Demand at the emergency department front door: 10-year trends in presentations

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Demand for emergency health care is rising consistently across the developed world, with the number of presentations to emergency departments (EDs) increasing by 3% to 6% per year.[1-4] ED performance is compromised by the resultant overcrowding,[5] increased waiting times and ED length of stay (LOS),[6] and ambulance diversion. Patient safety is threatened, as the risk of adverse events has been shown to be increased by overcrowding.[7]

Government agencies publish annual reports of ED performance that include presentation numbers,[1,3,4] and problems associated with rising demand are well documented in the peer-reviewed literature and the media.[8] However, there are few longitudinal analyses of routinely collected data. Therefore, we aimed to measure the volume and age-specific rates of ED presentations and ED LOS, and to investigate characteristics of ED utilisation across metropolitan Melbourne over the decade to 30 June 2009.

Methods

Study design and setting

We undertook a retrospective analysis of prospectively collected data describing presentations to public hospital EDs across metropolitan Melbourne over 10 financial years to June 2009. The study was approved by Monash University's Human Research Ethics Committee and the Victorian Department of Health.

De-identified data from the Victorian Emergency Minimum Dataset (VEMD)[9] were provided by the Victorian Department of Health. The VEMD contains demographic, administrative and clinical data recording patient-level presentations to Victorian public hospitals with 24-hour EDs. Data are collected by individual hospitals using standard definitions and protocols, to ensure interfacility comparability. Our analysis included data from metropolitan Melbourne

Abstract

Objectives: To measure the increase in volume and age-specific rates of presentations to public hospital emergency departments (EDs), as well as any changes in ED length of stay (LOS); and to describe trends in ED utilisation.

Design, patients and setting: Population-based retrospective analysis of Department of Health public hospital ED data for metropolitan Melbourne for 1999–00 to 2008–09.

Main outcome measures: Presentation numbers; presentation rates per 1000 person-years; ED LOS.

Results: ED presentations increased from 550 662 in 1999–00 to 853 940 in 2008–09. This corresponded to a 32% rise in rate of presentation (95% CI, 29%–35%), an average annual increase of 3.6% (95% CI, 3.4%–3.8%) after adjustment for population changes. Almost 40% of all patients remained in the ED for ≥ 4 hours in 2008–09, with LOS increasing over time for patients who were more acutely unwell. The likelihood of presentation rose with increasing age, with people aged ≥ 85 years being 3.9 times as likely to present as those aged 35–59 years (95% CI, 3.8–4.0). The volume of older people presenting more than doubled over the decade. They were more likely to arrive by emergency ambulance and were more acutely unwell than 35–59 year olds, with 75% having an LOS ≥ 4 hours and 61% requiring admission in 2008–09.

Conclusion: The rise in presentation numbers and presentation rates per 1000 person-years over 10 years was beyond that expected from demographic changes. Current models of emergency and primary care are failing to meet community needs at times of acute illness. Given these trends, the proposed 4-hour targets in 2012 may be unachievable unless there is significant redesign of the whole system.

EDs and excluded specialist maternity and eye and ear hospitals. We used Australian Bureau of Statistics annual population data[10] to calculate presentation rates by age and sex.

Data analysis

Data were obtained for financial years 1999–00 to 2008–09. Demographic and clinical factors for all presentations were categorised according to age group, sex, referral source, type of transport to the ED, Australasian Triage Scale (ATS) category, clinical diagnosis, ED LOS and discharge destination (Box 1).

We calculated annual age-specific and sex-specific presentation rates per 1000 person-years, adjusting for population changes over time. We used log-linear regression with weights inversely proportional to the variance of the outcome variable to model the effects of age and sex on ED presentations. We used descriptive statistics to compare trends from 1999–00 to 2008–09 in age, sex, referral source, transport type, triage category, primary diagnosis, ED LOS and dis-

charge destination. We examined changes over time in median ED LOS by triage category and age; and log-linear regression was used to model the effects of age, sex, mode of transport, triage category and admission or discharge from the ED on ED LOS over time. We used Stata, version 11 (StataCorp, College Station, Tex, USA) for all analyses.

Results

From 1999–00 to 2008–09, there were more than 7 million presentations to EDs in the Melbourne metropolitan area. The number of presentations rose from 550 662 in 1999–00 to 853 940 in 2008–09, a crude increase of 55% (Box 2). Population growth was 19% for this time period. The crude rate of ED presentation across all ages and sexes rose from 163 per 1000 person-years in 1999–00 to 212 per 1000 person-years in 2008–09.

Age-specific numbers and rates of presentations also increased. Median age rose from 31 years in 1999–00 to 34 years in 2008–09. Increases in presen-

1 Factors and VEMD categories used in the analysis

Referral source

Self/family/friends

Local medical officer/specialist

Transport arrival mode

Emergency ambulance (including helicopter)

"Walk-ins": arrival by private vehicle or community service

ATS category

1: Resuscitation

2: Emergency

3: Urgent

4: Semi-urgent

5: Non-urgent

Primary clinical diagnosis

ICD-10-AM diagnoses: external cause or poisoning, and illness

ED LOS

< 4 hours

≥ 4 hours

ED disposition

Discharge home

Admission to hospital (including short-stay observation units)

Transfer to another hospital

Left "at risk" (without being seen or without approval of ED clinical staff)

ATS = Australian Triage Scale. ED = emergency department. ICD-10-AM = International Classification of Diseases version 10, Australian modification. LOS = length of stay. VEMD = Victorian Emergency Minimum Dataset. ◆

2 Trends in absolute numbers of presentations to public hospital EDs* from 1999–2000 to 2008–2009, Melbourne, Victoria

	1999–00[†]	2008–09[†]	Difference	% change
No. of EDs	16	18	2	12%
Total no. of presentations	550 662	853 940	303 278	55%
Total population (million)	3.38	4.02	640 242	19%
Mean age (years)	35.3	37.7	2.4	8%
Median age (years)	31	34	3	10%
Males	292 414 (53%)	442 286 (52%)	149 872	51%
Referral source				
Self/family	445 122 (81%)	749 134 (88%)	304 012	68%
Doctor	65 454 (12%)	56 297 (7%)	– 9 157	– 14%
Arrival mode				
Emergency ambulance	123 247 (22%)	197 442 (23%)	74 195	60%
"Walk-ins"	415 560 (75%)	619 798 (73%)	204 238	49%
ATS category				
1	6 596 (1%)	7 352 (1%)	756	12%
2	37 135 (7%)	87 753 (10%)	50 618	136%
3	164 507 (30%)	280 433 (33%)	115 935	70%
4	276 213 (50%)	398 642 (47%)	122 442	44%
5	64 672 (12%)	77 447 (9%)	12 778	20%
Primary clinical diagnosis				
External causes	138 363 (27%)	195 686 (27%)	57 324	41%
Illness	376 079 (73%)	523 703 (73%)	147 624	39%
ED length of stay < 4 h	342 084 (62%)	517 103 (61%)	175 019	51%
No. ED bed-days occupied				
Discharged patients	56 541	81 102	24 561	43%
Admitted patients	44 662	80 054	35 612	79%
ED discharge destination				
Discharge home	371 559 (67%)	533 518 (62%)	161 962	44%
Admission to hospital ward	122 242 (22%)	141 550 (17%)	19 308	16%
Admission to SSOU[‡]	9 609 (2%)	77 877 (9%)	68 268	710%
Left "at risk"	30 640 (6%)	56 308 (7%)	25 668	84%

ATS = Australian Triage Scale. ED = emergency department. SSOU = short-stay observation unit.
* Excluding specialist maternity and eye and ear hospitals. † Data given as no. (%) unless otherwise indicated. ‡ Introduced from 2001–02. Source: Victorian Emergency Minimum Dataset. ◆

tation rates for each age group were of similar magnitude; the highest absolute rates were for the youngest and oldest age groups, both in 1999–00 and 2008–09 (Box 3). Of the population ≥ 85 years in 2008–09, 60% presented for emergency care; a presentation rate of 594 per 1000 people, compared with 438 per 1000 in 1999–00. In 2008–09, this age group comprised 4.7% of all ED presentations, and represented 1.7% of the population.

After adjustment for population changes, log-linear regression showed a 32.2% (95% CI, 29.2%–35.2%) increase in presentation rates per 1000 person-years over the decade. This represents an average annual increase of 3.6% (95% CI, 3.4%–3.8%). Women were 14.2% less likely to present than men (95% CI, 13.1%–15.4%). The risk of presentation rose with increasing age. Patients aged ≥ 85 years were 3.9 times (95% CI, 3.8–4.0) as likely as those aged 35–59 years to attend a metropolitan ED in 2008–09 (Box 4).

Descriptive analysis

The trends that have occurred in presentations to metropolitan Melbourne public hospital EDs over the decade are summarised in Box 2.

The number of self-referred presentations increased across all age groups by 68% (Box 2), with a 2.3-fold increase for patients aged ≥ 85 years.

Most presentations (73%) in 2008–09 were classified as "walk-ins". Although 23% arrived by emergency ambulance, this represented an increase in absolute numbers of 60% (Box 2). The likelihood of arriving by ambulance rose with increasing age, with a twofold increase for patients aged ≥ 85 years.

Throughout the study period, over half the presentations were classified as ATS category 4 or 5 (Box 2), with 47% aged 20–59 years in 2008–09.

However, the greatest absolute increase was among emergency and urgent patients (ATS category 2 or 3), who comprised 43% of all presentations in 2008–09. Forty-five per cent of all patients aged ≥ 85 years were classified into these more acute categories.

There were no significant changes in primary diagnoses over time. The most common external causes were injury or poisoning, and infectious and parasitic diseases, and the most common illnesses were respiratory, circulatory or digestive problems.

In 2008–09, most patients (61%) were discharged from the ED within 4 hours of arrival. Median LOS increased over the study period for more acutely unwell patients (ATS category 1, 2 or 3) and decreased for patients who were classified as less urgent (ATS category 4 and 5) (Box

3 Presentation rates per 1000 people, by age group, to public hospital EDs in Melbourne, 1999–00 to 2008–09*
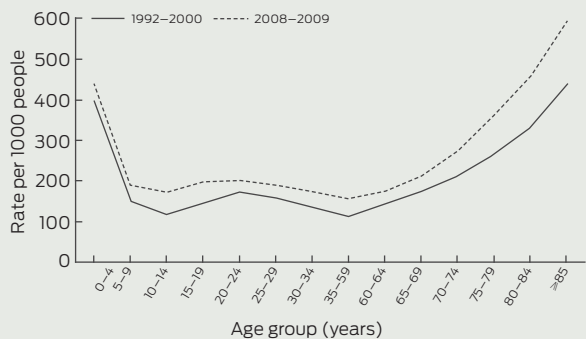
ED = emergency department. * Excluding specialist maternity and eye and ear hospitals; data adjusted for age and time. Source: Victorian Emergency Minimum Dataset. ◆

5 Trends in the proportion of all patients with an ED LOS < 4 h, by triage category, Melbourne public hospitals,* 1999–2000 to 2008–2009†

	1999–2000			2008–2009		
	No.	LOS < 4 h (%)	Median ED LOS (h)	No.	LOS < 4 h (%)	Median ED LOS (h)
Overall	550 662	342 084 (62.1%)	3.1	853 940	517 103 (60.6%)	3.3
ATS category						
1	6 596	3 384 (51.3%)	3.9	7 352	2 740 (37.3%)	5.2
2	37 135	15 994 (43.1%)	4.6	87 753	36 445 (41.5%)	4.8
3	164 507	85 522 (52.0%)	3.9	280 433	134 057 (47.8%)	4.2
4	276 213	180 763 (65.4%)	2.9	398 642	273 286 (68.5%)	2.8
5	64 672	54 924 (84.9%)	1.8	77 447	68 281 (88.2%)	1.6

ATS = Australasian Triage Scale. ED LOS = emergency department length of stay. * Excluding specialist maternity and eye and ear hospitals. † All differences were statistically significant, $P < 0.001$. Source: Victorian Emergency Minimum Dataset. ◆

4 Adjusted log-linear model looking at effects of age on public hospital ED presentations in Melbourne, 1999–00 to 2008–09*

Age group, years	Incidence rate ratio (95% CI)†
0–4	3.23 (3.19–3.38)
5–9	1.30 (1.26–1.34)
10–14	1.05 (1.02–1.09)
15–19	1.26 (1.22–1.30)
20–34	1.30 (1.28–1.33)
35–59	1.00‡
60–69	1.42 (1.40–1.52)
70–74	1.82 (1.80–1.91)
75–79	2.33 (2.31–2.42)
80–84	2.91 (2.83–3.01)
≥ 85	3.91 (3.82–4.01)

ED = emergency department. * Excluding specialist maternity and eye and ear hospitals; data adjusted for age, time and sex. † All results were statistically significant, $P < 0.001$. ‡ Reference group. Source: Victorian Emergency Minimum Dataset. ◆

5). Median LOS rose with increasing age within each ATS category (Box 6). Of patients aged ≥ 85 years, 75% had an LOS of ≥ 4 hours in 2008–09. Fixed effects modelling (Box 7) indicated that an LOS of ≥ 4 hours was associated with increasing age, being female, emergency ambulance arrival, being classified as ATS category 2 or 3, and admission.

Total hours of ED LOS increased for admitted patients by 79% (Box 2). In comparison, ED bed-days occupied for discharged patients rose by 43%.

Sixty-two per cent of patients were discharged directly home in 2008–09. The volume of patients admitted, including to a short-stay observation unit, rose by 79% over the decade

(Box 2), the rate increasing from 36 per 1000 person-years in 1999–00 to 55 per 1000 person-years in 2008–09. The likelihood of admission was greater with increasing age. In 2008–09, 61% of all patients aged ≥ 85 years were admitted — 22% were transferred to a short-stay observation unit and 39% to other wards (Box 8). In comparison, 21% of patients aged 20–59 years were admitted and 67% discharged, excluding those who left "at risk" (without being seen or before clinical approval) in 2008–09.

The proportion of patients leaving the ED at risk increased by 84% overall, representing 7% of all presentations in 2008–09 (Box 2). The largest proportion of patients who left at risk belonged to the 20–34 years age group, which showed a threefold increase over the study period.

Discussion

We confirmed a persistent rise in ED demand across metropolitan Melbourne, evidenced by an absolute increase of 55% in the volume of presentations over the decade to 2008–09. Older people presented at the highest per capita rate. The pressures on EDs are evident, with increases in LOS and higher frequencies of admission for older people. An abundance of literature recounts the problems associated with ED demand, but, to our knowledge, this is the first population-based longitudinal study of ED utilisation.

The trends observed represent an average annual growth rate of 3.6%

above that explained by population change. The 55% increase in the volume of ED patients surpasses the United Kingdom's 34% rise.[1] However, the presentation rate shown for Melbourne, at 212 per 1000 people in 2008–09, is lower than the UK rate of 305 per 1000 people.

Our finding that the per capita increase was highest among people ≥ 85 years concurs with other studies.[11-13] Our results here are also consistent with our recent study that demonstrated increasing and accelerating demand by older people for emergency ambulances.[14] Older patients had longer LOS and were more likely to be admitted than middle-aged patients. Given projected trends in population ageing, the trends shown in our study are likely to have a dramatic impact on all aspects of emergency and hospital care. An ED visit for an older person is a sentinel health event that can lead to substantial functional decline and other adverse outcomes.[15]

In 2008–09, most patients were classified as semi-urgent or non-urgent, and almost 50% were of working age (20–59 years). This age group was predominantly self-referred, arrived by their own means, were classified as less acute and were not admitted (data not shown), which suggests they could have been managed appropriately in community-based settings.

The increase in patients who left at risk was notable. Most of these were aged 20–34 years, more likely to be ATS category 4 or 5 with an LOS of < 4 hours (data not shown), which

implies lower urgency. The 6.6% in our study is higher than the 3.4% leaving at risk in the UK.[16] Patients most often leave due to protracted waiting times.[17] UK figures may be lower because of previously mandated 4-hour targets.

ED attendance by lower acuity patients could be related to changes in primary care service delivery. An association has been reported between ED utilisation and reduced general practitioner accessibility and increasing GP copayments.[18] Furthermore, EDs may appeal to people of working age, with the convenience of 24-hour, hospital-based, specialised multidisciplinary health care with no copayments.[19]

Over the study period, ED LOS increased for more urgent and admitted patients, suggesting much of the ED burden is associated with admitted patients. This could be related to overcrowding and increased waiting times from rising demand and access block.[20] The contribution of overcrowding to adverse outcomes is well documented.[7,20] Longer LOS is also associated with greater risk of short-term mortality and adverse events in patients requiring admission.[21] Increases in ED LOS have implications for the implementation of the 4-hour National Emergency Access Target.[22] This Australian health reform initiative, designed to address ED waiting times, currently proposes 90% of patients be admitted, referred elsewhere or discharged within 4 hours.[22,23] The increase in LOS suggests this target may not be achievable in the current system of care and context of persisting growth in demand, particularly by older patients. Introduction of this target must be accompanied by strategies to ensure patient safety is not compromised.[23]

Governments and service providers have progressively responded to demand for emergency health care with varied initiatives. The Victorian Hospital Demand Management Strategy, launched in 2001, targeted funding for EDs and new hospital-based models of care, including fast-track triage, care-coordination teams, short-stay observation units and medical planning units.[24] Ambulance services have also introduced strategies intended to divert need for transportation. With population ageing, demand for both ambulance and hospital services will continue to rise.

Increasing efficiency alone is unlikely to meet this demand. Fundamental restructuring of our models of care is necessary. Initiatives providing increased medical and nursing support for residential care and improved community-based chronic care programs are already being piloted. Expectations of the care that emergency health services should provide for older people also need discussion.

The strength of this population-based study is that it analysed 10 years of data including >7 million ED presentations. This study was based on routinely collected metropolitan data; hence the findings may not be generalisable to non-urban regions. Data quality and consistency are reliant on clinicians and clerical staff who work in an environment fraught with multiple distractions.[25] We have attempted to identify factors underpinning the increase in demand; however, routinely collected data may not identify all the elements.

We question whether current models of emergency and primary care are failing to meet community needs. This is a major cause for concern, considering the investment that has been made to date in the many interventions targeting demand. There is no routine capture of information about many factors that are thought to affect ED demand. These include access to GPs, patients' expectations of timely care, and the convenience of a 24-hour "one-stop shop". Urgent clarification of the impact of such factors is needed, to provide the evidence base on which to design alternative strategies for managing demand.

6 ED median LOS for all presentations, by age group, Melbourne public hospitals, 2008−09*
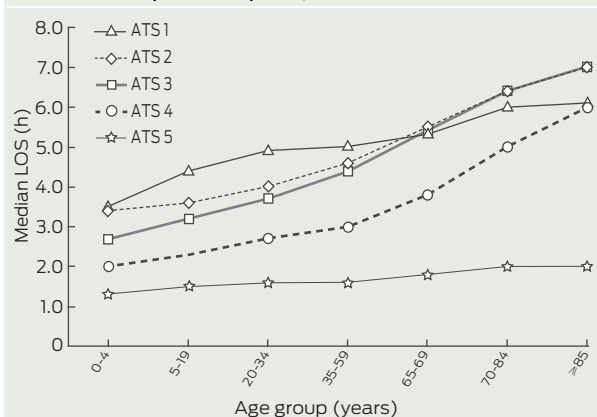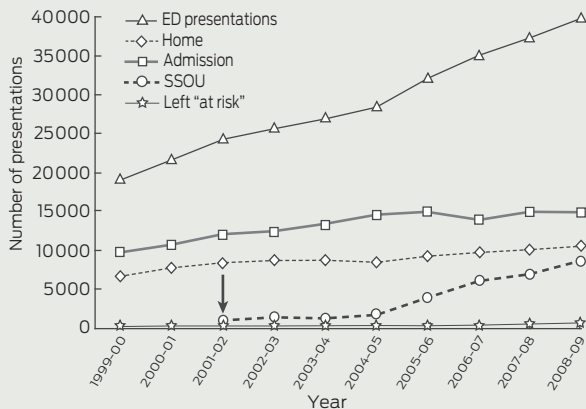

ATS = Australasian Triage Scale. ED = emergency department. LOS = length of stay. * Excluding specialist maternity and eye and ear hospitals. Source: Victorian Emergency Minimum Dataset. ◆

7 Multivariate model* of factors associated with an ED LOS ⩾ 4 hours, Melbourne public hospitals[†] 1999−2000 to 2008−2009

	Odds ratio (95% CI)[‡]
Age group (years)	
0–4	0.34 (0.34–0.35)
5–19	0.45 (0.45–0.46)
20–34	0.78 (0.77–0.79)
35–59	1.00[§]
60–69	1.37 (1.35–1.39)
70–84	1.76 (1.74–1.79)
⩾85	2.18 (2.13–2.22)
Sex	
Male	1.00[§]
Female	1.15 (1.14–1.16)
Arrival mode	
Emergency ambulance	1.75 (1.73–1.76)
Walk-in	1.00[§]
ATS category	
1	0.53 (0.51–0.55)
2	1.21 (1.19–1.22)
3	1.38 (1.37–1.39)
4	1.00[§]
5	0.41 (0.40–0.42)
Disposition from ED	
Not admitted	1.00[§]
Admitted[¶]	5.92 (5.83–6.14)

ED LOS = emergency department length of stay. * Adjusting for the effects of age group, sex, mode of arrival, clinical acuity, and ED disposition. † Excluding specialist maternity and eye and ear hospitals. ‡ All results were statistically significant, P < 0.001. § Reference group. ¶ Including to short-stay observation unit. Source: Victorian Emergency Minimum Dataset. ◆

8 Discharge destination for patients aged ⩾ 85 years from public hospital EDs, Melbourne, 1999–00 to 2008–09*

ED = emergency department. * Excluding specialist maternity and eye and ear hospitals. Denotes introduction of short-stay observation units (SSOUs). Source: Victorian Emergency Minimum Dataset. ◆

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