (2004)[52] Australia	Peer reviewed article	6 months retrospective study in a rural ED. Single hospital study.	3	1	Presence of an EP in a rural ED assessed. 12 000 ED presentations reviewed. EP present in 76% of cases. ED assessment within recommended time improved from 69% to 73% ($P < 0.05$).
Bucheli and Martina (2004)[53] Switzerland	Peer reviewed article	Before and after study of additional ED physician in a prospective cohort of ED patients. Single hospital study.	3	1	Patients managed before ($n = 200$) and after ($n = 160$) addition of a second physician on the shift. ED LOS decreased from 176 min to 141 min ($P < 0.05$).
Hegney *et al.* (2006)[54] Australia	Peer reviewed article	Before–after intervention. Single hospital study.	3	1	Application of a risk screening tool to ($n = 2139$ elderly patients) reduced risk of representation with the same condition by 16%; decreased readmission rate by 6%. The overall LOS in hospital reduced from 6.1 to 5.4 days.

Hwang *et al.* (2006)[55] USA	Peer reviewed article	Retrospective record review of a prospective cohort study. Single hospital study.	3	2	Elderly patients with hip fractures (158). 81% complained of pain. Mean time to analgesia = 40 min, time to treatment = 141 min. Of those with pain, 36% received analgesia. (but substantial underassessment of pain noted).
Cardin *et al.* (2003)[56] Canada	Peer reviewed article	Before–after multifaceted intervention to reduce crowding. Single hospital study.	3	1	Reported a successful reduction of ED crowding without increasing readmission rates (6.8% *vs* 6.6%) in 3 hospitals.
Forero *et al.* (2008)[57] Australia	Peer reviewed article	Retrospective cohort review of morphine use by ED patients. Single hospital study.	3	1	Prevalence of morphine use in ED 8%. Strong correlation between ED overcrowding and time to analgesia (r = 0.56, 32% variance explained, $P < 0.01$).
Mohsin *et al.* (2007)[58] Australia	Peer reviewed article	Follow-up cohort study of DNW patients. Single hospital study.	3	2	8.6% of ED patients DNW. 457 patients followed up by telephone 7 days later. Waiting time delays strongly associated with DNW. 39% felt angry about their ED experience. Young patients more likely to leave, including parents of young children.
Smart *et al.* (1999)[59] Australia	Peer reviewed article	Implementation of a MHTS for mental health patients in the ED. Impact evaluation program. Single hospital study.	3	1	Four item triage scale for mental health ED patients. Mean waiting times were significantly reduced, and transit time was also reduced for all MHTS categories.
Richardson *et al.* (2004)[60] Australia	Peer reviewed article	Before–after study of multidisciplinary triage and DNW. Single hospital study.	3	1	ATS performance improved for ATS cat 2 and 3 from 75% to 81% and 56% to 78%, respectively. DNW rate was reduced by 50%.
Chia *et al.* (2008)[61] Taiwan	Peer reviewed article	Retrospective records review of X-ray radiograph use. Single hospital study.	3	3	112 hip fracture patients. No difference in time to take X-ray radiograph and final decision on treatment.
Ruffin and Hooper (2003)[62] Australia	Special issue	Before–after multifaceted intervention. Single hospital study.	3	1	Multifaceted 1999 intervention comprising structural changes, team building and clinical initiatives reduced restricted access, ambulance bypass within 6 months. Hospital bed occupancy rates maintained in excess of 90%.
Takakuwa *et al.* (2007)[63] USA	Peer reviewed article	12 months before–after intervention. Single hospital study.	3	1	Bedside registration system. $n = 58\,225$ ED presentations. Total ED time was reduced from 42 min to 31–39 min post-bedside registration intervals. Results not sustained at the end of one year.

Table 2
Continued

Author, reference number, country	Type of publication	Study design	NHMRC Grade	Effect level	Methods/outcomes
Cobelas *et al.* (2001)[64] Australia	Peer reviewed article	Qualitative Focus Groups ESEP project evaluation. Multicentre study.	4	3	101 staff members participated in 4 groups. ESEP success factors perceived by staff as changes in staff profile, improving patient flows, changes in admin policies and changes in work practices.
Hammett and Robinson (2003)[65] Australia	Peer reviewed article	Multifaceted before–after intervention. Single hospital study	3	1	Major improvements in reducing admission rates and reduction in bed use, with negative effect of excessive closure of beds by management.
Group 4: Early discharge					
Foster *et al.* (2003)[23] USA	Peer reviewed article	Prospective cohort study of AE. Single hospital study.	2	2	400 consecutive patients discharged home. 19% had AE. 12% were preventable or ameliorable. 66% of events drug related. AE in the peri-discharge period were common.
Moss *et al.* (2002)[38] Australia	Peer reviewed article	Before–after intervention of CCT with historical control. Single hospital study.	3	1	CCT to coordinate discharge planning. Rates of ED admission fell from 31% 12 months before intervention to 6% 12 months after CCT implementation.
Wolstenholme *et al.* (2007)[66] UK	Summary review	National data on patient flow modelling. National data modelling.	2	2	Five National level studies conducted by the Local Government Association in 2003–2005. Patient flow data modelling used to estimate unintended effects of early discharge policy. Upward trend in ED readmissions due to early discharge.
Group 5: Descriptive studies and interventions on health outcomes					
Holroyd *et al.* (2007)[67] Canada	Peer reviewed article	RCT on TLP in ED. Single hospital study.	1	3	6-week RCT of a TLP intervention randomized by shift. Overall LOS decreased by 36 min (4:21 *vs* 4:57, $P < 0.001$). DNW cases reduced from 6.6% to 5.4% (a 20% relative decrease). No difference in the rates of ambulance diversion events.

Fatovich (2005)[25] Australia	Peer reviewed article	Retrospective data-linkage study of mortality and ambulance by pass. Single hospital study.	2	1	297 ambulance diversion periods in 2003. 28% reduction in patient mortality for patients attending ED during ambulance bypass implying that patients were most at risk during the pre-diversion period when ED overcrowding at its peak.
Richardson (2006)[26] Australia	Peer reviewed article	Retrospective stratified cohort study of 10 days mortality and overcrowding. Single hospital study.	2	1	Retrospective cohort of 48-week period in 2004–2005 comparing OC versus NOC period. OC (n = 34 377) and NOC (n = 32 231). Relative risk at 10 days = 1.34. Higher mortality rate by triage status.
Sprivulis *et al.* (2006)[27] Australia	Peer reviewed article	Retrospective data linkage of overcrowding and ED patient mortality. Multicentre study.	2	1	Retrospective review of 62 495 ED admissions and death records. Linear relationship between Overcrowding Hazard Scale ratio for death of 1.3 between 2 and 30 days and deaths per 1000 ED admissions of 1.9 (at 7 days) and 2.3 (at 30 days).
Bayley *et al.* (2002)[68] USA	Abstract	Prospective cohort study of extended costs of Hospital overcrowding for Cardiac patients. Single hospital study.	2	1	858 patients presented to ED. Lost revenue estimated as US$ 190 per patient >3 h, four times the average professional fee.
O'Brien *et al.* (2006)[69] Australia	Peer reviewed article	Impact evaluation of a fast track intervention. Single hospital study.	3	1	20% reduction in waiting time and LOS for all discharged patients.
Richardson (2001)[70] Australia	Abstract	Prospective data-linkage project of DNW and ED waiting time. Single hospital study.	3	2	8692 consecutive ED presentations. Linear increase of one DNW patient for each 2.3 min increase in mean ED waiting time.
Gilligan *et al.* (2008)[71] UK	Peer reviewed article	Retrospective cohort analysis of ED admissions. Single hospital study	3	2	13 357 ED presentations between January 2004 and June 2005. Average waiting list 20% (0–45%) and the average ED LOS 16 h. Increased mortality for the elderly and increased risk of MRSA infection found.

ATS, Australasian Triage Scale; CCT, Care Coordination Team; DNW, did not wait; EP, emergency physician; ESEP, Emergency Services Enhancement Program; GP, general practitioner; LOS, length of stay; MHTS, Mental Health Triage Scale; NHMRC, National Health and Medical Research Council; NOC, non-overcrowded; OC, overcrowded; OU, observation unit; OW, observation ward; QT, queuing theory; RCT, randomized controlled trial; TLP, Triage Liaison Physician.

interventions according to five classification groups (see as follows), plus an additional category on descriptive interventions on health outcomes. The table shows brief details on each research paper including type of publication, study design, country of origin, method and outcomes, level of evidence and effect level.

Grouping of initiatives (Table 2)

Of the 51 intervention papers included in the analysis, 14% described initiatives to avoid admission (Group 1); 14% described interventions to provide alternatives to admission (Group 2); 51% focused on interventions to produce better management of existing resources (Group 3); 6% on early discharge (Group 4); and 15% included interventions on health outcomes (Group 5).

Quality of research evidence (Table 2)

The quality of research of the 51 intervention papers showed only 4% were randomized controlled trials (NHMRC Grade 1); 33% were comparative studies (NHMRC Grade 2); 65% were single hospital interventions (NHMRC Grade 3); and 2% were qualitative studies or professional opinions (NHMRC Grade 4). Overall, 65% of the 51 intervention papers found a positive effect; 22% a negative effect; and 13% did not find a demonstrable effect.

Historical and prospective data show that when bed occupancy rates are reduced towards 85%, this facilitates patient transfers to the wards, which in turn frees up space in the ED to see and process new patients. This then reduces ED length of stay,[2,20,23,30] ambulance diversion rate[21,25] and theatre cancellations.[21]

Initiatives to avoid hospital admission (Table 2, Group 1)

Successful initiatives to avoid hospital admission include transit lounges, observation wards,[19,39] and multidisciplinary interventions[13,29] including reducing overall hospital occupancy,[30] additional ED staff[31] and rescheduling of some services. However, ED expansion alone does not have a demonstrable effect on indicators of access block such as hospital diversion and length of stay.[32] Some hospitals have reduced ED length of stay (another surrogate of access block) using strategies such as increasing working hours, and employing care coordinators, community nurses, ED nurses or additional medical officers at night.[12,22,31,52–54,65,72–74,76]

Alternatives to hospital admission (Table 2, Group 2)

Initiatives to avoid admission such as transit lounges[13] and multifaceted interventions such as short stay wards,[62] and holding or transit bays[74] have been combined with alternatives to admission such as fast track.,[34,40,69,75] ambulance diversion,[50] risk screening tools[54] and mental health triage.[59] Nurse-initiated X-ray radiograph improves patient satisfaction.[74,77–78] Mental health patients benefit from the co-location of psychiatric emergency services within the ED. This improves clinical care for patients and the ED and reduces access block.[37,79–81]

Better management of existing resources (Table 2, Group 3)

The majority of evidence compiled in our study relates to strategies to manage existing resources. Of these interventions, 62% were found to have a positive effect.[21,22,43,48,49,51–54,56,57,59,60,62,63,65,69,74,75] A good example of these is the systems approach used by the Victorian Health Department.[82–88] They used bed management processes to disseminate learning practices across the entire health system that included 11 metropolitan hospitals. Active bed management has also been used in the UK to improve service delivery.[87–88]

Another strategy to improve management of existing resources is a systematic hospital restructure such as that conducted in Canada in 20 hospitals between 1991 and 2000. The impact of incremental reductions in hospital resources was magnified as maximum operating capacity was approached.[48]

Bedside ED registration has been developed as a strategy for improving patient flow. This process consists of registering ED patients in the clinical care area to reduce registration delays and allow earlier clinical evaluation. This may reduce total ED time (a surrogate of access block), but was not sustainable at the end of one year as a single intervention.[63]

The ageing population is popularly believed to have placed an extra burden on ED hospitals. A recent study by Gray *et al.*[89] demonstrated that although the Australian aged population increased by 18% between 1993 and 2002 against a total population growth of 10%, the proportion of hospital beds occupied by older patients remained stable at 47%. The authors concluded that ageing of the Australian population by itself was not associated with an increase in the proportion of hospital beds used by older patients.

Access to GP services within a hospital has shown mixed efficacy. It proved unsuccessful in some hospitals in Australia[62] and New Zealand,[90] yet was shown to be effective in the Netherlands.[35,41] More research needs to be done to establish whether other as yet unrecognized factors have a counter-effect. An after-hours GP service located within an ED in South Australia was unsuccessful in reducing access block as a result of low numbers of patients being referred to the service.[62]

Han *et al.*[32] demonstrated that individual initiatives such as expanding the ED capacity from 24 to 54 beds in isolation, without addressing other bottlenecks in the hospital are ineffective and insufficient to produce significant change in ambulance diversion rate or the proportion of patients who left without being seen (did not wait: DNW).

Policies to reduce or control overcrowding considered associated with 79% of access block patients in Canada, are perceived by ED directors to be largely ineffective.[91] Thus in the UK, policies such as early hospital discharge have had unintended consequences, such as the creation of incomplete episodes of care resulting in increased readmissions.[66] In addition, telephone advice services fail to decrease the number of presentations to ED, may lead to inappropriate presentations and or incorrect advice to stay at home.[42]

Discussion

Access block has been likened to an illness, with known morbidity and mortality rates.[11] Indeed, if access block was considered an incurable disease, we would be forced to treat only some of the symptoms and the fundamental condition would remain unaffected. Table 2 demonstrates that some interventions are able to avoid admission of some patients,[19,29–33,39] or provide alternatives to admission,[34–37,40–42] or improve management of existing resources,[20–22,43–65] or have been successful in treating some key defined outcomes.[68–71] However, as long as the fundamental causes remain, the symptoms of access block sooner or later re-emerge.

A reduction in the number of hospital beds and increased occupancy rates above the recommended 85% in the name of operational efficiency has clearly had a negative effect, as the demand for hospital beds exceeds supply.[2,92] Burns *et al.*[20] were successful in reducing admission rates but this improvement was jeopardized by excessive closure of medical beds, in response to the additional bed capacity need, causing hospital occupancy rate to exceed the optimum 85% level. Hammett and Robinson[65] in Sydney demonstrated dramatic improvements as a result of multifaceted interventions in 2001, but occupancy rates in that hospital remained in excess of 90%.

People most affected by access block and overcrowding are those who require unplanned admissions to hospital because of their medical condition.[2,6–8,11] The reasons for some patient groups being more affected by access block are multifactorial and complex. Studies on access block and ED overcrowding that demonstrate an associated negative effect include deleterious effects on trauma patients with pneumonia,[44] delays in transfer to ICU,[45] delays in pain treatment,[46,55] increased numbers of patients who did not wait for treatment,[58,70] AE[23] and increased mortality.[25–27,71]

Cooke *et al.*[6] in the UK in 2004 indicated that although most evidence focuses on the magnitude and causes of delay in ED, there is little information on innovations and research in the areas of bed management, innovations to reduce delayed discharges, working practices and workforce numbers. We have found that there are no consistent outcome measures and definitions making it difficult to compare or combine study results, and assess their external validity.[6]

The majority of the evidence on interventions that work comes from single hospitals rather than multicentre interventions. More multilevel studies are needed to improve access block instead of retrospective or observational/descriptive studies. Thus for instance, the reduction of low acuity attendances to ED is not effective in reducing access block and should be discarded.[2,6,93–99]

Studies described in Table 2 found some intervention effects to be partially successful or of short-term impact relating to clinical bed closures. As indicated in Figures 1 and 2, the rates of available beds at the national level have remained at the same level between 2.5 and 2.6 public acute beds per 1000 population since 2002, which ranks at the bottom of the Organisation for Economic Cooperation and Development (OECD) spectrum. This is compared with 1998 levels when the bed capacity was 3.2 beds per 1000 population, more in line with the OECD average of 4 beds per 1000 population. The level of bed capacity therefore needs to increase to match present and future demand. A major barrier to future initiatives is the absence of an integrated national bed strategy. The American College of Emergency Physicians have stated 'Only when all stakeholders agree that the problem is systemic and hospital-wide can solutions be implemented.'[94]

We have found support for the Australian Medical Association recommendation of developing adequate number of beds to meet the needs of the population, in addition to adequate mental health and transitional care beds and the need for robust, long-term data collection and analysis systems.[1]

Finally, the complexity of the problem of access block and overcrowding is such that there are no single studies large enough to cover all the factors associated with the problem, nor are there ever likely to be.[100] Funding complex interventions on a short-term basis is short-sighted, inefficient and expensive to run and maintain.

ED research and funding

We believe that the NHMRC and the Federal Government should provide long-term funding to support skilled persons emerging from short-term grants to assist in dealing with the problem. ED Research Grants should be developed with special emphasis on complex interventions to address access block and overcrowding. Therefore, infrastructure for ED research funding across hospitals needs to be developed. ED researchers need to create extensive networks, set up large multisite studies, and be able to conduct and coordinate long-term longitudinal, collaborative data-linkage studies at a national level with all key stakeholders. Many agree that there is a need for a national focus and strong leadership to deal with the problem of access block and overcrowding from all levels of government, academia and professional organizations.

Conclusion

There are limited numbers of multicentre interventional studies targeting access block. In addition, most interventions to date discussed in this report have been aimed at different surrogate markers of access block, but few studies have focussed on addressing access block directly. Carefully drafted systematic research projects must be developed in the future, led by ED researchers and aimed at a multilevel, multifaceted 'whole of hospital' approach to the problem of access block and ED overcrowding.[101]

Competing interests

Sally McCarthy is President of the ACEM.

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