

## ORIGINAL RESEARCH



# Is the increase in emergency short-stay admissions sustainable? Trends across Melbourne, 2000 to 2009

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## Abstract

**Objectives:** To describe the trends in emergency admissions over 10 years in terms of volume, age-specific rates, hospital length of stay (LOS) and clinical reasons.

**Methods:** A retrospective analysis of population-based linked Department of Health ED and hospital admission data for metropolitan Melbourne 1999/2000 to 2008/2009 was conducted. Outcome measures included: hospital admission numbers (total, single day/overnight,  $\geq 2$  days LOS); admission rates per 1000 person-years (total, single day/overnight,  $\geq 2$  days LOS); hospital LOS.

**Results:** The volume of patients admitted to hospital through EDs rose by 56% over the 10 years to June 2009. The number of same day/overnight admissions rose by 60%, equating to a 6.1% average annual increase beyond that accounted for by demographic change (95% CI 5.7–6.5%). The volume of patients admitted for  $\geq 2$  days also increased; however, the admission rate per 1000 persons for these longer-stay patients declined over the decade by 9% (95% CI 5–12%). The most frequent discharge diagnoses were injury or poisoning, and disorders of the circulatory, respiratory or digestive systems. The numbers and mortality rate for ED admissions declined over the decade.

**Conclusion:** Emergency hospital admissions have risen over the last decade even after adjustment for population changes. There was a disproportionate rise in same day/overnight admissions, with overrepresentation of the elderly. This is possibly related to changes in ED models of care, including introduction of short-stay units, improved diagnostic and therapeutic capability, and risk-averse management to optimise safe discharge, within the context of time-based performance targets.

**Key words:** *care model, elderly, emergency admission, trend.*

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## Background

ED presentations across metropolitan Melbourne continue to increase by an average of 3.6% per year beyond that which can be explained by population change.<sup>1</sup> Greater demand alongside increasing numbers of patients requiring hospital admission causes congestion in the ED, which contributes to access block.<sup>2</sup> Over 25% of all ED presentations across metropolitan Melbourne in 2008/2009 required admission to a hospital ward or short-stay observation unit (SSOU), of which nearly two-thirds were admitted to a hospital ward and one-third to a SSOU.<sup>1</sup> This is consistent with national figures reported by the Department of Health and Ageing.<sup>3</sup> In 2008/2009, 55% of patients aged 70 years or more were admitted, with 66% to a hospital ward and 33% to a SSOU.<sup>4</sup> This study aimed to describe the trends in hospital admissions from the ED and to identify any underlying factors in the context of rising demand for ED services and an ageing population. The objectives were to measure the increase in volume and age-specific rates of admissions through EDs, quantify changes in hospital length of stay (LOS), and describe any changes over time regarding the clinical reasons for emergency hospital admissions through EDs.

## Methods

### Study design and setting

Retrospective analysis was conducted of routinely collected discharge data describing the emergency episode of care from ED presentation through admission to hospital discharge across metropolitan Melbourne over the 10 years ending 30 June 2009. This study was approved by the Monash University Human Research Ethics Committee and the Victorian Department of Health.

### Data

The analysis included data from metropolitan Melbourne hospitals with 24 h EDs, and excluded specialist maternity and eye and ear hospitals. De-identified data were provided by the Victorian Department of Health from the Victorian Emergency Minimum Dataset (VEMD)<sup>5</sup> and the Victorian Admitted Episodes Dataset (VAED).<sup>6</sup> Data were provided in financial year files from July 1999/June 2000 to July 2008/June 2009. Year-specific population data published by the Australian Bureau of Statistics for the geographical regions serv-

iced by included EDs were used to calculate hospital admission rates by age and sex.<sup>7</sup>

Same day/overnight admissions were defined as patients admitted to hospital for 1 day/night, and multi-day admissions were defined as patients admitted to hospital for  $\geq 2$  days.

### Analysis

For the purposes of this study, the Department of Health assigned a unique identification number for each patient that was common across the VEMD and VAED. We used deterministic linkage<sup>8,9</sup> to link the two datasets to enable analysis of the trends in hospital admissions through EDs.

Demographic and clinical factors for all patients in the linked dataset were categorised according to age group, sex, principal diagnosis reflecting the medical reason for admission, hospital LOS and hospital discharge destination.

Age- and sex-specific admission rates per 1000 persons were calculated for each year, adjusting for population change over time. Log-linear regression was used to ascertain the effects of age and sex on the likelihood of admission. Changes across the 10-year period in primary diagnosis on admission, LOS and hospital discharge destination were analysed. Confidence intervals were generated to quantify precision of estimates. Stata version 11 was used for all analyses (StataCorp., College Station, TX, USA).

## Results

### All hospital admissions through EDs

The total number of patients admitted to metropolitan Melbourne public hospitals through the ED rose by 56% from 144 134 in 1999/2000 to 224 229 in 2008/2009. This represented an increase in rate from 42.6 to 55.7 ED admissions per 1000 persons. The greatest growth occurred for patients aged  $\geq 85$  years, with a 99% increase in volume over the study period. Table 1 summarises the increase in the number and rate per 1000 persons admitted to hospital through EDs from 1999/2000 to 2008/2009.

After adjustment for population changes in age and sex, the overall increase in the rate of hospital admission over the study period was 28% (95% CI 21–35%). This represents an average annual increase of 3.9% (95% CI 3.5–4.4%). Women were 16% less likely than men to be

**Table 1.** Growth in absolute numbers of ED admissions and ED admission rates/1000 persons through metropolitan Melbourne public hospitals by age group, 1999/2000 and 2008/2009, using linked Victorian Emergency Minimum Dataset/Victorian Admitted Episodes Dataset and Australian Bureau of Statistics population data

Age group (years)	No. and rate of hospital admissions through EDs		% increase in crude numbers
	1999/2000	2008/2009	
0–4	13 894	15 062	8.4
Rate per 1000 persons	64	59	
5–19	15 810	21 725	37.4
Rate per 1000 persons	24	29	
20–34	24 539	37 666	53.5
Rate per 1000 persons	31	39	
35–59	34 586	60 516	74.9
Rate per 1000 persons	30	45	
60–69	15 592	24 242	55.5
Rate per 1000 persons	61	70	
70–84	29 857	45 410	52.1
Rate per 1000 persons	121	157	
≥85	9856	19 608	98.9
Rate per 1000 persons	226	292	
All ages	144 134	224 229	55.6
Rate per 1000 persons	42.6	55.7	

admitted (95% CI 13–18%). The likelihood of being admitted rose with increasing age with patients aged ≥85 years seven times (incident rate ratio 7.1 [95% CI 6.7–7.5]) as likely as patients aged 35–59 years to be admitted to hospital through EDs.

### Hospital length of stay

Further investigation revealed that the majority of patients admitted through the ED had a same day/overnight LOS in hospital. Further analysis revealed that the overall rise in hospital admissions over the decade was significantly larger in same day/overnight admissions, increasing from 53% to 65% of all admissions through EDs in 1999/2000 and 2008/2009, respectively. Same day/overnight admissions increased by 92%, compared with a 15% rise in the number of multiday admissions over the study period. A comparison between numbers and rates per 1000 persons for patients with a same day/overnight LOS hospital admission and for those with a multiday LOS hospital admission is summarised in Figures 1–3.

### Same day/overnight hospital admissions

Log-linear regression adjusting for the effects of age and sex indicated a total increase in same day/overnight admissions of 60% over the study period (95% CI 53–67%) with 146 543 patients admitted in 2008/2009. This equated to an average annual increase in same day/overnight admissions of 6% per year (95% CI 5.7–6.5%). Women were 12% less likely than men to be admitted (95% CI –11 to –14%). Patients aged ≥85 years were 5.1 times as likely to be admitted for a same day/overnight stay as patients aged 35–59 years (95% CI 4.8–5.4; Table 2). In 2008/2009, 23% of same day/overnight admissions were aged 70 years or more.

There have been significant changes in certain diagnostic categories for same day/overnight admissions, as summarised in Table 3. Forty-eight per cent of the increase in same day/overnight admissions over 10 years was attributable to patients admitted with injury, digestive system or circulatory system problems. There were interesting changes to condition-specific management processes, particularly in the areas of chest pain (unspecified), abdominal pain and gastroenteritis.

### Hospital admissions with a length of stay ≥2 days

The volume of multiday patient admissions increased by 15% from 1999/2000 to 2008/2009; however, after accounting for changes in population structure, the admission rate per 1000 persons declined by 8.5% (95% CI –5 to –12%) over the time period. Women were 21% (95% CI –20 to –23%) less likely than men to be admitted. Likelihood of hospital admission for ≥2 days rose with increasing age, with patients aged ≥85 years 11.1 times as likely (95% CI 10.5–11.8; Table 2) as those aged 35–59 years to be admitted for ≥2 days. Thirty-one per cent of these multiday admissions were aged 70 years or over.

There were no significant changes in the numbers of patients admitted for ≥2 days for circulatory, respiratory or genitourinary problems; however, there was a marginal increase in the numbers admitted with digestive system problems and with an injury or poisoning. There were minor changes in condition-specific processes, particularly with a rise in admissions in the areas of congestive heart failure, gastroenteritis and urinary tract infections.

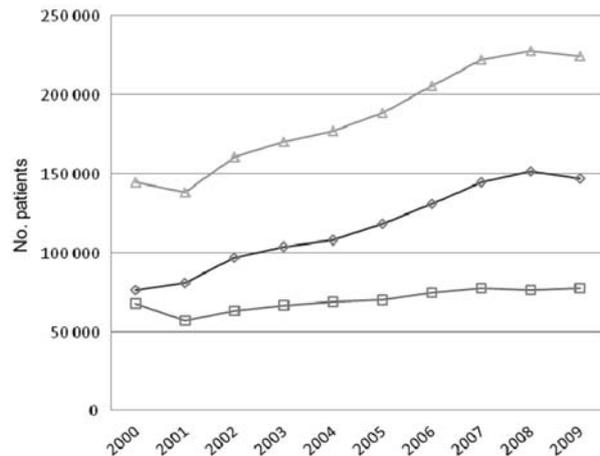
### Mortality

The absolute numbers and mortality rate declined over the study period, from 15 to 9 deaths per 1000 ED

**Table 2.** Adjusted log-linear model of the effects of age and sex on admission through metropolitan Melbourne public hospital EDs, 1999/2000 to 2008/2009 using linked Victorian Emergency Minimum Dataset/Victorian Admitted Episodes Dataset data

	All ED admissions IRR (95% CI, $P < 0.001$ )	Single-day ED admissions IRR (95% CI, $P < 0.001$ )	ED admissions $\geq 2$ days IRR (95% CI, $P < 0.001$ )
Female	0.84 (0.82–0.87)	0.88 (0.86–0.89)	0.79 (0.80–0.77)
Age group (years)			
0–4	1.7 (1.6–1.8)	1.7 (1.6–1.8)	1.7 (1.6–1.8)
5–19	0.71 (0.67–0.75)	0.73 (0.69–0.78)	0.67 (0.63–0.71)
20–34	0.97 (0.92–1.02*)	1.07 (1.01–1.14)	0.76 (0.70–0.80)
35–59	1.0	1.0	1.0
60–69	1.8 (1.7–1.9)	1.5 (1.4–1.6)	2.4 (2.3–2.5)
70–84	3.8 (3.6–4.0)	2.8 (2.6–2.9)	5.7 (5.4–6.1)
$\geq 85$	7.1 (6.7–7.5)	5.1 (4.8–5.4)	11.1 (10.5–11.8)

\*Not statistically significant ( $P < 0.06$ ). CI, confidence interval; IRR, incident rate ratio.

**Figure 1.** Hospital admissions by length of stay through metropolitan Melbourne EDs, 1999/2000–2008/2009, using linked Victorian Emergency Minimum Dataset/Victorian Admitted Episodes Dataset data.  $\circ$ — 1 day;  $\square$ —  $\geq 2$  days;  $\triangle$ — total.

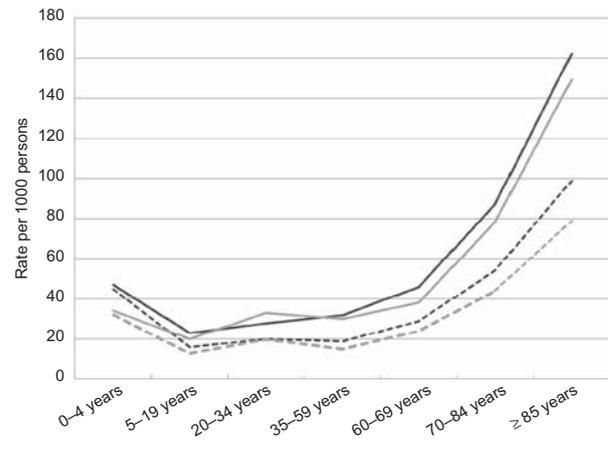
admissions for same day/overnight patients, and from 37 to 33 deaths per 1000 ED admissions for multiday patients in 1999/2000 and 2008/2009, respectively.

### Discharge destination

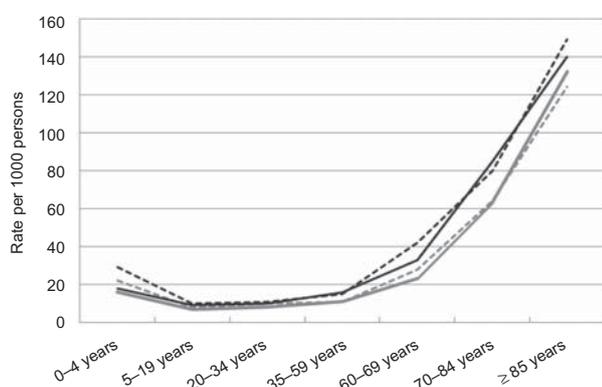
The majority of patients admitted to ward/SSOU were discharged home – 82% of same day/overnight patients and 79% of multiday patients in 2008/2009.

### Discussion

Our study has shown dramatic growth in the rate of same day/overnight admissions to public hospitals via

**Figure 2.** Hospital admission rates by age group and sex through metropolitan Melbourne EDs, 1999/2000–2008/2009, using linked Victorian Emergency Minimum Dataset/Victorian Admitted Episodes Dataset data for patients with a same day/overnight length of stay. --- 2000 male; ---- 2000 female; — 2009 male; — 2009 female.

EDs across metropolitan Melbourne over the 10 years to June 2009. With implementation of the National Emergency Access Target, these trends have major ramifications for acute health services that are currently struggling to cope. To our knowledge, this is the first Australian study to make this distinction, and is the first to measure the increase in admissions through EDs, while taking population changes into account. The increase in same day/overnight admissions was almost 60% after taking changes in demographic structure into account. This was in the context of a 32% growth in ED presentations beyond that explained by population changes over the same time period.<sup>1</sup>



**Figure 3.** Hospital admission rates by age group and sex through metropolitan Melbourne EDs for patients with a hospital length of stay  $\geq 2$  days, 1999/2000–2008/2009, using linked Victorian Emergency Minimum Dataset/Victorian Admitted Episodes Dataset data. ···· 2000 male; ···· 2000 female; —·—· 2009 male; — 2009 female.

A rise in the volume of emergency admissions to public hospitals has also been reported in the UK and Scotland since the mid 1990s.<sup>10–12</sup> Of note is that we measured a 56% increase in the number of hospital admissions through EDs over a 10-year period to 2008/2009, which was higher than the 12% growth reported in the latter 5 years in the UK. The UK has also experienced significant growth in short-stay admissions, defined as zero and one bed-day admissions.<sup>11</sup> Population growth has been similar in these countries over these time periods.

Older patients who present to EDs are at an increased risk of being admitted to hospital.<sup>13,14</sup> Our study confirms this, with patients aged  $\geq 85$  years more than 5 and 11 times as likely as 35- to 59-year-olds to be admitted to hospital overnight and for  $\geq 2$  days, respectively. It is reasonable to conclude that continuing ageing of the population is a contributing factor to the rise in ED admissions. Almost one-quarter of same day/overnight admissions were aged 70 years or more. Given the projected growth of this age group, we recommend exploration of appropriate evidence-based out-of-hospital care models for this age group, for example, mobile specialist teams, home-visiting general practitioners or nurse practitioners. In addition, the interface between hospitals and general practitioners is of vital importance for this more vulnerable age group in terms of handover and ongoing management issues.

The increased frequency of certain discharge diagnoses that has driven the rise in same day/overnight admissions suggests major changes in the process of

**Table 3.** Change over time in the volume of same day/overnight admitted patients by primary diagnosis

	2000	2009	% change
Total No. admissions through EDs	76 475	146 543	92
	<i>n</i>	<i>n</i>	
Circulatory disorders (total)	10 340	20 371	97
Heart disease			
Unstable angina	1431	1625	14
Atrial fibrillation and flutter	876	1932	120
Acute MI	560	1332	137
Chest pain unspecified	3413	8799	158
Cerebrovascular disease			
Transient ischaemic attack	363	865	138
Intracerebral haemorrhage	118	172	46
Stroke	198	250	26
Cerebral infarction	122	201	65
Respiratory disorders (total)	8243	13 319	62
Acute URTI unspecified	500	1098	120
Croup (acute obstructive laryngitis)	1010	639	–37
Acute tonsillitis unspecified	202	943	367
Asthma	2414	3545	47
COPD	792	1134	43
Pneumonia	973	1798	85
Digestive system disorders (total)	10 163	21 721	114
Constipation	706	1342	90
Gastritis unspecified	250	1276	410
Abdominal pain	3881	7072	82
gastroenteritis	1807	4497	159
Viral intestinal infection	298	791	165
Genitourinary disorders (total)	4363	9219	111
Calculus of ureter	415	646	56
Unspecified renal colic	1008	1287	28
UTI site not specified	845	2233	164
Injury, poisoning and external causes	18 486	30 832	67

care for conditions, such as undifferentiated chest pain, gastroenteritis and minor injuries. A risk-averse management approach could certainly play a role, as differential diagnosis helps optimise the quality of care and patient safety before discharge home from the ED. Accessibility to appropriate senior staff and 24 h pathology and imaging would also impact on timely diagnoses. Given the reduction in multiday admissions and significant rise in ED presentations on a population basis, it is likely that some of these short-stay admissions would have previously been multiday stays. Such substitution of longer LOS with same day/overnight admissions might be associated with hospital advancements in diagnostics alongside the advent of less inva-

sive procedures. In addition, some patients might be admitted for procedures previously conducted in an out-patient setting.

The rapid rise in same day/overnight admissions might reflect a change in the models of acute care. SSOU's were part of the Victorian Government's *Hospital Demand Management Strategy* initiative in 2001/2002. The aim was to improve the safety of patients requiring short-term assessment and/or management in a hospital setting before streamlined discharge.<sup>15</sup>

Such an increase in the volume and rate of same day/overnight admissions raises the question of whether some patients could have been managed in an alternative community-based setting<sup>11</sup> if they had not attended the ED. One could speculate that changes in the organisation of general practice alongside workforce shortages over the past decade,<sup>16</sup> and specialist appointment waiting lists affecting accessibility might influence the choice to use the ED as a source of healthcare.<sup>16,17</sup> In addition, changing community expectations for timely specialised care are also likely contributing factors.<sup>10</sup>

Population ageing and the growing chronic disease burden have increased the complexity of emergency care.<sup>18</sup> In addition, improved community health awareness and continuing advancements in medical technology heighten expectations for comprehensive quality care. Modern EDs afford emergency physicians a vast array of diagnostic and therapeutic capability. The relentless rise in ED attendances<sup>1</sup> and overcrowding together with incentives created by variable payments for ED performance under Casemix funding with time-based penalties<sup>19</sup> are likely to influence emergency care pathways. The possibility of a reduction in threshold to admit patients in the context of time-based targets in order to ensure that quality of care and patient safety is not compromised with unsafe discharge has been suggested by others.<sup>11</sup> The majority (82%) of same day/overnight admissions were discharged home in 2008/2009.

The strength of this study is that it is population-based, with analysis of 10 years of data derived from the deterministic linkage of two routinely collected datasets. The limitations associated with this process need to be recognised, as there is potential for a margin of error. Data linkage, in general, is dependent on the accuracy of the data and the accuracy of the linkage process; hence not all matches are perfect and sometimes true matches can be missed.<sup>20</sup> However, the large size of the dataset used minimises the potential for error. There were no missing data for the variables used in this analysis. A limitation is that our study did not analyse

the trends in re-attendance/re-admission over time. This study was based on routinely collected metropolitan data, hence the findings might not be generalisable to non-urban regions.

## Conclusion

Emergency hospital admissions have risen over the last decade even after adjustment for changes in population growth and age structure. There was a disproportionate rise in same day/overnight hospital admissions through EDs, with disproportionate representation of the elderly. This was associated with the introduction of SSOU's, together with changes in ED models of care to manage persisting demand for acute hospital-based care. It is highly likely that demand for same day/overnight admissions through EDs will continue to grow in the future, particularly in the context of time-based targets in EDs. This calls for an urgent need to investigate alternative models of community-based care, particularly to manage the acutely unwell elderly patients.

## Author contributions

Each author has contributed to the study design, analysis or interpretation, drafting or revision of the manuscript, and approval of the version.

## Competing interests

PAC is a Section Editor for *Emergency Medicine Australasia*.

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