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**INCREASING DEMAND FOR
EMERGENCY PATIENT SERVICES:
UNDERLYING DRIVERS, IMPLICATIONS
AND POTENTIAL SOLUTIONS**

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A thesis submitted for the degree of Doctor of Philosophy



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December 2011

“The goal is to transform data into information, and information into insight”

Carly Fiorina

Chairwoman, Hewlett-Packard Co (2000-2005)

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACEM	Australasian College of Emergency Medicine
AV	Ambulance Victoria
ED	Emergency Department
ED LOS	Emergency Department Length of Stay
ERP	Estimated Residential Population
GP	General Practitioner
ICD-10	International Classification of Diseases, Tenth Revision
LGA	Local Government Area
LOS	Length of Stay
SLA	Statistical Local Area
SSOU	Short Stay Observation Unit
STR	Standardised Transportation Ratio
VACIS	Victorian Ambulance Clinical Information System
VAED	Victorian Admitted Episodes Dataset
VEMD	Victorian Emergency Minimum Dataset

GLOSSARY

Casemix funding	An activity-based funding model, based on the average cost of treating patients
Demand	What people ask for, a measure of desire
Emergency demand	A felt need for emergency healthcare - when attendance at a health service is used as a proxy for need
Emergency patient services	Emergency ambulance and emergency department services
General Practitioner	Primary care doctor
Medicare	Australia's publicly funded universal health care system, operated by the Commonwealth Government. Medicare ensures that all Australians have access to free or low-cost medical, optometrical and hospital care while being free to choose private health services and in special circumstances allied health services. Medicare provides access to: free treatment as a public (Medicare) patient in a public hospital, free or subsidised treatment by doctors. Australia's public hospital system is jointly funded by the Australian Government and state and territory governments and is administered by state and territory health departments.
Presentation	A single visit to an Emergency Department by a patient
Residential Aged Care Facility	Nursing care home, where patients are dependent on nursing care
Triage	A classification of clinical urgency comprising 5 categories from Category 1 (most time critical) to Category 5 (least time critical)

CANDIDATE'S GENERAL DECLARATION

Monash Research Graduate School

Monash University

Declaration for thesis based or partially based on conjointly published or unpublished work

In accordance with Monash University Doctorate Regulation 17/ Doctor of Philosophy and Master of Philosophy regulations the following declarations are made:

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes 5 original papers published in peer reviewed journals and 3 unpublished manuscripts. The core theme of the thesis is increasing demand for emergency patient services. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of me, the candidate, working within the Department of Epidemiology and Preventive Medicine under the supervision of Professors McNeil, Cameron and Stoelwinder.

The contribution of co-authors to jointly authored manuscripts is outlined in the declaration accompanying each publication in the Thesis.

In the case of Chapters 1, 2, 4, 5, 6, 7 and 8, my contribution to the work involved the following:

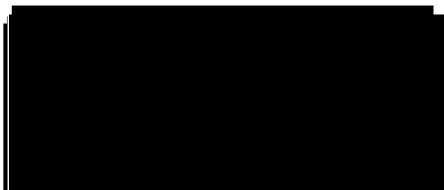
Thesis chapter	Publication title	Publication status	Nature and extent of candidate's contribution
1	Emergency demand access block and patient safety: a call for national leadership	Published <i>Emerg Med Aust</i> 2009; 21: 435-439	Principal author, responsible for literature search, development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.
2	Increasing utilisation of emergency ambulances.	Published <i>Australian Health Review</i> 2011; 35:63-9	Principal author, responsible for study design; search, collection and review of potentially relevant articles; selection and interpretation of articles used in the study; development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.
2	Systematic review of trends in emergency department attendances: an Australian Perspective	Published <i>Emerg Med J</i> 2011; 28: 373-377 pub on-line 20 Oct 2010	Principal author, responsible for study design; search, collection and review of potentially relevant articles; selection and interpretation of articles used in the study; development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.

Thesis chapter	Publication title	Publication status	Nature and extent of candidate's contribution
4	The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995-2015.	Published <i>Med J Aust</i> 2011; 194:574-578 rapid on-line pub 23 May 2011	Principal author, responsible for overall study concept design, literature review, preparation of dataset for analysis, development of Stata analysis codes; analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.
5	Demand at the ED front door: Ten-year trends in Emergency Department presentations	Accepted for publication <i>Med J Aust</i> Accepted 21 Nov 2011; publication date 6 February 2012	Principal author, responsible for overall study concept design, literature review, coding and recoding of variables and all preparation of datasets for analysis, development of Stata analysis codes, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.
6	Emergency demand and re-presentations by older patients - longitudinal trends 2000 to 2009	Prepared for submission	Principal author, responsible for overall study concept design, literature review, coding and recoding of variables and all preparation of datasets for analysis, development of Stata analysis codes, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.

Thesis chapter	Publication title	Publication status	Nature and extent of candidate's contribution
7	Why older patients with lower acuity choose to attend the Emergency Department.	Under Review <i>Int J Med</i> Nov 2011	Principal author, responsible for overall study concept design, literature review, development of patient interview tool, interviews of all patients, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.
8	Trends in hospital admissions through Emergency Departments, 2000 to 2009: Rising demand from short-stay patients	Prepared for submission	Principal author, responsible for overall study concept design, literature review, coding and recoding of variables and all preparation of both VEMD and VAED datasets for analysis, development of Stata analysis codes, linkage of the 2 data sets, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.

I have renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Signed:



Date: Tuesday, December 13, 2011

ASSOCIATED PUBLICATIONS, PRESENTATIONS AND AWARDS

PEER-REVIEWED PUBLICATIONS

Lowthian JA, Curtis A, Jolley D, Stoelwinder J, McNeil J, Cameron P. Demand at the ED front door: Ten year trends in Emergency Department presentations. *Med J Aust* Accepted for publication 21 Nov 2011

Lowthian JA, Jolley D, Curtis A, Currell A, Cameron P, Stoelwinder J, McNeil J. The challenges of population ageing: Accelerating demand for emergency ambulance services by older patients, 1995-2015 *Med J Aust* 2011; 194(11): 574-578 eMJA Rapid Online Publication 23 May 2011

Lowthian JA, Curtis AJ, Stoelwinder JU, Cameron PA, Cooke MW, McNeil JJ. Systematic review of trends in emergency department attendances: an Australian perspective *Emerg Medicine J* 2011; 28(5):373-377 originally published online 20 October 2010

Lowthian JA, Cameron P, Curtis A, Currell A, Stoelwinder J, Cooke M, McNeil J. Drivers of increasing utilisation of emergency ambulances: a review of the literature *Aust Health Rev* 2011; 35(1):63-9

Lowthian JA, Cameron P. Emergency demand access block and patient safety: a call for national leadership *Emerg Med Australasia* 2009; 21(6):435-439

MANUSCRIPT UNDER REVIEW

Lowthian JA, Smith C, Stoelwinder J, Smit deV, McNeil J, Cameron P. Why older patients of lower clinical acuity choose to attend the Emergency Department. *Submitted Int J Med* 26 Nov 2011

CONFERENCE PRESENTATIONS - ORAL

Lowthian JA, Curtis A, Jolley D, Stoelwinder J, McNeil J, Cameron P. Demand at the ED front door: Is the four hour target the answer? Australasian College of Emergency Medicine, Sydney 2011

Lowthian JA, Jolley D, Cameron PA, Curtis AJ, Currell A, Stoelwinder JU, McNeil JJ. Persisting accelerated demand for emergency ambulances by the elderly: 1995-2008. Australasian College of Emergency Medicine, Canberra 2010 (Abstract published in *Emerg Med Aust* 2011)

Lowthian JA, Jolley D, Cameron PA, Curtis AJ, Currell A, Stoelwinder JU, McNeil JJ. Accelerated demand for emergency ambulances by the elderly in Melbourne: 1995-2008. Australasian College of Ambulance Professionals Conference, Perth 2010

Lowthian JA, Jolley D, Cameron PA, Curtis AJ, Currell A, Stoelwinder JU, McNeil JJ. The accelerating demand by the elderly for emergency pre-hospital services in Melbourne: 1995-2008. International Conference on Emergency Medicine, Singapore 2010

Lowthian J, Cameron P, Jolley D, Currell A, Stoelwinder J, McNeil J. Changes in the metropolitan emergency workload of Ambulance Victoria: 1995 to 2005. Australasian College of Emergency Medicine Conference, Melbourne 2009 (Abstract published in *Emerg Med Aust* 2010)

INVITED PRESENTATIONS

Lowthian J. Ambulance Demand Trends – past and future. Victorian Department of Health Funding and Policy Division, Melbourne - May & July 2011

Lowthian J. Emergency Demand and Patient Flow: Pre-hospital services. CREPS Emergency Management Course, Melbourne 2010

CONFERENCE PRESENTATIONS - POSTER

Lowthian J, Curtis A, Jolley D, Stoelwinder J, McNeil J, Cameron P. Who enters the front door? Ten year trends in Emergency Department presentations across Melbourne, Australia: 2000-2009. American College of Emergency Physicians Research Forum, San Francisco 2011 (Abstract published in *Annals of Emerg Med* Oct 2011)

Lowthian J, Cameron P, Stoelwinder J, Curtis A, Currell A, Cooke M, McNeil J. Increasing utilisation of emergency ambulances: possible underlying drivers. Australasian College of Emergency Medicine Conference, Melbourne 2009 (Abstract published in Emerg Med Aust 2010)

Lowthian J, Cameron P, Jolley D, Currell A, Stoelwinder J, McNeil J. Changes in the metropolitan emergency workload of Ambulance Victoria: 1995 to 2005. Monash Higher Degree Research Student Poster Exhibition 2008 (*Awarded Faculty Prize*)

AWARDS

NHMRC Public Health Postgraduate Scholarship (579733) 2009 - 2011

Monash Postgraduate Travel Award 2010

Monash Higher Degree Research Student Poster Exhibition Faculty Prize 2009

ADDITIONAL RESEARCH ACTIVITY DURING CANDIDATURE

Throughout my candidature, I held a part-time academic staff appointment. This enabled me to be involved in numerous other research projects and teaching post-graduate students. The following publications and conference activities reflect some of these activities.

PEER-REVIEWED PUBLICATIONS

Lowthian JA & Curtis AJ, Comitti BL, Cameron PA, Keogh MJ, Johnson WR, Tomlinson J, Stripp AM. Streamlining elective surgery care in a public hospital: the Alfred experience. *Med J Aust* 2011; 194(9): 448-451

Diug B, Evans S, **Lowthian J**, Maxwell E, Dooley M, Street A, Wolfe R, Cameron P, McNeil J. The unrecognised psychosocial factors contributing to bleeding risk in warfarin therapy. *Stroke* 2011; 42(10):2866-71 Epub 2011 Aug 11

Lowthian J, Joyce C, Diug B, Dooley M. Patient safety in primary care: Are general practice nurses the answer to improving warfarin safety? An Australian perspective. *Worldviews on Evidence Based Nursing* 2011; 1st Qtr: 25-29 Epub 2010 Dec 23

Lowthian J, Diug B, Evans S, Maxwell E, Street A, Piterman L, McNeil J. Who is responsible for the care of patients on warfarin therapy? *Med J Aust* 2009; 190:674-677

GOVERNMENT REPORTS

Brand C, Jolley D, Cameron P, Evans S, Andrianopoulos N, **Lowthian J**. Advice on Methodology for Patient Safety Culture Survey. 2010 for Victorian Quality Council / Victorian Managed Insurance Agency

GRANTS / TENDERS

Cameron P, Smit deV, Newnham H, Hunter P, Brand C, Barker A, **Lowthian J**
Determining best practice for safe discharge for the older emergency patient –
SEED (Safe Elderly Emergency Discharge) Alfred Health Research Trusts
2011/2012 – 2013/2014, \$500,000

Brand C, Jolley D, Cameron P, Evans S, Andrianopoulos N, **Lowthian J**. Advice on
Methodology for Patient Safety Culture Survey. Victorian Quality Council/
Department of Health 2010, \$10,000

CONFERENCE PRESENTATIONS – ORAL (FIRST AUTHOR)

Lowthian J, Cameron P, Smit P deV, Newnham H, Hunter P, Brand C, Barker A
Determining best practice for safe discharge for the older emergency patient –
SEED (Safe Elderly Emergency Discharge) Australasian College of Emergency
Medicine Conference, Sydney 2011

Lowthian J, Diug B, Evans S, Maxwell E, Street A, Piterman L, McNeil J.
Collaborative Patient Care with Warfarin Therapy, Australasian Association of
Quality in Health Care Conference, Sydney 2009

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ABSTRACT

The rise in demand for emergency patient services is a significant issue for the health system. The ever increasing burden on emergency transportation services, emergency departments (EDs) and acute hospitals has implications for resourcing and the quality of care delivered. Governments and service providers have responded with various strategies, however demand for emergency healthcare continues to rise. Ageing of the population is also an important issue for health service planning.

Reviews of the international and national literature of trends in the utilisation of emergency ambulance and ED services suggested numerous factors including ageing were associated with the rise in emergency demand. However it was apparent that emergency demand had not been investigated systematically from an epidemiological perspective.

Therefore the aim of this thesis was to analyse the main elements of the persistent rise in demand across metropolitan Melbourne, with a particular focus on clarifying how the ageing population impacts on emergency demand.

Longitudinal analyses was undertaken, of emergency ambulance transportations, ED presentations and admissions to hospitals through EDs using unique population-based datasets. Numbers and rates of emergency ambulance transportations, ED presentations and emergency admissions from EDs; and ED and hospital length of stay were analysed. Regression models evaluated the effects of multiple factors on these outcomes.

The volume and rates of utilisation of all emergency health care services over the study periods increased beyond that expected from changes in population growth and ageing.

The study of emergency ambulance transportations provides new evidence about an acceleration in usage by the elderly. All emergency transportations rose

by an average annual rate of 4.8%. Predictive modelling suggested further increase up to 69% by 2015.

Investigation of the trends in all ED presentations were analysed and demonstrated a similar increasing disproportionate representation of the elderly over a 10 year period. It was also established that a subgroup of the elderly make multiple visits to EDs; and over 50% of elderly patients are admitted to hospital following ED presentation.

The overall average annual rate of increase in ED presentations by all age groups was 3.6%. ED length of stay increased over the study period for those who were older, more acutely unwell, and required hospital admission. As it was not possible to understand all the factors associated with the rise in ED presentations, a descriptive study explored patient perspectives through qualitative interviews. Reduced accessibility to general practitioners and an expectation of timely accessible specialist care were the main reasons underpinning their attendance at a metropolitan ED.

Further analysis of patients admitted to hospital from EDs discovered that the growth in emergency hospital admissions was driven by a 60% increase in the number of single day/overnight admissions. This represented an average growth rate of 6.1% per year. This rise in short-stay hospital admissions from EDs may signal that there has been a shift in patterns of care in the ED. It also raises the question of whether ED attendance by this group of patients was necessary.

The significance of this thesis is the identification and measurement of the rise in emergency demand, but with an increasing and accelerating usage of emergency health services by older patients, together with a growing propensity of this subgroup re-present to EDs over time. With population ageing, demand by the elderly will continue to rise and will have a dramatic impact on all elements of emergency healthcare in the future. This information is valuable for policy makers and service providers. It indicates a pressing need to consider how to develop coordinated systems of care, particularly for the elderly seeking acute care.

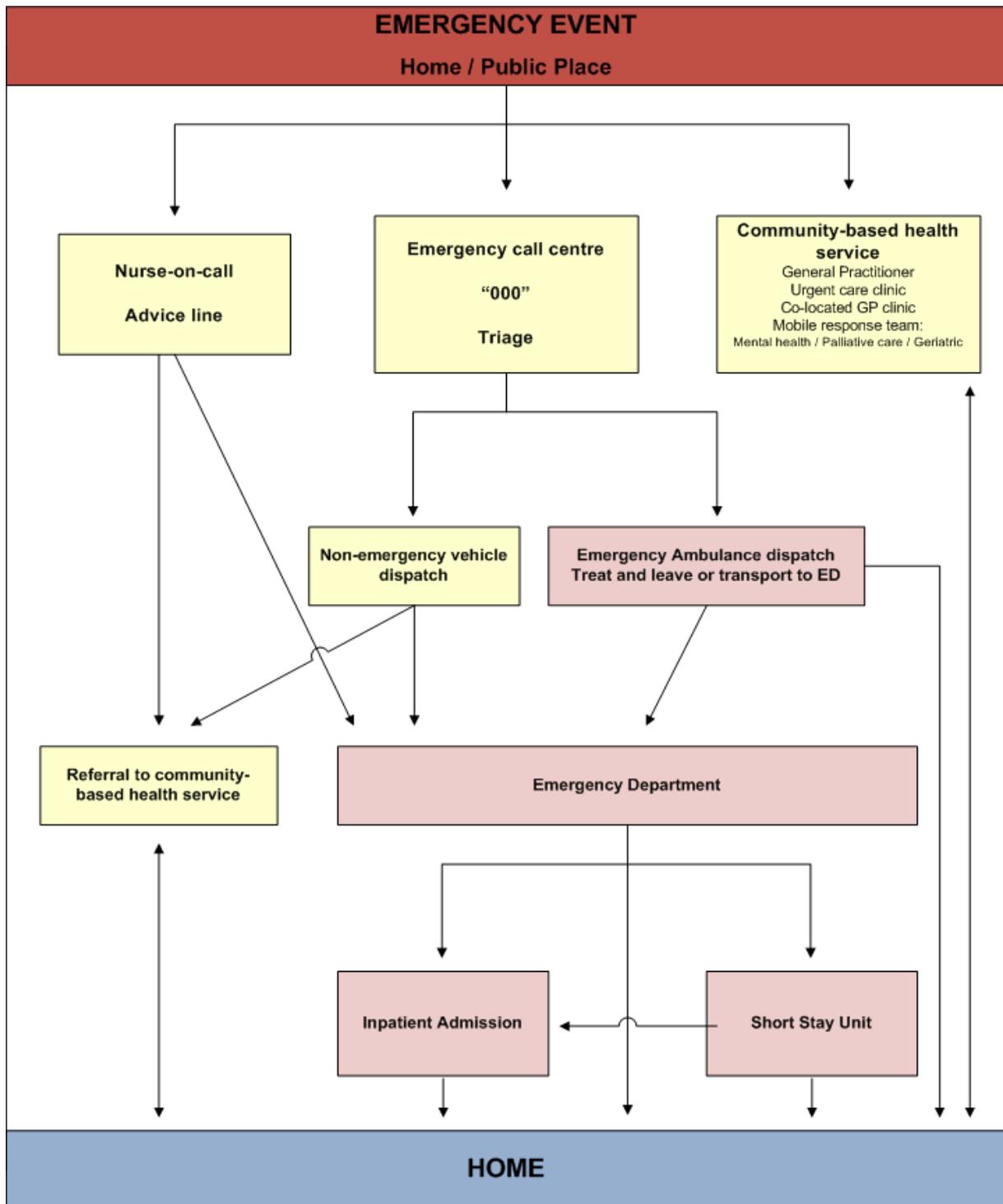
CHAPTER ONE: INTRODUCTION

1.1 THE DEMAND FOR EMERGENCY HEALTH CARE

The increasing burden on acute hospital care and patient flow resulting from a persistent rise in demand for emergency health care is of major concern nationally and internationally. Changing demography, technological advancements in diagnostics and treatments and heightened expectations from better informed patients culminate in an ever-increasing demand for healthcare, including emergency care.¹

Emergency healthcare in Australia is delivered within a range of inter-connected settings: in the community by general practitioners (GPs), urgent care clinics, community-based and community outreach specialist teams and ambulance service paramedics; and in acute hospital Emergency Departments (EDs). Ambulance services, hospital EDs and their supporting acute beds constitute the components of specialist emergency care, as shown in Figure 1.

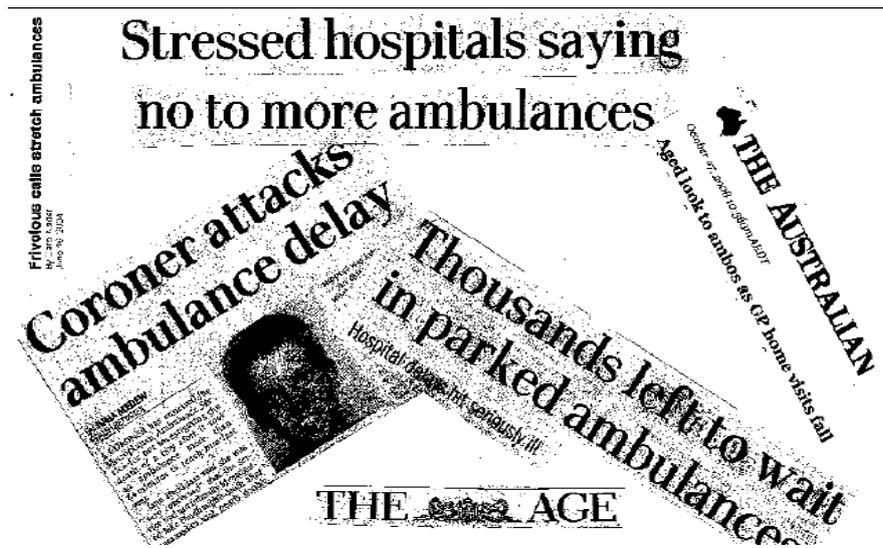
Figure 1: Melbourne’s emergency healthcare system



The elements shaded pink are the subject of this research

Various audits commissioned by State authorities report that demand for both emergency ambulance and hospital-based services across Australia has increased year on year, culminating in significant growth over the past decade.²⁻⁸ The rise in demand places pressure on the acute health system. Congestion and overcrowding of Emergency Departments (EDs) and ambulance bypass compromise access to emergency care, and pose a threat to patient care and patient safety.^{9 10 11} Delayed access together with diversion to other EDs impedes ambulance service capacity to respond to other emergencies. These issues are referred to frequently by the media¹²⁻¹⁴ (Figure 2) and in the peer-reviewed literature.¹⁵⁻¹⁸ Growth in emergency demand is reported across the developed world, with rising demand for ambulance services occurring in parallel with increased ED attendances.^{10-13 19-24}

Figure 2: Media headlines

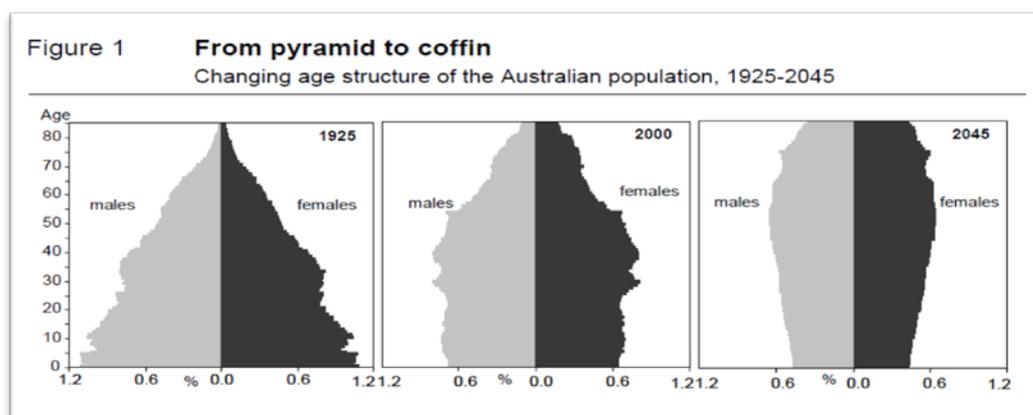


Changing demographics and the increase in life expectancy are regularly referred to in association with growth in utilisation of health services.²⁵ Australia's population has been growing at an average annual rate of 1.75% since 2004/2005, estimated to be 22.8 million in December 2011.²⁶ Although growth is expected to slow over the next 40 years to an average rate of 1.2% per annum;

²⁷ it is projected that Australia's population will rise to between 30.9 and 42.5 million by 2056. ²⁸

As with other developed countries, Australia's age structure is shifting upwards as a result of declining fertility and delayed mortality (Figure 3). Population projections predict that the proportion of people aged ≥ 65 years will increase over the next 25 years from the current levels of 13% to 25% of the population. The proportion of those aged ≥ 85 years will rise from 1.5% to 5% of the population. ²⁹

Figure 3: Australia's shifting age structure



From: "Economic Implications of an Ageing Australia: Productivity Commission Research Report 2005. Canberra" ³⁰

The increase in life expectancy and survival has been partly attributed to improvements in diagnoses and available treatments. ³¹ The impact of the gains in life expectancy on health services cannot be ignored. The growing burden of chronic disease disproportionately affects the elderly, with over half of the Australian population aged ≥ 65 years reporting a disability, whereby 19% report profound limitations. ³² In addition, the proportion of people needing assistance with one or more core self-care activities due to a health condition or disability lasting more than 6 months rises with age. Six percent of 60-64 year olds, 29% of 80-84 year olds, and 68% of those aged ≥ 90 years require assistance with such activities. ³³

Therefore it is not surprising that health service consumption and health expenditure are also increasing. Although the population aged ≥ 65 years

comprise 13% of the population, they consume over 30% of all Medicare services. Overall health expenditure per capita by this age group in 2004/2005 was just over four times that of those <65 years - on average A\$7973 for those aged ≥65 years, versus A\$1944 for people aged <65 years.³⁴ Demand for public hospital bed-days is projected to increase by between 70% and 130% by 2050, with the number of bed days devoted to older people predicted to increase from a 50% share to in excess of 70%.³⁵ As a consequence of population ageing there will continue to be a substantial increase in demand for health services.

However, finite resources require the demand for health care to be managed by providing appropriate and timely care in the most effective, efficient and equitable manner, meeting health care needs in a balanced order of priority whilst not impacting negatively on patient safety.³⁶ In order to manage increasing emergency demand effectively, there is a need for systematic assessment of the underlying drivers. Whilst service providers and governments publish annual reports on emergency health service utilisation, to date there has been little attempt within Australia, to methodically analyse the trends and patterns over time from an epidemiological perspective.

1.2 CONSEQUENCES OF INCREASING EMERGENCY DEMAND

Increased demand for emergency patient services is associated with ED overcrowding, which hinders ED performance. This is aggravated further by the increase in numbers of patients being admitted to hospital from ED. Difficulties in accessing inpatient beds from ED culminate in an obstruction of patient flow through the acute continuum of care (Figure 4).

Figure 4: Emergency Department overcrowding



source: Courtesy of Peter Cameron

The delay experienced by patients waiting for an inpatient bed is referred to as access block³⁷. The consequences of access block include delayed time-critical care, greater risk of adverse events, as well as increased morbidity and mortality^{18 38}. As such, access block is an indicator of ED safety and quality as described in the following Editorial.

1.3 PUBLICATION: EMERGENCY DEMAND, ACCESS BLOCK AND PATIENT SAFETY

CO-AUTHOR DECLARATION FOR PUBLICATION INCLUDED IN THESIS

Monash University

Lowthian JA, Cameron PA. Emergency demand, access block and patient safety: A call for national leadership [Editorial] *Emergency Medicine Australasia* 2009; 21:435-9

Declaration by candidate

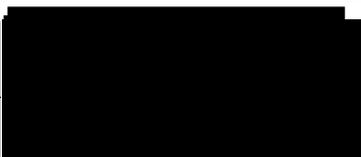
In the case of the publication in Chapter 1, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for literature search, development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	80

The following co-author contributed to the work:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Peter A Cameron	Contributed to review and editing of the manuscript	N/A

Candidate's Signature

	Tuesday, 13 December 2011
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Declaration by co-author

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
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Co-Author signature		Date
		Tuesday, 13 December 2011



Emergency demand access block and patient safety: A call for national leadership

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See also pp. 472–8

There is increasing pressure on ED caused by a relentless increase in ED attendances and rising emergency admissions. This is compounded by the challenge of reduced inpatient bed access. In this issue of *Emergency Medicine Australasia*, Richardson and colleagues confirm that access block is worsening, having increased nationally by an average of 27% over the 4 years to September 2008.¹ Of interest is the reported improvement in patient flow attributed to the ‘patient journey’ project, despite continuing rising demand throughout this time period in New South Wales. It is not clear whether this has been sustained. Richardson *et al.* conclude that hospitals have possibly reached saturation point regarding efficiency in managing patient flow. These findings will be no surprise to ED clinical staff, who have consistently stated that the problem extends beyond the walls of individual hospitals.^{2–4} The causes for this access block are known and solutions are evident. It is now time that leadership is shown at both clinical and policy levels to stop the problem.

The Australasian College for Emergency Medicine (ACEM) defines an excessive wait for an inpatient bed as greater than 8 h,⁵ the UK defines it as 4 h⁶ and Western Australia has followed suit. However, in the context of comparison within and between countries, it is pertinent to also consider how access block is defined and measured. For example, ACEM includes the time of arrival to departure from the ED in their calculation,⁷ whereas New South Wales Health has excluded ED waiting time, commencing their computation at the time

the patient is attended to by a doctor.⁸ This latter measure fails to include time delay attributable to hold-up in processes associated with ED overcrowding, and therefore underestimates the overall delay experienced by the patient. The time is also subject to manipulation. There are many ways of measuring access block, including total patient time in ED,⁷ time from medical assessment to departure time and collective ‘total access block time’.⁸ It is essential for benchmarking to occur that all states collect data in a standardized fashion, which can be verified by outside agencies.

Is access block an indicator of ED safety and quality?

Whichever way it is analysed,⁹ access block leads to diminished ED performance and restricted access to timely urgent care, thus representing a threat to patient safety. There are multiple consequences of access block that place patients at risk of a poor outcome: overcrowding, whereby ED capacity is exceeded by the number of patients waiting to be seen, undergoing assessment and treatment or awaiting discharge; increased burden in caring for patients whose emergency treatment has ceased but are awaiting an inpatient bed; increased likelihood of adverse events; and ED blockage with ambulance diversion.¹⁰

Demonstrable evidence of an association with adverse events^{10,11} includes an estimated annual

20–30% excess mortality rate corresponding to 1500 additional deaths directly attributable to access block and ED overcrowding, using data from 2003.^{12,13} In addition, prolonged length of stay in the ED has been associated subsequently with increased inpatient length of stay,^{14,15} and disruption to elective surgery.¹³ As such, access block can be interpreted as a quality indicator for safety in the ED.

Causes of access block

The underlying causes of access block relate to the increase in emergency demand together with a decreased hospital bed capacity to meet these needs.

Emergency demand

Since 2003/2004, the number of emergency attendances has risen nationally by 73% from 4.1 million to 7.1 million in 2007/2008. This represents an increase from 202 to 321 ED presentations per 1000 persons.¹⁶ Rising demand is not limited to Australia, as the UK, New Zealand, Canada and the USA also report increased ED attendances since the 1990s, with current annual increases ranging from 3% to 6%.^{17–20} The underlying drivers of this increase in demand are thought to be multifactorial.

Ageing

Population ageing is a likely contributor, with the fastest growth of ED attendances in recent years in the 75+-year-old age group.^{21–24} Underlying reasons include the growing prevalence of chronic medical conditions and the incidence of age-related acute illnesses and cognitive or physical dysfunction, with 19% of Australians aged >65 years reporting a disability.²⁵ Compounding this are changes in social structure. Wider participation of middle-aged women in the workforce and erosion of the extended family has decreased capacity for family to care for older relatives.²⁶ In addition, government policies encourage older people to remain living in their homes, with the majority of those aged >65 years now living alone.²⁷ Ensuing fragmentation of support can lead to vulnerability, and there is evidence that loneliness and limited social support are associated with a much higher ED attendance rate by the elderly.^{28–30}

Mainstreaming of care

Encouragement for mainstreaming of care within the community also includes de-institutionalization of

mental health patients.³¹ This is thought to have contributed to the increased attendance by patients with mental health problems, which rose 10-fold over a 10 year period at one South Australian ED.³² Other studies of repeat ED attendees have noted a high incidence of psychiatric illness and substance abuse.^{33–35}

Organization of service delivery

Changes in health care practice and the medical workforce have resulted in the reduced availability and access to general practitioners.^{36,37} Studies cite lack of access to a general practitioner as one of the patients' reasons for attending an ED.^{24,38,39} Furthermore, improvements in accessibility to quality emergency care from specialist paramedic and emergency physicians for low or no cost raises the question of moral hazard as another potential driver of demand. The convenience of a 'one-stop shop' with availability of total care from a specialist alongside relevant diagnostics has also been cited by patients as a reason for attendance.³⁹

Health promotion and threshold for seeking care

Health promotion activities and mass media campaigns have raised the general public's awareness about the desirability of seeking early medical attention for a variety of conditions. This might reduce the threshold for seeking care by patients and health professionals. Although alluded to in one study,⁴⁰ this does not appear to have been quantified in relation to emergency service use in Australia. However, presentations by 75+-year-olds increased following a health screening program in the UK,⁴¹ and stroke presentations increased to Canadian ED following a media campaign.⁴²

The extent to which each of the above factors contributes to increasing demand is yet to be established. Despite this, strategies should be implemented to reduce ED presentations.

Emergency admissions and bed capacity

The impact of demand on ED access is exacerbated by an increasing number of patients requiring admission from the ED. In 2007/2008, 28% of ED presentations were admitted.¹⁶ However, there has been no increase in hospital capacity with the number of available public beds remaining at 1998/1999 levels at 2.6 beds per 1000 persons,¹⁶ plus an additional 1.2 private beds per 1000 persons.⁴³ In combination, this means that our national acute bed availability lies below that of the Organisation for Economic Co-operation and Development

(OECD) average of 3.9 acute care beds per 1000.⁴⁴ However, almost 60% of the population are unable to access these additional private beds, leaving the public hospital bed capacity well below the OECD average. In-hospital bed capacity is also directly affected by access to community residential facilities. In many circumstances, acute hospital beds are used as inappropriate substitutes for more long-term residential care.

Solutions attempted

Access block and overcrowding became a critical issue in Australia, the UK, Canada and the USA in the 1990s.^{2,10,45-47} By the late 1990s, emergency physicians through their professional associations and peer-reviewed journals began to initiate organizational changes primarily at the level of the individual hospital.^{3,10,45,48-50} Variable but generally positive improvement occurred in access block in a number of ED around Australia following implementation of changes throughout 2001/2002.⁴⁸ Of particular interest was the reported striking improvement at Royal North Shore Hospital following a hospital-wide focus on discharge planning and centralization of bed management.⁴⁸ However, the study commissioned by ACEM in 2008 suggested that this progress has not been sustained, as 40% of ED workload was devoted to caring for patients awaiting admission following completion of their emergency treatment.⁵¹

Recommended solutions

Solutions lie with effective short-term operational changes at a hospital level in conjunction with long-term systemic policy change. Operational change requires strong clinical leadership within and across hospitals. Although bed capacity is important, an increase in capacity without changes across the system will not resolve access block. The most effective solution will be to also reconfigure the wider system. With the relentless rise in the number of patients seeking care at ED, it is essential to take an upstream approach to reduce the demand on emergency services through system reform.

Long-term systemic policy change

In addition to the current focus on prevention and early intervention, reform would include expansion of

hospital outreach programs and primary health services to include multidisciplinary health teams providing coordinated care for the elderly and patients with chronic disease in the community. Furthermore, targeted media campaigns could potentially educate the community and health professionals⁵² on the appropriate and timely use of community and emergency health services. In addition, clinical and policy leadership is required to prioritize access to care. At present, priority access is decided by the length of the queue, either on the elective waiting list, or the ramp in an ED. Many patients are denied access to appropriate care, with its good evidence to support improved outcomes, whereas costly treatments with minimal evidence of effectiveness are provided.

System redesign

System redesign is a key recommendation of the National Health and Hospitals Reform Commission.⁵³ One of the priorities recognized was 'timely access to quality care in public hospitals, particularly care in emergency departments...'. Although increased funding to guarantee bed availability for emergency admissions features as a key recommendation of the commission, it is unlikely that this will occur in the immediate future, given the current state of the economy, nor will it resolve access block. The National Health Service in the UK have determined that bed occupancy rates above 82% lead to a high risk of access block and cancellation of elective surgery.⁵⁴ In this context, consideration should be given by the Federal Government to assist hospitals to maintain such levels of occupancy that enable a degree of flexibility to manage the fluctuations in demand, without compromising patient safety. The key to this will be to ensure appropriate bed use, to fund public hospital bed numbers to at least an OECD average level, and to balance elective and emergency demand with seasonal fluctuations. Simplistically stating that hospitals should maintain 15% of beds free for ED demand is not workable in a capped federally funded public health system. The capacity to flex beds in individual wards across hospitals (including varying staff: bed ratios), providing that there is tight bed management, could enable hospitals to manage variable demand.

Conclusion

Access block is a problem that extends beyond the walls of hospitals, with solutions in the hands of hospital

administrators, policy-makers and politicians. Clinicians must provide leadership to ensure that workable solutions are developed. We have to move beyond the simplistic approach of constant redesign projects that attempt to improve hospital and ED efficiency, and instead look at more fundamental issues.

A uniform national measurement would provide a consistent benchmark across the country. We must increase the capacity of hospitals to manage variable emergency demand to approximately 15% of base-level bed stock. We need to identify and mitigate drivers for increased emergency demand. Most importantly, we must discuss a rational approach to prioritization of effective medical care that is not determined by the length of an ED ramp, or days on an elective waiting list.

Acknowledgement

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Competing interests

Nil.

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This Editorial described the nature and consequences of access block in the context of increasing emergency demand and its detrimental impact on acute hospital flow. Governments and service providers have responded to emergency demand with a variety of initiatives, as described in the Editorial. In addition, ambulance service providers in the United Kingdom (UK) and Australia have introduced strategies to divert the need for transportation to EDs^{39 40}. New models of care have also been introduced including collocated urgent care clinics, specialist mobile response teams, fast-track triage, care-coordination teams, short stay observation units and medical planning units.^{41 42}

The effectiveness of the impact of these demand management strategies is uncertain,⁴³ as growth in emergency demand has persisted. It is possible they have had an effect; however these interventions have targeted patient flow at the level of individual service providers rather than from a broader health system perspective.

Previous research and annual reports published by Health Departments provide evidence of a persistent rise in the utilisation of emergency ambulance and emergency department services, albeit in studies over short time frames or of individual service providers. A number of potential associated influences have been proposed, however to date, analysis of the factors associated with the apparent increased demand for emergency patient services has been limited.

Therefore it is timely to undertake a systematic examination to facilitate untangling the dynamics of the increase. Understanding the trends and underlying associated factors is fundamental to inform service providers and policy makers. This will help the planning and restructuring of services and allocation of resources across the health care continuum with targeted demand management strategies.

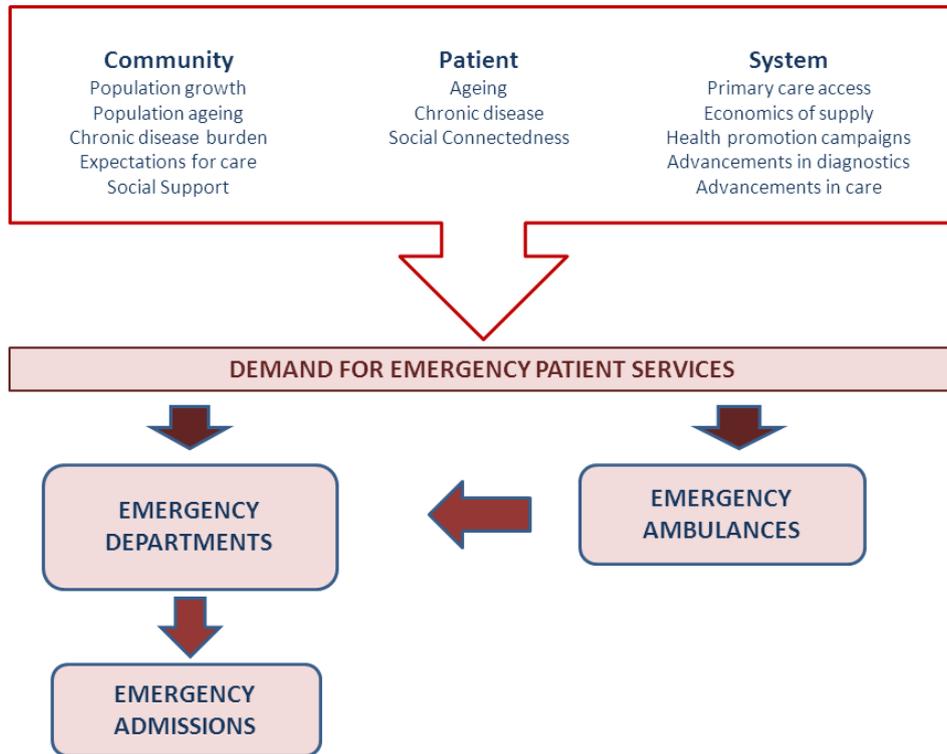
1.4 THESIS AIMS AND OBJECTIVES

The overarching aim of this thesis is to improve the evidence base regarding the epidemiology of the increase in demand for emergency patient services, in the context of population ageing. Rigorous methods will be used to systematically investigate the trends in demand for emergency patient services. The objectives of this program of research are:

- I. To identify and synthesise studies and service provider reports relevant to trends in the utilisation of emergency ambulance and ED services through a systematic review of the literature
- II. To measure the longitudinal changes in the volume and rate of transportation by emergency ambulances, presentation to EDs and hospital admission through the ED across metropolitan Melbourne
- III. To measure the contribution of changes in the demographic structure of the population to changes in emergency demand
- IV. To explore other possible patient, community and health system factors associated with changes in demand

Figure 5 overleaf highlights factors thought to be associated with the rise in demand.

Figure 5: Influences hypothesised to underpin the rise in demand

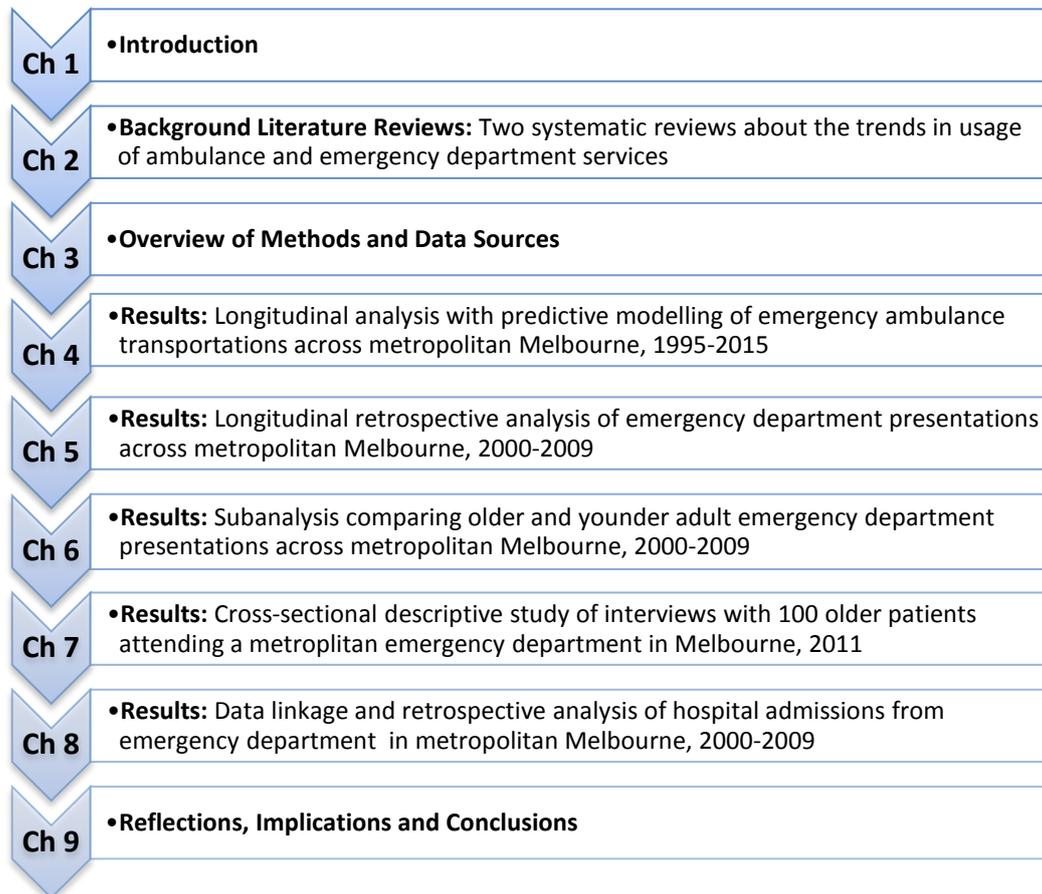


In order to meet these objectives, five inter-related studies were designed by the researcher to collectively investigate the nature of emergency demand across metropolitan Melbourne. Changes in emergency ambulance utilisation were measured over the time period 1994/1995 to 2007/2008. Changes in emergency hospital service utilisation were analysed between 1999/2000 to 2008/2009.

1.5 SCOPE AND OVERVIEW OF THESIS

This thesis consists of 9 chapters, as outlined in Figure 6.

Figure 6: Structure of Thesis



Chapter 1 has described the motivation and rationale for this research program and thesis, which arises from an environment of changing consumption of health services, specifically a persisting rise in demand for emergency patient services. A publication *“Emergency demand, access block and patient safety: A call for national leadership”* highlights the effect of increased demand and ED overcrowding on ED performance and acute hospital flow.

Chapter 2 provides the context for this thesis with review of the literature. This includes two publications that synthesise and evaluate research undertaken internationally and nationally over the past twenty years on the factors associated with emergency demand: *“Increasing utilisation of emergency*

ambulances” and “Systematic review of trends in emergency department attendances: an Australian perspective.”

Chapter 3 outlines the framework and study design of the inter-related projects developed to collectively investigate the nature of emergency ambulance and hospital service utilisation. This chapter details the numerous data sources drawn upon for the thesis. The methodology for each study is outlined in the relevant chapters.

Investigation of the trends in demand for emergency ambulance transportations is detailed in Chapter 4 in a publication: *“The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995-2015.”* This study includes the use of modelling to measure the growth in transportations over the 14 years 1994/1995–2007/2008 and to forecast future demand to 2015.

Chapter 5 provides a descriptive analysis of the variation in trends and factors associated with ED presentations in the ten years since 1999/2000 with discussion about the proposed Four Hour Target designed to reduce ED demand in a manuscript accepted for publication: *“Demand at the ED front door: Ten-year trends in Emergency Department presentations.”*

Chapter 6 describes a sub-analysis of the trends and characteristics associated with ED presentations by older age groups. This complements the publication in Chapter 5, with a paper entitled *“Emergency demand and re-presentations by older patients – longitudinal trends 2000 to 2009”*.

Some of the factors thought to be associated with emergency demand are not represented in the information collected at the time of ED presentation. The manuscript in Chapter 7, *“Why older patients with lower clinical acuity choose to attend the Emergency Department”* explores through a series of patient interviews, whether their perceptions of accessibility to primary healthcare and social isolation are associated with older patients seeking health care at a metropolitan ED.

Chapter 8 reviews the trends in emergency admissions over the ten years to 2008/2009. This study encompasses data linkage of two distinct hospital-based datasets to expand the data. A manuscript *“Trends in hospital admissions through Emergency Departments: Rising demand from short-stay patients”* examines the changes in the length of stay over time for patients admitted through the ED.

The final chapter offers reflections that draw together key themes and issues arising from the studies conducted. This chapter discusses the aims and key findings of the thesis; the merits and limitations; implications for policy and practice, and recommendations for future research. Whilst study specific discussions and conclusions are provided in Chapters 4 to 8, Chapter 9 provides a broad overview of this body of work and its implications.

1.6 SUMMARY

This chapter has broadly outlined the rationale and aims of this research program, as well as delineating the scope and objectives with a summary of each chapter.

CHAPTER TWO: BACKGROUND LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides a review and synthesis of the literature pertaining to the increases in utilisation of emergency health services since the late 1980's. Previous research describes the impact and consequences of increasing demand on acute hospitals, however there is a dearth of literature about the nature of the change in demand for ambulance services. Various studies have highlighted individual factors associated with increased utilisation of emergency health services, however they have not been described and synthesised in a systematic manner.

The review of the literature is presented in the form of two publications, one focused on utilisation of emergency ambulances and the other on attendances at hospital emergency departments. The first is a narrative review *Increasing utilisation of emergency ambulances* which synthesises the research on the underlying factors of ambulance demand. This is followed by a *Systematic review of trends in emergency department attendances*. These reviews, conducted during 2009 – 2010, provide the foundation for this research program.

2.2 PUBLICATION: INCREASING UTILISATION OF EMERGENCY AMBULANCES

CO-AUTHOR DECLARATION FOR PUBLICATIONS TO BE INCLUDED IN THESIS

Monash University

Lowthian JA, Cameron PA, Stoelwinder JU, Curtis AJ, Currell A, Cooke MW, McNeil JJ. Increasing utilisation of emergency ambulances. *Australian Health Review* 2011; 35:63-9

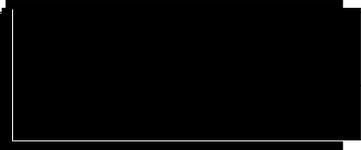
Declaration by candidate

In the case of the publications in Chapter 2, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for study design; search, collection and review of potentially relevant articles; selection and interpretation of articles used in the study; development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	80

The following co-authors contributed to the work:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Peter A Cameron	Contributed to review and editing of the manuscript	N/A
Johannes Stoelwinder	Contributed to review and editing of the manuscript	N/A
Andrea J Curtis	Contributed to review and editing of the manuscript	N/A
Alex Currell	Contributed to review and editing of the manuscript	N/A
Matthew W Cooke	Contributed to review and editing of the manuscript	N/A
John J McNeil	Contributed to review and editing of the manuscript	N/A

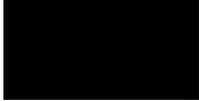
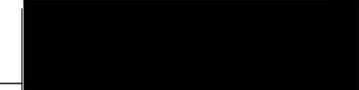
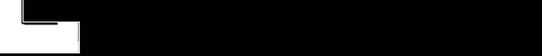
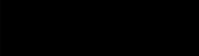
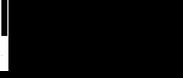
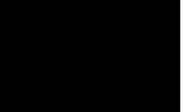
Candidate's Signature		13 December 2011
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Declaration by co-authors

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- (3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
- (4) there are no other authors of the publication according to these criteria;
- (5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
- (6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location	Department of Epidemiology and Preventive Medicine Monash University
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Co-Authors signatures	Date
	26 October 2011
	26 October 2011
	27 October 2011
	1 July 2011
	1 October 2011
	28 November 2011

Increasing utilisation of emergency ambulances

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Abstract

Background. Increased ambulance utilisation is closely linked with Emergency Department (ED) attendances. Pressures on hospital systems are widely acknowledged with ED overcrowding reported regularly in the media and peer-reviewed literature. Strains on ambulance services are less well-documented or studied.

Aims. To review the literature to determine the trends in utilisation of emergency ambulances throughout the developed world and to discuss the major underlying drivers perceived as contributing to this increase.

Method. A search of online databases, search engines, peer-reviewed journals and audit reports was undertaken.

Findings. Ambulance utilisation has increased in many developed countries over the past 20 years. Annual growth rates throughout Australia and the United Kingdom are similar. Population ageing, changes in social support, accessibility and pricing, and increasing community health awareness have been proposed as associated factors. As the extent of their contribution has not yet been established these factors were reviewed.

Conclusion. The continued rise in utilisation of emergency ambulances is placing increasing demands on ambulance services and the wider health system, potentially compromising access, quality, safety and outcomes. A variety of factors may contribute to this increase and targeted strategies to reduce utilisation will require an accurate identification of the major drivers of demand.

What is known about the topic? Ambulance utilisation is increasing annually throughout the developed world, with previous research suggesting numerous underlying factors.

What does this paper add? These factors have not been previously synthesised in the international literature. This narrative review clearly articulates the underlying problems.

What are the implications for practitioners? This paper outlines the need for further research of the causes of increased emergency ambulance utilisation, to enable the development of appropriate strategies to manage demand in the future.

Additional keywords: ambulances transportation, pre-hospital services, trends.

Background

In Australia, as in other developed countries, there is an expectation that the health system will fulfil our care needs, especially those that are acute, urgent and life threatening. The role of ambulance services has evolved over the past 20 years into a vital community resource embedded in the health system. Initially designed as an emergency transport service, ambulance services now provide a range of healthcare needs, including pre-hospital emergency and urgent primary care, emergency and non-emergency patient transport, and referrals to alternative healthcare professionals.

In recent years escalating growth in demand for emergency patient services has placed increasing strain on both ambulance and hospital resources. Rising utilisation of ambulances is occurring in common with increased Emergency Department (ED) attendances¹. Pressures on hospital systems are well recognised, with congestion and overcrowding reported regularly in the media² and peer-reviewed literature.³

The aim of this paper has been to review the literature concerning trends in utilisation of emergency ambulances throughout the developed world and to discuss the major underlying drivers perceived to be contributing to this increase. A better understanding of causes of increased demand is essential to enable the development of strategies to manage demand in the future.

Method

For this review, a search was conducted of the online databases of Ovid Medline and PubMed from 1996 to 2009. Keywords used included 'ambulances', 'pre-hospital care' (Ovid), 'paramedic', 'paramedic prehospital' (PubMed), 'utilisation', 'ambulance transport', 'trends', 'health services needs and demand', and 'healthcare utilisation' (see Appendix).

The titles of manuscripts were initially screened for inclusion; and abstracts of ambiguous titled papers were reviewed (where available). This search was supplemented by a web-based search through Google and Google Scholar. Finally, references of the chosen articles and audit reports were scanned by the first author, in an attempt to ensure relevant papers had not been overlooked by the initial search. In addition manual searches were conducted of relevant journals and grey literature including service provider reports from Australia, New Zealand, the United Kingdom, Canada and the United States of America. This search was limited to literature written in English that described usage of emergency ambulances in developed countries.

Articles were included if they focussed on trends in transportation by emergency road ambulances, or described the factors underlying the increase. Excluded manuscripts are described in Fig. 1.

Findings

This search yielded various service provider reports and 298 peer-reviewed articles pertaining to trends in patterns of utilisation of emergency ambulances. After screening for relevance, 45 articles and reports were drawn on for this review (Fig. 1).

Demand on ambulance services encompasses several aspects of service provision by the service provider, including receipt of calls for assistance, emergency vehicle dispatch, paramedic

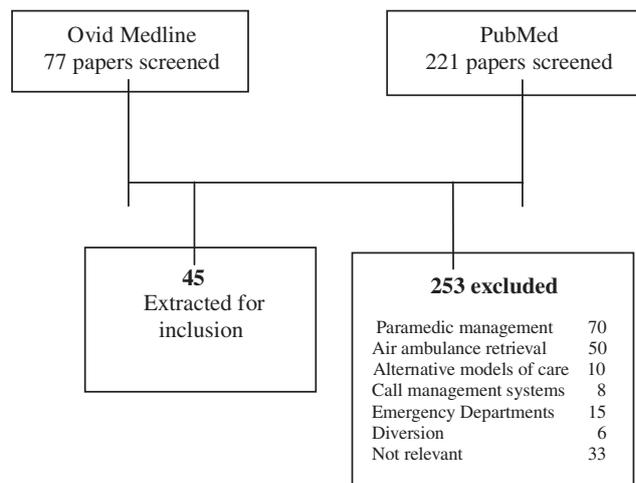


Fig. 1. Results of peer-reviewed literature searches.

attendance at the scene, and treatment or transportation of patients. In order to tease out the underlying factors that drive overall demand, we reviewed papers focussing on trends and patient characteristics associated with transportation by emergency ambulances.

In the studies identified, it was apparent that the research to date, and the information collected by service providers, has focussed principally on the volume of reported events and patient transports over varying time periods. Few studies have investigated the possible association between the rise in usage with patient, community or health system factors.

Evidence of increasing utilisation of emergency ambulances

The majority of peer-reviewed publications identified were from the UK, and the USA, with additional reports from service providers sourced from the Internet. International studies and service provider reports identified by this review covered different time periods, hindering a comparative analysis over time. However, there was evidence that the numbers of patients transported by emergency ambulance services has increased over the past two decades in many developed countries.

In summary:

- The emergency workload of the London Ambulance Service 'doubled' between 1989 and 1999,⁴ the number of patients transported to EDs having increased at an average annual rate of 8.9%.⁵ This trend has continued with 7% growth in London between 2007–08 and 2008–09⁶;
- In the USA, a national survey of ambulatory care in 2005 reported a 25% increase in all ambulance arrivals at EDs since 1997⁷;
- In Canada there was a rise of 20% over between 2003–04 to 2008–09⁸; and
- In New Zealand growth in incidents in the year ending 2007–08 was 20%.⁹

Three Australian papers were identified, with each describing increased utilisation; however, their prime focus was to

describe possible predictive factors.^{10–12} Ambulance services are organised at a State level. Service providers, the Council of Ambulance Authorities Inc. and the Productivity Commission provide data on all aspects of services rendered annually to the Federal Government. These reports indicate an annual rise in ambulance responses ranging from 7% per annum to 12.5% per annum since 1996.^{1,13–18} In the year ending 30 June 2008, the number of patients transported increased across Australia by 5.4%.⁹

Discussion

The sustained increase in emergency ambulance demand throughout the developed world has been attributed to a range of drivers. Population ageing, changes in social support, accessibility and pricing, and increasing community health awareness have been postulated. The extent of their contribution has not yet been established; as such it is reasonable to review these factors.

Population growth and ageing

Generally demand for ambulances is growing faster than can be explained by population growth. Australia's annual population growth is currently 1.7%,¹⁹ making little contribution to increased utilisation of emergency ambulances. However, the population is ageing, which has been cited as contributing to the rise since the early 1980s. American researchers Gerson and Shvach,²⁰ McConnell and Wilson²¹ and Rucker *et al.*²² identified patients aged ≥ 65 years were almost twice as likely to use emergency ambulances compared with those < 65 years, with a concomitant incremental increase in usage from 65 to 85+ years of age.²³ Australian and British studies found a similar association in the late 1990s.^{10,11} Review of London Ambulance Service's workload at that time showed consistently high rates for patients greater than 75 years old over a 10-year period. Despite this there was no statistical evidence that call rates had increased disproportionately in any particular age group.⁴

The associated increase in utilisation with ageing is likely due to the growing prevalence of chronic medical conditions and incidence of age-related acute illnesses and cognitive or physical dysfunction.²¹ In support of this, over half of the Australian population aged > 65 years reported a disability, with 19% reporting profound limitations.²⁴ The impact of age-related health conditions on ambulance services is demonstrated by a study showing that 85+ year olds utilised ambulances at five times the rate of patients aged 45–64 years, due to cardio-respiratory problems, fall-related injuries or advanced life support needs.²⁵ Recent data from Ambulance Victoria demonstrates the incremental increase in utilisation by patients aged 65+ years (Fig. 2) (Ambulance Victoria, Historical utilisation rates, pers. comm., 2008).

Although some evidence supports the association of increasing age and associated morbidities with increased emergency services usage, analysis of one Australian service provider indicated that only 25% of growth in emergency ambulance usage between 1996 and 2001 was attributable to ageing and population growth.²⁶ This indicates that other factors may make a substantial contribution.

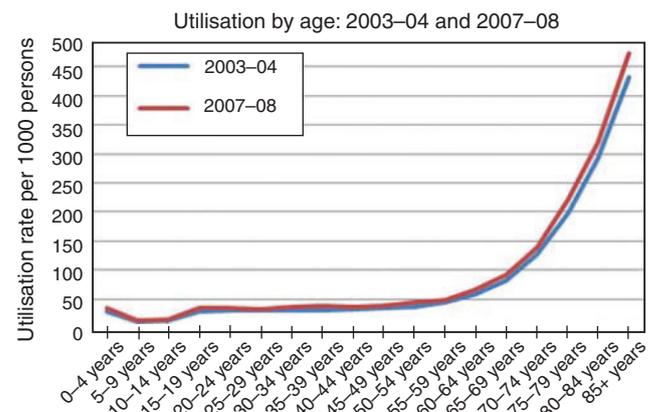


Fig. 2. Utilisation per 1000 persons by age 2003–04 to 2007–08. Source: data courtesy of Ambulance Victoria.

Social support

Changes in social support may contribute to rising ambulance utilisation. Increased usage was associated with living alone,²² and limited access to alternative transport has been cited as a contributing factor to rising usage.²⁷ In contrast, patients with a current or previous partner were less likely to use ambulance resources than those who remained single.¹⁰

The number of Australians approaching older age who are living alone, divorced, widowed or never married has increased over the past thirty years.²⁸ Simultaneously, wider participation of middle-aged women in the workforce, and erosion of the extended family has resulted in a decreased capacity to care for older relatives.²⁹ In addition, government policies encourage older people to remain living in their homes, with the majority of over 65 year olds doing so. Just 7% of those over 65 years live in retirement or aged care accommodation.²⁸ Of those living in private dwellings, 62% live alone.³⁰ It is projected that by 2026, the number of people living alone over 65 years will continue increasing by an estimated 57–100%.²⁸

Subsequent fragmentation of support can leave the elderly with limited access to alternative transport and access to health-care. Therefore decreasing social support and social isolation is a plausible driver of increased ambulance utilisation.

Pricing and accessibility

American studies have associated higher rates of ambulance use by patients entitled to free transport in their insurance coverage.^{22,31} Similarly, in Australia, at a time when the majority of the Queensland population (~60%) was covered by a low-cost annual subscription scheme, there was an increased likelihood of ambulance use by subscribers compared with non-subscribers ($P = 1.54$, 95% CI 1.40–1.71).¹⁰ Some years later the introduction of a small universal levy, following abolition of any direct patient fees, realised an increase in usage.¹² Of particular interest, was an increase in use by a younger age group with lower clinical acuity. A survey recently conducted in Japan investigated the effect of introducing user charges on demand. Responses suggested that a 'reasonable' charge (US\$190) for transport by

ambulance might in fact reduce the unnecessary calls that compound demand without reducing medically necessary calls.³²

Improved accessibility and pricing raises the question of moral hazard as a potential driver of demand. Moral hazard describes the tendency to use more health services when people are covered by some form of insurance and therefore their out-of-pocket expenses at the time of service are lower or non-existent.³³ An ambulance subscriber in need of urgent medical attention may default to telephoning the ambulance service which provides an immediate response and specialised treatment at low or no cost. This may contrast with a perception of the costs and waiting time involved with seeking consultation with the local doctor.³⁴

Reduced access to traditional primary care services

Gradual changes in practice by community-based primary care doctors seeking 'work-life balance' have resulted in shorter working hours and more General Practitioners (GPs) working part-time. Workforce shortages have also affected GP availability and access.^{35,36} One Australian study noted that the majority of ED patients cited lack of access to a GP as their reason for attendance.¹⁶ Reduced primary care may therefore impact on ambulance usage; however, there were no studies identified directly investigating this as a contributing factor.

Increased health awareness

A variety of health promotion activities and mass media campaigns have raised general public awareness about the desirability of seeking early medical attention for a variety of conditions.³⁷ In the USA, mass media promotion about acute myocardial infarction increased emergency ambulance usage,³⁸ whereas in Canada, an increase in stroke presentations to EDs followed a stroke awareness media campaign.³⁹ Although ambulance use was not measured, this would be expected to increase concomitantly. These findings suggest that ongoing national and international 'Think FAST for Stroke Awareness' campaigns⁴⁰ are likely to increase emergency ambulance utilisation.

Media campaigns have been shown to have a sustained impact on health awareness.⁴¹ Indeed, a Japanese campaign was effective in decreasing ambulance usage.⁴² Therefore it is possible that a targeted campaign could educate the community on appropriate use of emergency health resources.

Changing community expectations

Changing community expectations may contribute to rising ambulance usage. These are rising as expectations increase regarding accessibility, quality and accountability of providers.⁴³ No attempts to quantify this effect on emergency healthcare have been identified in the published literature. However, the consistent pattern of increased utilisation regardless of age group or diagnostic category suggests that this may be an important factor.

Appropriate use and accessibility to alternative services

The rise in demand has facilitated investigation into the appropriateness of utilisation. Up to 40–50% of patient requests for emergency transport have been described as potentially avoidable or unnecessary,^{44–50} being more suited to alternative community

services, such as social, psychiatric or district nursing services⁴⁴; or warranting transport to the ED by alternative means such as a non-emergency vehicle.⁴⁹ However, it is difficult to define what is inappropriate or unnecessary, as clinicians and patients may hold different viewpoints. To date inappropriate usage has been mostly defined only from the clinician's perspective.

Governments and service providers have attempted to reduce unnecessary usage of emergency health services with the introduction of 24-h health telephone call lines and telephone triage. Initiatives such as the UK's NHS Direct and Victoria's Nurse-On-Call have improved access to telephone advice⁵¹; however, there is some evidence suggesting they have had little impact on reducing demand on emergency resources.⁵²

Telephone triage, where structured call-taking systems prioritise requests for emergency response, is now used by most ambulance services. A second level of telephone triage based on standardised protocols is also used to manage lower priority calls in London and Melbourne. This has enabled referral to alternative community services or the dispatch of a non-emergency vehicle to some lower priority callers. In Melbourne 7.2% of requests for an emergency response received an alternative to an emergency ambulance in 2008–09.⁵³ However, telephone triage is constrained by the capacity of the patient or carer to provide reliable information. Service providers are appropriately risk-averse, limiting the scope for referral to alternative care out of necessity. This may contribute to a reduced threshold for seeking medical care. However, the occasional problems reported by the media reinforce the need for systems to ensure patients genuinely requiring a rapid response are not overlooked.

Conclusion

This review found evidence that patient transportation by emergency ambulances has been increasing over the past two decades. Such continued rise in demand places increasing stress on ambulance services and the wider health system, potentially compromising access, quality and safety of care and patient outcomes.

Many contributing factors have been postulated, related to changes in the needs of the community arising from ageing, declining health, social structural change, and changes in organisation of primary healthcare. Limited price signals and improved accessibility of ambulances, alongside improved community health awareness and expectations possibly contribute to a degree of avoidable use. The relative contribution of these factors to the continuing rise in transportations has not been well studied.

We recommend further investigation of the major causes of rising demand. For this to be undertaken, there must be collection and recording of standardised data with common definitions of demographic, socioeconomic and health-related factors. Effective management of future demand will depend on a comprehensive analysis that goes beyond simple demographics of age and population growth.

Competing interests

Judy Lowthian is the recipient of an NHMRC postgraduate research scholarship to undertake her doctorate on emergency demand. Alex Currell is employed by Ambulance Victoria in the

capacity as General Manager of Strategy & Planning. However, this literature review was conducted independently and was not influenced by the scholarship or the employment.

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Manuscript received 16 December 2009, accepted 18 May 2010

Appendix. Search strategy

Online databases	Ovid Medline, PubMed	
Cross-checking of references	Published reviews, original articles, audit reports (1996–2009)	
Manual searches: relevant journals and ambulance service reports	Australia, New Zealand, United Kingdom, United States of America, Canada	
Keywords	Ambulances, pre-hospital care, paramedic, paramedic prehospital, utilisation, ambulance transport, trends, health services needs and demand, healthcare utilisation	
Ovid Medline search		
	Number of papers	
1	Exp Ambulances/ut [Utilization]	251
2	'pre-hospital care'.mp	150
3	'paramedic'.mp	731
4	1 or 2 or 3	1106
5	utilization.mp	55 469
6	trends.mp	46 860
7	'health services utilization'.mp	33
8	5 or 6 or 7	101 089
9	4 and 8	85
10	Limit 9 to (English language and humans and year = '1996–2009')	77
PubMed (excluding Medline) [English language, humans, items with abstracts]		
	Number of papers	
1	Ambulance transport	1048
2	Paramedic prehospital	837
3	Healthcare utilization	58 733
4	Trends	134 209
5	1 or 2	4768
6	3 or 4	186 737
7	5 and 6	221

2.3 PUBLICATION: SYSTEMATIC REVIEW OF TRENDS IN EMERGENCY DEPARTMENT ATTENDANCES

CO-AUTHOR DECLARATION FOR PUBLICATIONS TO BE INCLUDED IN THESIS

Monash University

Lowthian JA, Curtis AJ, Cameron PA, Stoelwinder JU, Cooke MW, McNeil JJ. Systematic review of trends in emergency department attendances: an Australian Perspective *Emergency Medicine Journal* 2011; 28: 373-7 originally published online October 20, 2010

Declaration by candidate

In the case of the publications in Chapter 2, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for study design; search, collection and review of potentially relevant articles; selection and interpretation of articles used in the study; development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	80

The following co-authors contributed to the work:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Andrea J Curtis	Contributed to review and editing of the manuscript	N/A
Peter A Cameron	Contributed to review and editing of the manuscript	N/A
Johannes U Stoelwinder	Contributed to review and editing of the manuscript	N/A
Matthew W Cooke	Contributed to review and editing of the manuscript	N/A
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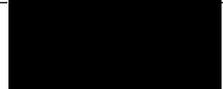
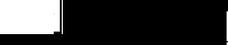
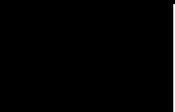
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Declaration by co-authors

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- (3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
- (4) there are no other authors of the publication according to these criteria;
- (5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
- (6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

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Systematic review of trends in emergency department attendances: an Australian perspective

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ABSTRACT

Emergency departments (EDs) in many developed countries are experiencing increasing pressure due to rising numbers of patient presentations and emergency admissions. Reported increases range up to 7% annually. Together with limited inpatient bed capacity, this contributes to prolonged lengths of stay in the ED; disrupting timely access to urgent care, posing a threat to patient safety. The aim of this review is to summarise the findings of studies that have investigated the extent of and the reasons for increasing emergency presentations. To do this, a systematic review and synthesis of published and unpublished reports describing trends and underlying drivers associated with the increase in ED presentations in developed countries was conducted. Most published studies provided evidence of increasing ED attendances within developed countries. A series of inter-related factors have been proposed to explain the increase in emergency demand. These include changes in demography and in the organisation and delivery of healthcare services, as well as improved health awareness and community expectations arising from health promotion campaigns. The factors associated with increasing ED presentations are complex and inter-related and include rising community expectations regarding access to emergency care in acute hospitals. A systematic investigation of the demographic, socioeconomic and health-related factors highlighted by this review is recommended. This would facilitate untangling the dynamics of the increase in emergency demand.

Emergency departments (EDs) in developed countries are experiencing increased workloads due to a continuing increase in patient presentations and rising emergency admissions. This is compounded by the challenge of accessing limited numbers of hospital inpatient beds in a timely manner. The emergency care pathway is multifaceted, with patients presenting to an ED via emergency ambulances, self-referral or referral by a healthcare or community service provider. Patients are triaged on arrival at the ED; however, timely care is reliant on resources within the ED and hospital efficiency and capacity to manage patient flow.

The UK, New Zealand, Canada and the USA report increased ED attendances, with current rates ranging from 3% to 6% annually.^{1–5} The number of emergency attendances across Australia has risen by 73%, from 4.1 million in 2003–2004 to 7.1 million in 2007–2008. This represents an increase from 202 to 321 presentations per 1000 persons⁶; with state average annual increases ranging up to almost 7%^{7 8} (table 1).

In an environment with less inpatient bed availability, rising ED presentations and emergency patients requiring admission causes access block, leading to diminished ED performance and overcrowding.^{9–11} This also results in increased waiting times, an increased burden in caring for patients awaiting admission, patients leaving without being seen and ED blockage, resulting in ambulance diversion and diminished capacity to respond to other calls.¹²

Such disruption to the provision of timely care poses a threat to patient safety,^{11 13} with evidence of associated adverse events,^{12 14 15} and estimates of an annual 20–30% excess ED mortality rate directly attributable to overcrowding and access block.¹⁶ In addition, prolonged length of stay in the ED has been associated with subsequent increased inpatient length of stay^{17 18} and protracted patient flow throughout the wider hospital system.

Rising demand and overcrowding in the ED was initially described in the early 1980s in the USA and UK. However, major concerns were not raised until 10 years later, prompting investigation of the trends and characteristics of attendees.¹⁹ This review aims to synthesise the peer-reviewed literature and unpublished reports to identify the key factors associated with the increase in presentations to EDs.

METHOD

Inclusion criteria

Peer-reviewed articles and audit reports dating back to 1995 were included if they were published in English and described factors associated with the rise in adult presentations to EDs in developed countries.

Search strategy

An English-language Medline search was conducted via OVID and PubMed, a database of the US National Library of Medicine to identify relevant literature from January 1995 to January 2010. Combinations of key words included: ‘emergency medical services’ [MeSH Terms] OR (‘emergency’ [All Fields] AND ‘medical’ [All Fields] AND ‘services’ [All Fields]) OR ‘emergency medical services’ [All Fields] OR (‘emergency’ [All Fields] AND ‘service’ [All Fields]) OR ‘emergency service’ [All Fields] AND ‘hospitals/utilization’. This search generated 521 articles. The titles were initially screened for relevance to this paper, and abstracts of ambiguous titled papers were scrutinised for analyses of key factors associated with rising ED attendances (where available). This search was supplemented by a web-based search through Google and Google Scholar; alongside manual searches of relevant journals and grey literature including reports on hospital emergency

Table 1 Rise in presentations to emergency departments (EDs)

Australia	2007/08	20% of total population visited an ED, with 28% admitted to hospital National average of 321 presentations per 1000 persons
	2003/04	National average of 202 presentations per 1000 persons ⁶
	1999/00–2005/06	Average annual increase of 5.3% ⁷
	2004/05–2006/07	Average annual increase of 6.9% ⁸
New Zealand	2003/04–2007/07	National average growth of 20% in presentations ²
UK	2008/09	18% of the total population visited an ED, with 20% admitted to hospital
	2002/03–2008/09	Average annual increase of 5.9% ¹
Switzerland	1996–1999	Average annual increase of 5.9% ⁵
Canada	1993–1999	increase in ED presentations by 27.5% ³
USA	1996–2006	National growth of 32% Average annual increase of 3.2%
	1990–1999	National average of 405 visits per 1000 persons ⁴ Total number of visits to California EDs increased by 27% ⁹

services from Australia, New Zealand, the UK) and the USA. Finally, the references of the chosen articles and audit reports were scanned in an attempt to ensure that relevant papers had not been overlooked by the initial search.

Assessment of quality

The aim of this review was to synthesise evidence from the peer-reviewed and grey literature published and unpublished work about the factors associated with increased utilisation of EDs. The search identified cohort and cross-sectional studies and audit reports that analysed administrative databases, medical records, surveys or interviews. These publications were critically appraised and publications lacking a description of their methods, and letters or opinions were excluded.

Synthesis

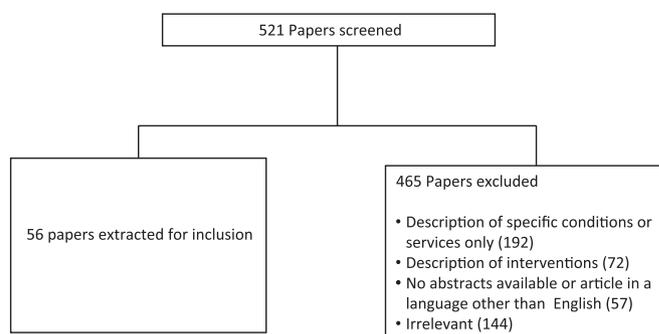
The acquired publications were systematically examined and categorised into major factors associated with increased presentations. The data were synthesised by narrative summaries, then analysed thematically to identify and describe the main factors attributed to the rise in ED utilisation.

Limitations

The search was limited to publications from 1995 as it was believed the underlying factors would be dynamic in nature, therefore anything older would no longer apply. In addition, the search strategy was limited to two large electronic databases – Ovid MEDLINE and PubMed; however, this was supplemented by extensive web-based and manual searches. This review was based largely on observational studies; hence the identified factors cannot be considered as causal but as associations. These associations will vary in different regions and countries, so may not be generalisable. Sources of bias must be taken into consideration. Publication bias is likely, as positive associations are more likely to be reported and published; and observer bias is also possible as the majority of published studies are conducted by emergency physicians, who may be influenced by prior perceptions, experience and knowledge.

FINDINGS AND DISCUSSION

This process produced 56 peer-reviewed articles from the Medline search (figure 1), with the supplementary search

**Figure 1** Medline search findings.

generating a number of additional articles and audit reports in which a variety of major factors were described as contributing to the ongoing rise in ED attendances.

Ageing

ED attendances are increasing in per capita terms, indicating a rise that is faster than population growth. This may partly be explained by ageing of the population, with the current proportion of people aged over 65 years in the UK, USA and Australia at around 13% of the population. It is projected that this will increase to 25% over the next 25 years; with the proportion of those aged over 85 years rising from 1.5% to 5% of the population in these countries.^{20–22}

Several studies across the world report the fastest growth in ED presentations among patients aged over 65 years.^{23–29} In the UK in 2004, a 3.8-fold increase of ED patients aged 80+ years was reported compared with 1990 levels.²⁴ Older people present with more complex clinical conditions, consume more resources, have longer lengths of stay in the ED and are more likely to be admitted to hospital.^{23 24 30 31} They also have a higher rate of return visits to the ED.³⁰

Loneliness and lack of social support

Studies from the USA have observed increased ED visits to be linked with loneliness, vulnerability and lack of access to family support.^{32–34} Among older people without a family network, one study found that the likelihood of ED usage increased sevenfold.³⁵ Possible contributory factors include an increase in dual career and dual income families coupled with increased geographic mobility of the workforce over the past 20 years. This may contribute to the fragmentation of the extended family unit, affecting the capacity to care for and support older relatives.³⁶ Additionally, government policies encourage older people to remain living in their own homes; with the majority of Australians aged over 65 years doing so.³⁷ Of those living in private dwellings, 62% live alone,³⁸ and over the next 15 years it is projected this will continue to increase.³⁷ Based on the above study findings, this could be expected to increase ED usage in the future.

Mainstreaming of psychiatric care and frequent attendees

Government policies across the developed world have encouraged mainstreaming of care from long-stay psychiatric hospitals to community-based settings. Along with other countries, Australia commenced de-institutionalisation of mental health patients in the mid-1990s.³⁹ This is thought to have contributed to increased ED presentation by patients with mental health problems, with a study noting a tenfold rise in such presentations to their ED over the 10-year period to 2003.⁴⁰ Other studies in Australia, the UK, New Zealand and Europe have reported

a high incidence of psychiatric illness and substance abuse among repeat attendees in the last decade.^{41–45}

De-institutionalisation is likely to have a direct association with an increased propensity to use an ED for healthcare, with access to stable housing and community-based primary care recognised as being problematic for this group of people.^{46–49}

Organisation of service delivery, access to primary care and co-payments

Several studies, including some from countries providing universal insurance, cite limited access to a primary care physician (PCP) or General Practitioner (GP) as patients' reasons for attending an ED.^{8 28 50–53} In Australia, this is likely to be a consequence of reduced availability of and access to GPs, arising from medical workforce shortages and changes in healthcare practice, including a decline in the rate of home and nursing home visits^{54–56} (facilities providing nursing care for residents). It is also possible that a gradual shift in GPs charging co-payments for consultations may have an impact, as there are no out-of-pocket expenses for ED consultations.⁵⁷ In the USA, a study reported that although the majority of their study cohort had a PCP, 60% of patients used the ED following unsuccessful attempts to source care from their PCP.⁵⁸

In terms of after-hours access to GPs, the UK saw changes to the General Medical Services contract in 2004, which enabled GPs to 'opt out' of such care.⁵⁹ As a consequence, such arrangements have been shown to cause an increase in after-hours presentations to EDs.⁶⁰ Additionally, a study in Holland demonstrated that easier access to after-hours urgent primary care decreased attendances to the ED.⁶¹

These findings lend support to an association between the changes in accessibility of GPs or PCPs to increased demand.

Health promotion and health awareness

Community awareness to seek early medical attention for certain conditions has been heightened by health promotion activities, along with popular media coverage over the past 20 years. The effectiveness of such campaigns has been demonstrated with an increase in ED presentations by those aged over 75 years following a health screening programme in the UK.⁶² In addition, stroke presentations increased to Canadian EDs following a media campaign.⁶³ Improved health awareness from media campaigns possibly increases care expectations for immediate care, particularly when patients perceive there is an urgent need for medical attention.⁵⁷

Convenience

Accessibility and convenience as a 'one-stop shop'^{8 57} that provides 'total care' with relevant diagnostics, delivered by a specialist team trained in emergency medicine, has been cited as a reason for using the ED in Europe, New Zealand and Australia.^{51 64–67}

Emergency medicine developed as a speciality in the late 1970s at varying rates around the world,^{68–70} whereas urgent care was previously provided by casualty departments staffed by general medicine doctors. This was when emergency presentations commenced increasing inexorably, which could suggest an association between demand and the availability of access to specialised care. Reports of patient beliefs that GPs are not trained or equipped to manage their situation,⁵⁷ together with heightened community expectation and accessibility to specialist emergency healthcare, could lend support to this theory; however, this has not been studied in depth.

Appropriateness of use and risk aversion

The phenomenon of 'inappropriate' or unnecessary ED attendances is increasingly recognised as an important contributing factor to increased ED demand, with several studies investigating this in recent years. However, there is debate about whether it is inappropriate attendance or inappropriate health system design or response.⁷¹

In the USA in the early 1990s, inadequate primary care at nursing homes contributed to inappropriate transfer to EDs, with suggestion of the possibility of ED referral to avoid possible legal problems.⁵⁶ Other studies from the USA and Canada estimated approximately 40% of such presentations to be inappropriate, stating that patients could have been managed in their facility.^{72 73} In an environment of increasing litigation related to medical care, it is conceivable that nursing homes could unavoidably be risk-averse if there is no on-site medical care, and this may contribute to a reduced threshold for transfers to the ED.

Conversely, more recent studies from Canada and Australia determined that 85% of nursing home transfers were appropriate.^{74 75} Nevertheless, the Australian study identified evidence of primary care doctor involvement in only 25% of referrals, and a lack of clinical support for nursing home staff in general. Primary care involvement may have prevented these transfers.⁷⁶ A decline in primary healthcare visits to nursing homes⁷⁷ may be a factor, indicating that nursing homes may lack necessary supportive medical and nursing expertise.⁷⁶

Self-referred patients are another group scrutinised in terms of 'appropriateness'. ED physicians generally agree that older self-referred patients are appropriate attendees, as they present with serious acute medical problems, usually requiring inpatient admission.^{27 30 31 78 79} However, a significant proportion of younger self-referred patients are often described as 'inappropriate' and 'non-urgent', with treatment in the primary care setting thought to be more suitable.^{34 80 81} One US national study described the greatest proportion of total healthcare visits for 20–29-year-olds being to an ED, having risen from 19% to 22% over the 10 years to 2006.⁸² These visits were classified as non-urgent and less likely to require admission. The authors correlated the rise to the decline in primary care utilisation by young adults; attributing lack of health insurance coverage as a likely contributor.

However, defining what is an inappropriate or unnecessary presentation is difficult, as clinicians and patients may hold different viewpoints and it is also dependent on system design.^{83 84} Appropriateness of presentation has been mostly defined from the clinician's perspective; however, patient perspectives have recently been explored, with the majority of patients perceiving that they require urgent care.^{50 52 53 79 85 86}

Increased emergency ambulance utilisation

Demand for emergency ambulances throughout the developed world is also rising.⁸⁷ Fifteen per cent of ED presentations arrive by ambulance in the USA; with 25% doing so in Australia.^{4 88} In the UK, the number of requests for emergency ambulances is rising by an average of 6.5% per year, 60% resulting in transportation.⁸⁹ With utilisation of emergency ambulances having also increased across the developed world, it would seem logical to assume that an increase in emergency ambulance transportations is another contributing factor, the ED being a universal destination point for transported patients in most countries.

CONCLUSION

The multiple factors associated with increasing ED presentations are complex and inter-related. These include demographic changes, changes in the organisation and delivery of care,

improved access to specialist emergency treatment, heightened health awareness and rising community expectations.

A contributing factor appears to be ageing of the population, as older people have an increased risk of more frequent acute illnesses as well as complications from age-related chronic diseases. In addition, the evidence suggests that social and health support mechanisms for older people are becoming increasingly fragmented, with changes in family structures, alongside reduced access to primary care, whether patients are living independently in a nursing home. As the older proportion of the population continues to rise, there will be a persistent increase in demand for emergency care and hospital admission unless initiatives are put in place. Practical strategies to manage this demand in the community and outpatient setting are essential. Further investigation into the impact of older people on rising emergency demand is recommended to help identify the underlying causes and will help target the planning of appropriate models of care for this age group.

Systematic investigation of the other demographic, socio-economic and health-related factors highlighted by this review is also recommended. This would facilitate untangling the dynamics of the increase in emergency demand. Analysis of standardised data with common definitions would help quantify the relative contributions of underlying factors across countries, which would assist in understanding international variations and influences. This will provide health policy makers with the information required, to enable appropriate and responsible development of strategies for the future management of emergency services.

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Competing interests None.

Ethics approval This study was conducted with the approval of the Monash University.

Contributors The manuscript forms the foundation of a doctoral research project. JL undertook the search of the peer-reviewed and grey literature. She collated the articles and synthesised the literature for this manuscript. In their capacity as supervisors and mentors, AC, PC, JS, MC and JM raised issues for discussion pertaining to the first author's interpretations of the findings of this review, and contributed to preparation of the final manuscript.

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Systematic review of trends in emergency department attendances: an Australian perspective

Judy A Lowthian, Andrea J Curtis, Peter A Cameron, et al.

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2.4 SUMMARY

These syntheses of previous research and the grey literature confirmed an increase in utilisation of emergency ambulance and hospital services throughout developed countries over the past two decades. The underlying factors appear complex and interconnected, and relate to patient, community and health system issues; and are similar for both emergency ambulance and hospital ED demand. In summary, the rise in demand appears to be associated with changing community needs; due to population ageing, declining health and social structural change. In addition underlying health system factors have been linked with changes in the delivery of healthcare including improved accessibility to emergency services. Improved community health awareness and increased expectations as a result of health promotion campaigns compounds the rise in demand.

The relative contribution of these factors has not been systematically studied. A more sophisticated description of the major causes of the changes in usage of emergency ambulance and ED services is recommended to assist with unraveling the dynamics of increasing emergency demand. It is particularly important to measure the impact of population ageing due to the effects on timely access, the quality and safety of care, patient outcomes, patient flow throughout the hospital system and increasing cost.

The following chapter describes the research framework, the five inter-related studies, their data sources and techniques of analysis.

CHAPTER 3: OVERVIEW OF METHODS AND DATA SOURCES

3.1 INTRODUCTION

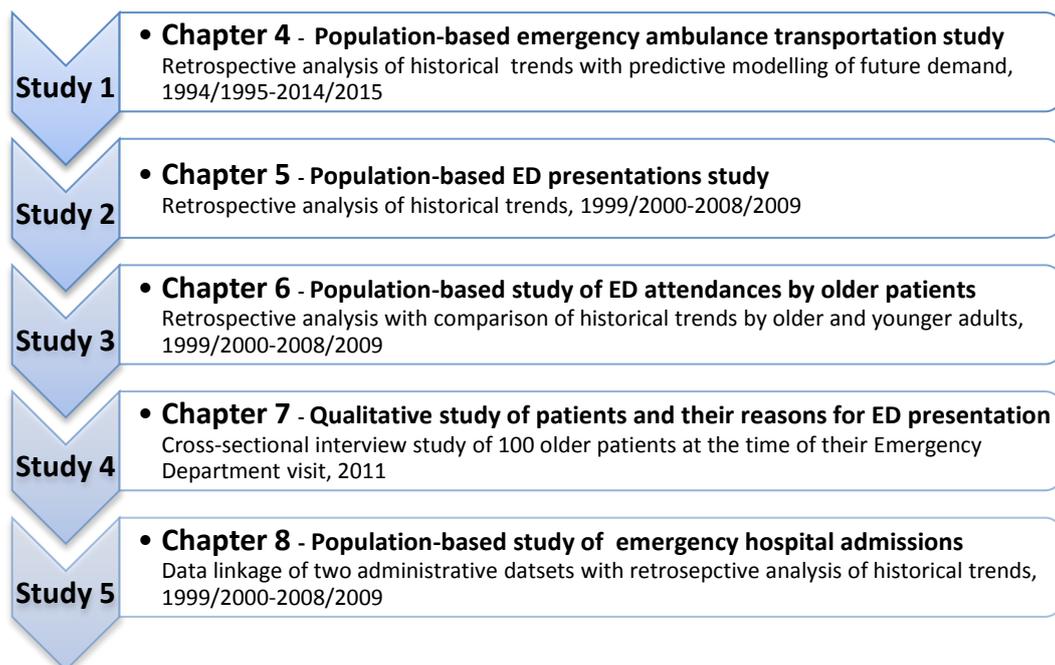
This Chapter provides an overview of the research methods employed in this thesis. This will comprise a general description of the study settings, study designs, ethics approvals, along with information about the data used in each study. Further details of the methods employed in each study are discussed in the relevant publications incorporated into the subsequent Results Chapters.

3.2 STUDY SETTINGS AND STUDY DESIGN

This program of research encompassed five inter-related studies, designed to identify and describe the drivers underlying the rise in demand for emergency ambulance and hospital services across metropolitan Melbourne.

Figure 7 encapsulates the individual studies, study designs and study settings; and delineates where they are described in the thesis.

Figure 7: Studies included in Research Program



3.3 ETHICS APPROVALS

The individual studies for this thesis were approved by Human Research Ethics Committees as summarised in Table 1.

Table 1: Summary of Ethics Committee Approvals

Research Project Title	Study	Chapter	Ethics Committee	Certificate of Approval No.
Identifying the drivers of emergency ambulance demand	1	4	Monash University Ambulance Victoria	CF09/0802:2009000354 R09-004
Identifying the drivers of demand for emergency department services	2,3	5, 6	Monash University	CF10/0157-201000050
Trends in emergency hospital admissions	5	8	Department of Health	ADF/10/2379 Fully Executed Deed with Conditions of Release
Identifying the drivers of emergency demand – Understanding why people come to Emergency Departments	4	7	Alfred Hospital Monash University	112/11 CF11/1280 - 2011000702

Copies of all Ethics Committee Certificates of Approval are located in Appendix 1.

3.4 DATA SOURCES AND DATA QUALITY

3.4.1 EVALUATION AND SYNTHESIS OF PREVIOUS RESEARCH

The systematic reviews of the literature entailed Medline searches of on-line databases OVID and of PubMed; web-based searches via Google and Google Scholar; manual searches of emergency medicine, nursing and pre-hospital journals; web-based searches of the grey literature including service provider, institutional and technical reports and conference proceedings; and scanning through the references of selected articles and audit reports, with review of relevant full-text papers.

The two reviews sought to:

- identify all relevant published and unpublished studies and reports pertaining to the trends in emergency health service usage and associated factors
- use pre-determined selection criteria for inclusion/exclusion
- appraise the quality of each study or report
- synthesise the study or report findings in an unbiased manner
- interpret the findings in order to communicate a balanced independent summary of the available literature ⁴⁴

The search strategies, inclusion/exclusion criteria, assessment of quality, method of evidence synthesis, and limitations of each review are outlined in the two publications in Chapter 2.

3.4.2 RESULTS STUDIES 1, 2, 3, 4 AND 5

The data sources for the Results studies in Chapters 4, 5, 6, 7 and 8 are summarised in Table 2.

Table 2: Data Sources for the Results Studies

Study	Study population	Data Sources
1	Emergency ambulance transportations	Ambulance Victoria <ul style="list-style-type: none"> • Administrative emergency transportation data 1994/1995 to 2007/2008 Australian Bureau of Statistics Web Site <ul style="list-style-type: none"> • Estimated Residential Population data 1994/1995 to 2007/2008 ⁴⁵ • Census of Population & Housing data 1996, 2001, 2006 ⁴⁶ • Population projections data ²⁸
2 & 3	ED presentations	Department of Health <ul style="list-style-type: none"> • VEMD 1999/2000 to 2008/2009 Australian Bureau of Statistics Web Site <ul style="list-style-type: none"> • Estimated Residential Population data 1999/2000 to 2008/2009 ⁴⁵
4	Patients interviewed in an ED	<ul style="list-style-type: none"> • Patients recruited for the study
5	ED hospital admissions	Department of Health <ul style="list-style-type: none"> • VEMD & VAED 1999/2000 to 2008/2009 Australian Bureau of Statistics Web site <ul style="list-style-type: none"> • Estimated Residential Population data 1999/2000 to 2008/2009 ⁴⁵

3.4.2.1 – Population Data

3.4.2.1.1 Population Data Sources

Population data for the four retrospective longitudinal studies (Studies 1, 2, 3 and 5) were sourced from the Australian Bureau of Statistics (ABS) website. The ABS is Australia's national statistical agency, and is responsible for the collection, compilation, analysis and dissemination of population-based statistics to Federal and State & Territory governments and the community. The purpose of ABS statistical activities is to describe the population's social composition. Statistics are made available at regular intervals for each area of social concern and for relevant key population groups, and provide a framework to inform decision making and community discussion. This supports policy development, the development, delivery and evaluation of government supported programs, and enables the ongoing monitoring of social progress.⁴⁷

Three types of population measures were used for this thesis.

- i. *Census counts* which are conducted at five yearly intervals provide the basis for production of the official population estimate, the Estimated Resident Population (ERP).

The Census is a detailed survey that counts the population by place of usual residence, as well as collecting information about population characteristics such as age, sex, education levels, employment, voluntary work, housing, income, family characteristics, ethnicity, and transport.⁴⁶

- ii. *Estimated resident population (ERP)* figures are based on the Census 'usual residence' counts, compiled as at 30th June of each Census year. The geographical areas reported are by spatial unit subdivisions: Statistical Local Areas (SLAs) and Local Government Areas (LGAs). SLA and LGA boundaries occasionally change, however the ABS release annual time series of ERPs to enable comparison over time. Estimates are updated quarterly between censuses, using births, deaths and overseas

migration data, along with estimates of interstate migration from Medicare data.⁴⁵

- iii. *Population projections* demonstrate future growth in the population and reflect current trends, based on historical trends, current settlement patterns and demographic modelling techniques.⁴⁷

3.4.2.1.2 Population Data Quality

As the national statistical agency, the ABS is responsible for ensuring optimal data quality. This is achieved through development and testing of survey tools, rigorous sampling techniques, use of trained interviewers, procedures to ensure low non-response rates, systematic data editing, and so forth. The ABS quality framework comprises six dimensions: relevance to users, accuracy and timeliness of availability, accessibility, interpretability and coherence. Various mechanisms are employed to assure quality. All ABS publications include data quality declarations detailing specific issues that may impact on the data quality.⁴⁸

3.4.3 STUDY 1 - DEMAND FOR EMERGENCY AMBULANCES

3.4.3.1 Data Sources

The study described in Chapter 4 analysed data sourced from Ambulance Victoria (AV) and the Australian Bureau of Statistics (ABS).

Population data from the ABS were used in this study on emergency ambulance transportations to take changes in demographic structure into account. This study drew on all three population measures described above in 3.3.2 as follows:

- (i) *Estimated resident population (ERP)* figures⁴⁵ were extracted from the ABS web sites and aggregated by age group and gender for each geographical area that the AV transportations originated from, as listed in Appendix 2. The highest upper age limit in the ERP data is 85 years and over.
- (ii) *Census* data for the years 1996, 2001 and 2006⁴⁹ were used for modelling of the transportation rates for the 70 - 100 year old age

groups. Considering our upper limit for the age of transported patients was in excess of 100 years, census data were used as they include the age group 99 years and over. These data were used for this modelling work of this older age group.

- (iii) *Projected population estimates* data were used for forecasting future demand through 2015. The ABS publishes 72 series of population projections for metropolitan Melbourne. The ABS was consulted regarding the objective of this forecasting analysis, and their advice was to use Series 29B(53), which was based on conservative assumptions, namely
- low fertility
 - medium life expectancy at birth
 - low net overseas migration and
 - medium net interstate migration ²⁸

Emergency ambulance transportation data encompassing transportations across metropolitan Melbourne were provided by the data custodian, AV, for the years 1 July 1994/30 June 1995 to 1 July 2007/30 June 2008. These data are collected for internal organisational purposes. These data were initially provided in an aggregated format of the monthly totals for emergency transportations by specific age groups and gender, geographical location of transportation origin, and clinical condition as defined according to protocols used by the 'Triple Zero' Call Centre.

3.4.3.2 Data Quality

Initial review of the aggregated data revealed the monthly totals were not whole integers, rather contained decimal points. AV then revealed these figures included estimates for missing data - the assumption being that transportations with missing age and/or gender are distributed as per those for which the age/gender was available. It was apparent there was a need to verify the data, therefore de-identified individual patient level data were requested.

Requested data comprised 2,227,144 de-identified patient records for patients transported by an emergency ambulance throughout the 14 year time period. There were no missing data. Aggregation of these data set confirmed similar monthly totals to those stated in the data provided originally.

The de-identified patient record data were used in the analyses for this thesis. Study 1 is described in full in Chapter 4.

3.4.4 STUDIES 2 AND 3 – TRENDS IN ATTENDANCES AT EMERGENCY DEPARTMENTS

3.4.4.1 Data Sources

Studies 2 and 3 examined the trends in presentations to emergency departments (EDs) throughout metropolitan Melbourne as outlined in Chapters 5 and 6. Data sources included:

- ABS ERP data, as described in 3.4.3.1 (i). The ABS population data used in these studies were ERP data from the geographical areas serviced by the metropolitan EDs analysed in Studies 3 and 4
- De-identified data from the Victorian Emergency Minimum Dataset (VEMD) provided by the data custodian, the Victorian Department of Health.

The VEMD, developed in 1995, is an administrative dataset collated by the Department of Health detailing patient presentations to Victorian public hospitals with 24-hour EDs. It comprises demographic, administrative and clinical information collected by clerical and clinical ED staff at the time of the emergency episode of care. The information is submitted electronically by individual hospitals on a monthly basis to the health department.⁵⁰ To protect and maintain patient privacy, “only the minimum data required for effective monitoring and analysis purposes are collected”⁵¹ Data are collected according to standard definitions and collection protocols to ensure comparability across hospitals over time. Data fields and definitions conform to definitions in the

National Health Data Dictionary published by the Australian Institute of Health and Welfare.⁵² The categories and definitions are published annually in the VEMD Manuals and are available on the web.⁵³

3.4.4.2 Data Quality

One of the purposes of administrative health datasets is to aid service planning, performance monitoring/improvement and funding; hence there is a requirement for the data to be accurate and reliable. The VEMD Technical Reference Group is responsible for ongoing development and maintenance of the VEMD, including evaluation of data quality. This group comprises representatives of ED clinicians, hospital management, ED clerical staff, Health Information Managers, and the Department of Health.⁵⁰

Accurate recording of data is inherently challenging in the ED, as it is reliant on clinicians and clerical staff working in an environment fraught with multiple distractions. This has been previously discussed in the literature and in international reports.⁵⁴⁻⁵⁶ Independent quality audits of data are now conducted routinely to ensure data accuracy.^{54 57-59} Limitations about data quality are acknowledged in the relevant manuscripts.

Studies 2 and 3 that analyse the VEMD, are described in full in Chapters 5 and 6.

3.4.5 STUDY 4 – DESCRIPTIVE STUDY OF OLDER EMERGENCY PATIENTS

This qualitative study comprised interviews with patients of lower clinical acuity aged 70 years and over who presented to the Alfred Hospital ED. The aim was to investigate whether their perceptions of accessibility to General Practitioners and/or social isolation are contributing factors for older people seeking healthcare from an ED.

A survey was developed by the researcher to explore these factors. Many questions were obtained from publically available surveys on health service utilisation⁶⁰ and a questionnaire evaluating social isolation and social connectedness.⁶¹ The survey was reviewed by three emergency physicians and

three allied health professionals from the Alfred Hospital Emergency Department; then initially piloted on 10 patients to assess face validity of the questions. No amendments of the survey tool were required. A copy of the Survey is located in the Appendix of the manuscript in Chapter 7.

Study 4 is described in full in Chapter 7.

3.4.6 STUDY 5 – CHANGES IN ADMISSIONS FROM EMERGENCY DEPARTMENTS

3.4.6.1 Data Sources

The data for Study 5 were provided by the Victorian Department of Health, the data custodian. This study involved linkage of two administrative data sets by the researcher – the VEMD (described in 3.3.4.1) and the Victorian Admitted Episodes Dataset (VAED).

The VAED is the administrative dataset of acute hospital admitted patient data, which enables the Department of Health meet the requirements of the *Health Act 1958 (General Amendment 1988)* and contribute to the National Health Information Agreement. Since 1987/1988, the VAED has collated information from all Victorian public and private acute hospitals. Uses of the VAED include: monitoring of population morbidity, administration of Casemix-based funding, and monitoring of utilisation and performance of health services. In addition, the VAED is made available for research that is authorized by the Department of Health.⁶²

For the purposes of this study, the demographic and clinical data variables requested to enrich the linked dataset of patients admitted from the emergency department were: type of residence prior to this admitted episode, marital status, carer availability, preferred language, whether an interpreter was required; principal and other diagnoses, interventions conducted during the admission, duration of stay in intensive care; and discharge destination.

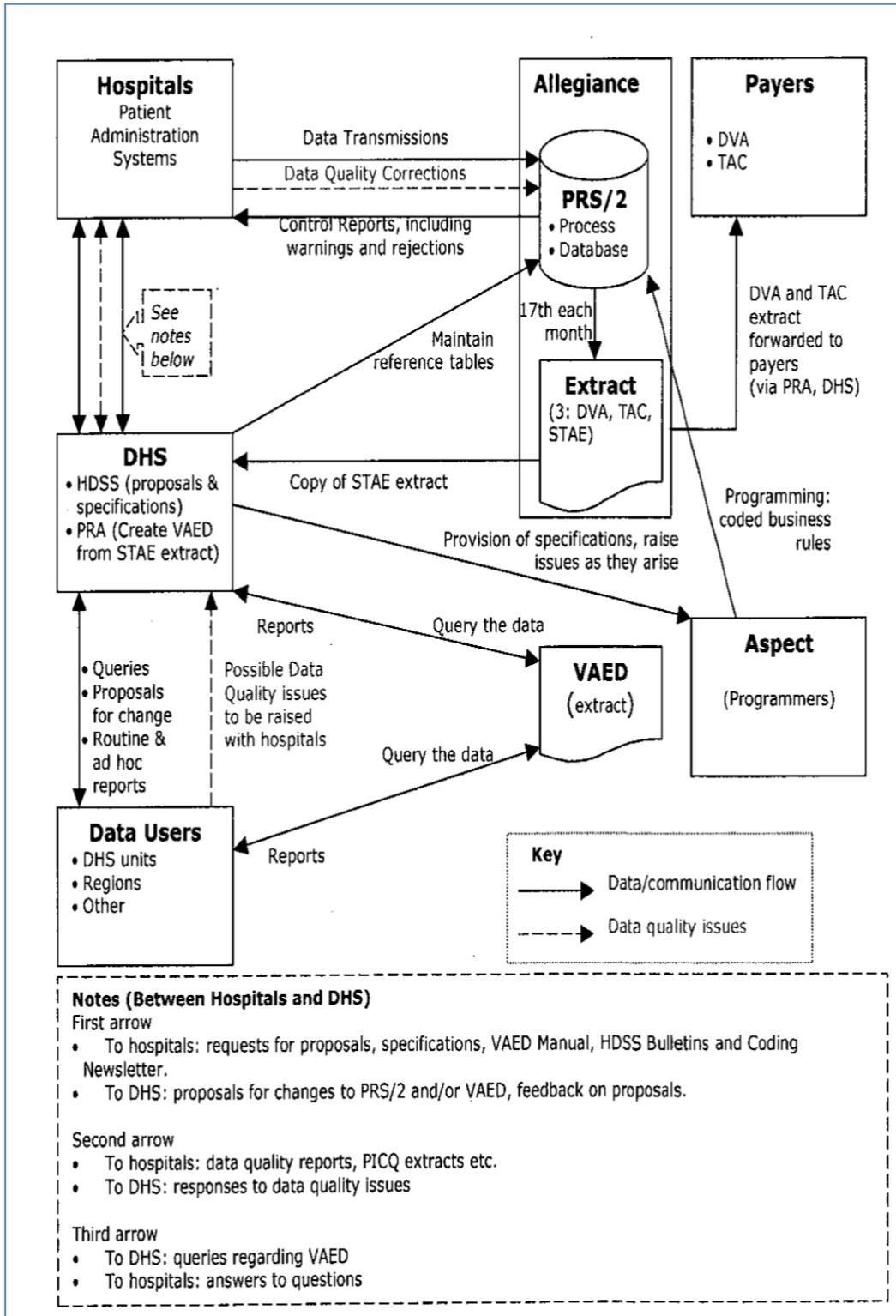
As with the VEMD, variation in the categories and definitions over time required unification of coding methods used in the VAED. Please refer to the data dictionary in Appendix 2.4.

3.4.6.2 Data Quality

Data quality of the VAED has been subject to formal review since mid 1993, when Casemix based funding was introduced.⁶² Numerous quality evaluations are conducted at multiple levels as represented in Figure 8, namely by:

- individual hospitals, the data sources
- Allegiance Systems, the data processing agency who provide technical services and support - who receive and compile the VAED from the hospitals
- Department of Health, who analyse the data and compile quarterly and annual files

Figure 8: The sequence of data capture and quality control from hospital to the VAED



Reproduced with permission from the Health Data Standards & Systems Coding Newsletter⁶³

The Department monitors quality issues through regular analyses of the VAED; through referrals from various committees, including the Victorian Advisory Committee on Data Integrity and the Victorian ICD Coding Committee; and through audits by external consultancy firms. These audits confirm that the coding within the VAED is of high quality ⁶⁴.

The linkage process and linkage success rates undertaken by the researcher for Study 5 are discussed in Chapter 8.

3.5 DATA MANAGEMENT

Data for Studies 1, 2, 3 and 5 were obtained in de-identified formats.

Data for Study 4 were derived from patient interviews. All identifiers were removed from the surveys when the data were collated and entered onto an excel spreadsheet. Hard copies of the de-identified survey form are stored in a locked filing cabinet in the Department of Epidemiology.

All data for this thesis were stored on a password protected computer data base, accessible only to the researcher and her supervisors, to comply with privacy legislation requirements. The hard drive file server is backed up daily to a facility nearby. In accordance with the Ethics Committee approvals, all data pertaining to this thesis will be retained for a period of 7 years from the completion date.

3.6 DATA ANALYSIS

The studies included in this thesis incorporated a variety of data analysis techniques including systematic reviews, descriptive trends analyses, regression modelling, predictive forecasting, data linkage and a qualitative thematic-based analysis. These techniques are described in the individual study chapters in the papers published and in those submitted for publication.

3.7 SUMMARY

This Chapter has summarised the studies, research designs, and study settings for this thesis; and has provided a description of the data sources, their features, and strengths and limitations. The methods for the individual studies are discussed in detail in the relevant Chapters.

CHAPTER 4: CHANGES IN EMERGENCY AMBULANCE TRANSPORTATIONS: 1995-2015

4.1 INTRODUCTION

This first study investigates longitudinal historical and predicted trends in emergency ambulance usage across metropolitan Melbourne. As highlighted in Chapter 2, to date, previous research has focused predominantly on describing the increasing rate of ambulance utilisation and the effect on response times over short timeframes⁶⁵⁻⁷¹.

Taking this into consideration, the objective of this study was to conduct a longitudinal population-based study using administratively collected data from Melbourne's sole ambulance service provider in order to:

- i. Measure the growth in volume and rate per 1000 persons in transportation by emergency ambulances across a 14 year period, 1994/1995 to 2007/2008
- ii. Measure the impact of population growth and ageing on the numbers and rate of emergency ambulance transportation across a 14 year period, 1994/1995 to 2007/2008
- iii. Model the longitudinal trends in emergency transportations, taking changes in demographic structure into account, and use the model to predict future demand for services from 2007/2008 to 2014/2015

The methods are outlined below, and publication that follows describes this study in full.

4.2 METHODS AND MODELLING TECHNIQUES

The results of this study were based on the development of a number of regression models.

4.2.1 RATES OF EMERGENCY AMBULANCE TRANSPORTATION

The rates of emergency ambulance transportation were calculated as a crude or unadjusted rate per 1000 persons over the 14 years, using annual total ERP numbers as the denominator (Section 3.4.3.1). Then the rates were adjusted for changes in population growth by age group.

4.2.2 STANDARDISED TRANSPORTATION RATIOS

A simple model was developed to ascertain the impact of population change on the rate of transportation. Average rates of transportation by age and gender across the 14 years were calculated. These rates were used to compute age/gender specific expected number of transportations per year, assuming the calculated average transportation rates over all years. The observed and expected numbers transported were used to generate a *Standardised Transportation Ratio (STR)* per year ⁷².

$$STR = \frac{\text{Observed numbers transported}}{\text{Expected numbers transported}}$$

4.2.3 REGRESSION MODELS

Transportations are a count of the number of transportations occurring in a given time period. Such data can only take whole integer values; thereby following a Poisson or negative binomial distribution. As the count becomes large, the Poisson distribution converges toward a normal distribution. Consequently log-linear models are often applied for event rates with large counts.

This study was population-based with large (2.3 million) counts of transportations. The outcome variable was the logarithm of the transportation rate per 1000 persons-years, because the rates themselves were quite skewed, whereas the log of the rate was symmetric.

The effects and interactions of the predictor variables of gender and age, and age and time were modeled on the outcome variable, whilst controlling for the effects of an intervention. Analytic weighting methods were used to balance the regression. Analytic weights are weights inversely proportional to the variance of an observation. In this analysis, the variance of the log rate was equal to $1 / (\text{denominator of the rate})$, so the number of transportations were used as the analytical weights.

The model used was:

```
Regress lograte (i.gender c.cyear)##ib(45).agegrp i.referral[aweit=transportations]
```

4.2.4 TESTING THE MODEL

To test the model, the log-linear model was then compared with a linear model using the first seven years of data (1994/1995–2001/2002), as a basis for predicting the transportation rates for the remaining years of data (2002/2003–2007/2008). Both models fitted the data with almost perfect R-squared statistics, namely $R^2=0.9998$ and $R^2=0.9912$, log-linear and linear respectively.

4.2.5 FORECASTING

Both linear and log-linear models were extrapolated to forecast predicted transportation rates to 2014/2015. The number of transportations was also calculated by multiplying these predicted rates by the projected population estimates described in Chapter 3, section 3.4.3.1. The results for both models are outlined in the following publication.

4.2.6 LIMITATIONS

The models only account for the effects of gender, age, time and the intervention. In addition, the predicted rates and numbers of transportations are based on the demographic and transportation trends identified over the 14 year study period; therefore are reliant on similar trends throughout the forecast period.

The following publication describes Study 1.

4.3 PUBLICATION: THE CHALLENGES OF POPULATION AGEING:
ACCELERATING DEMAND FOR EMERGENCY AMBULANCE SERVICES BY
OLDER PATIENTS, 1995-2015

CO-AUTHOR DECLARATION FOR PUBLICATIONS TO BE INCLUDED IN THESIS

Monash University

Lowthian JA, Jolley DJ, Curtis AJ, Currell A, Cameron PA, Stoelwinder JU, McNeil JJ. The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995-2015. *Medical Journal Australia* 2011; 194:574-8 eMJA Rapid Online Publication 23 May 2011

Declaration by candidate

In the case of the publications in Chapter 4, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for overall study concept design, literature review, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	75

The following co-authors contributed to the work:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Damien J Jolley	Contributed to the study design; analysis and interpretation of results; review and editing of manuscript	N/A
Andrea J Curtis	Contributed editing of the manuscript	N/A
Alex Currell	Contributed to review of analysis; review and editing of the manuscript	N/A
Peter A Cameron	Contributed to editing of the manuscript	N/A
Johannes U Stoelwinder	Contributed to editing of the manuscript	N/A
John J McNeil	Contributed to the study design; and review and editing of the manuscript	N/A

Candidate's
Signature

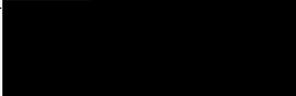
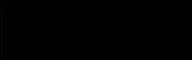
		13 December 2011
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Declaration by co-authors

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- (3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
- (4) there are no other authors of the publication according to these criteria;
- (5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
- (6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location	Department of Epidemiology and Preventive Medicine Monash University
-----------------	---

Co-Authors signatures	Date
	26 October 2011
	27 November 2011
	1 July 2011
	26 October 2011
	26 October 2011
	27 November 2011

The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995–2015

Judy A Lowthian, Damien J Jolley, Andrea J Curtis, Alexander Currell, Peter A Cameron, Johannes U Stoelwinder and John J McNeil

Over the past 20 years, there has been a sustained rise in demand for emergency ambulance services across the developed world.^{1–4} Growth in emergency transportations is an important determinant of emergency department attendances.⁵ In particular, transport of older patients has a significant impact on acute hospital capacity because of high admission rates and long lengths of stay.^{6,7} Resultant pressure compromises access, quality of care and patient safety, with emergency department congestion and overcrowding reported regularly.^{8–11} The strains on ambulance services, however, are less well documented.

Demand on ambulance services encompasses telephone requests via Triple Zero (000) to ambulance call centres, dispatch of paramedics and ambulance vehicles (road and air, emergency and non-emergency), treatment of patients at the scene without transportation, and transport of patients to an emergency department, a non-acute care facility or the patient's place of residence.

To date, researchers and service providers have focused on describing the increasing rate of ambulance use and the effect on response times over short periods.^{1–4,12–14} Some have examined the influence of demographic and health system dynamics on the use of emergency resources. Two recent reviews have suggested that changes in demographics, population health, health system practices, public expectations and accessibility of ambulance services contribute to rising demand, with population growth and ageing proposed as key drivers.^{15,16}

Older people will make up an increasingly larger proportion of the population in the future.¹⁷ About 13% of the population in the United Kingdom, United States and Australia are currently aged over 65 years. It is projected that this will increase to 25% over the next 25 years, with the proportion aged over 85 years rising from 1.6% to around 5%.^{18–20}

We aimed to measure the growth in emergency road ambulance transportations in metropolitan Melbourne since 1995, to measure the impact of population growth and ageing on these services, and to forecast demand for these services in 2015.

ABSTRACT

Objective: To measure the growth in emergency ambulance use across metropolitan Melbourne since 1995, to measure the impact of population growth and ageing on these services, and to forecast demand for these services in 2015.

Design and setting: A population-based retrospective analysis of Ambulance Victoria's metropolitan emergency ambulance transportation data for the period from financial year 1994–95 to 2007–08, and modelling of demand in the financial year 2014–15.

Main outcome measures: Numbers and rates of emergency ambulance transportations.

Results: The crude annual rate of emergency transportations across all age groups increased from 32 per 1000 people in 1994–95 to 58 per 1000 people in 2007–08. The rate of transportation for all ages increased by 75% (95% CI, 62%–89%) over the 14-year study period, representing an average annual growth rate of 4.8% (95% CI, 4.3%–5.3%) beyond that explained by demographic changes. Patients aged ≥ 85 years were eight times (incident rate ratio, 7.9 [95% CI, 7.6–8.3]) as likely to be transported than those aged 45–69 years over this period. Forecast models suggest that the number of transportations will increase by 46%–69% between 2007–08 and 2014–15, disproportionately driven by increasing usage by patients aged ≥ 85 years.

Conclusions: These findings confirm a dramatic rise in emergency transportations over the study period, beyond that expected from demographic changes. Rates increased across all age groups, but more so in older patients. In the future, such acceleration is likely to have major effects on ambulance services and acute hospital capacity. This calls for further investigation of underlying causes and alternative models of care.

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METHODS

We undertook a retrospective analysis of administrative data collected by Ambulance Victoria (Melbourne's sole provider of emergency ambulance responses) for all emergency ambulance transportations in metropolitan Melbourne over the 14-year period from the financial year 1994–95 to 2007–08. We also modelled demand in the financial year 2014–15. The study was approved by the Monash University Human Research Ethics Committee and Ambulance Victoria's Research Governance Committee.

Data

Emergency transportation data were provided in a de-identified format by Ambulance Victoria. Data elements comprised demographic characteristics (including age and sex) and clinical condition of the patient as identified at the time of the request for assistance using the Advanced Medical Priority Dispatch System (Priority Dispatch Corporation, Salt Lake City, Utah, USA). Population data published by the Australian

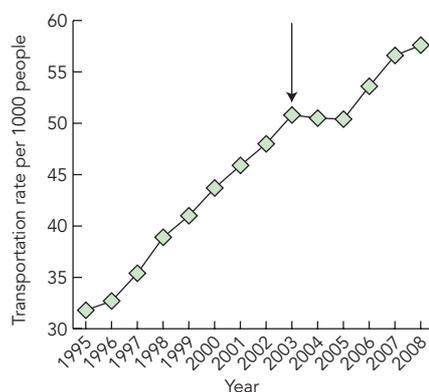
Bureau of Statistics^{21–23} were used to calculate emergency transportation rates by age and sex. Projected population estimates from the Australian Bureau of Statistics (based on conservative assumptions of fertility, life expectancy and migration) were used to forecast demand for emergency transportation in 2014–15.

Analysis

All analyses were performed using Stata version 11 (StataCorp, College Station, Tex, USA). The primary outcome event was transportation in an emergency ambulance. We used confidence intervals to quantify the precision of our estimates throughout.

We calculated the average rate of transportation by age and sex over the 14-year study period and the expected number of transportations per year, aggregating age and sex. Observed and expected numbers of transportations were used to generate a standardised transportation ratio for each year. This was used to estimate the increase in transportations over time, allowing for

1 Emergency transportation rates for males and females of all ages, Melbourne (1994–95 to 2007–08 financial years)*



*Arrow denotes introduction of referral service. ◆

changes in the demographic structure of the population.

Using log-linear regression with weights inversely proportional to the variance of the outcome variable, we modelled the main effects and interactions of sex and age, and of age and time on the logarithm of the transportation rate while controlling for the introduction of a referral service. This was compared with a linear model to test an alternative method of modelling.

We extrapolated the models for transportation rates to 2014–15. Predicted numbers of transportations were calculated by multiplying predicted rates by projected population estimates.

RESULTS

During the 14 years studied, there were 2 227 144 emergency ambulance transportations in metropolitan Melbourne. The crude rate of emergency transportation for males and females of all ages increased from 32 per 1000 people in 1994–95 to 58 per 1000 people in 2007–08 (Box 1). The rate decreased in late 2003 following the introduction of an ambulance referral service designed to curb demand — after adjusting for the effects and interactions of age, sex and the referral service, the rate was decreased by 10%. However, the rate increased again by 2006 to levels above those in 2003. For suitable patients, the referral service enables provision of self-care telephone advice, referral to a non-emergency transport service or referral to a community-based service as an alternative to emergency ambulance dispatch at the time

of the initial telephone call. Ambulance Victoria data for 2011 indicate that about 8% of callers are currently directed to one of these options.

Transportation rate increases were only partly accounted for by changes in population size and age and sex distribution. The rate of transportation for all ages increased by 75% over the 14 years studied (95% CI, 62%–89%). This represented an average annual growth rate of 4.8% (95% CI, 4.3%–5.3%) beyond that explained by demographic changes. There were similar relative proportional increases in all age groups and the highest absolute rates were in the oldest patients (Box 2). Transportation rates relative to those in 1994–95 increased for males and females in all age groups in a linear and uniform manner (Box 3), suggesting an exponential increase in the transportation rates over time.

Patients aged ≥ 85 years were eight times (incident rate ratio, 7.9 [95% CI, 7.6–8.3]) as likely to be transported as those aged 45–69 years. Their transportation rate rose from 248 to 474 per 1000 population, and increased 3.1% faster per year (95% CI, 2.1%–4.1%) than the transportation rate for patients aged 45–69 years. By 2007–08, the proportion of Melbourne's population aged ≥ 85 years rose from 1.1% to 1.6%, yet the proportion of emergency transportations accounted for by this group rose from 8.4% to 13.6%.

Annual standardised transportation ratios indicated a significant rise in transportations despite taking population growth and ageing into account. Compared with 1994–95, the number of transportations observed in 2007–08 was 68% greater than expected.

For older patients, the predominant reasons for emergency ambulance requests were falls, chest pain and breathing prob-

lems. The proportional increases in transportation of patients with each of these conditions were similar.

When log-linear modelling, which is usually applied to rates of occurrence of events, was tested against linear modelling of the data to 2007–08, the difference in performance was imperceptible. We therefore used both models to forecast demand in 2014–15 (Box 2). The total number of emergency transportations in metropolitan Melbourne could increase by 46%–69% by 2014–15.

The projected numbers and rates of transportations by age group to 2014–15 (Box 4 and Box 5) demonstrate that demand by people aged ≥ 85 years will continue to accelerate in the future. Among those aged ≥ 85 years, the rate could rise from the observed 474 per 1000 people in 2007–08 to more than 800 per 1000 people in 2014–15, with the absolute numbers of transportations rising more than twofold.

DISCUSSION

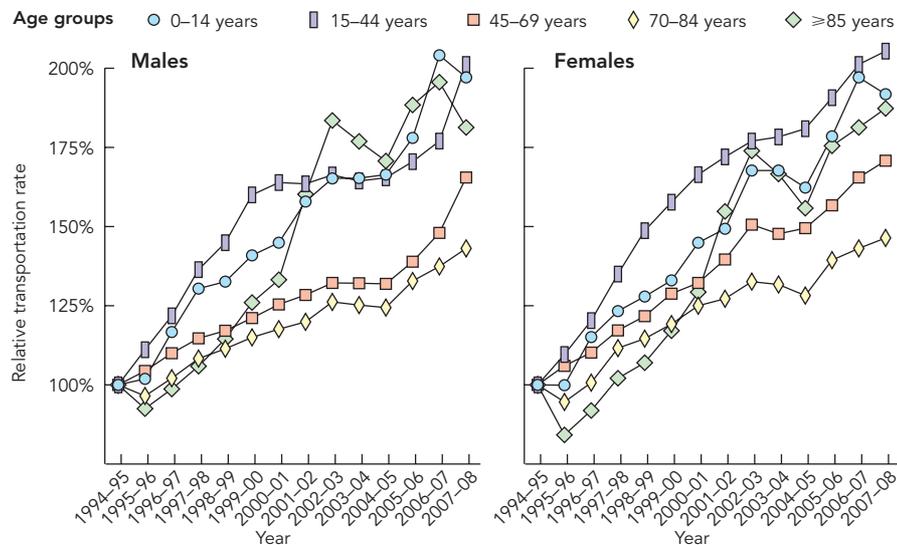
Our study shows that there has been a dramatic rise in emergency transportations in Melbourne over the 14-year period to June 2008. The association that we identified between transportation rates and increasing age concurs with previous findings.^{2,15,25-27} However, to our knowledge, this is the first study to identify an increasing and accelerated rate of demand by patients aged ≥ 85 years compared with other age groups, which cannot be explained by demographic changes alone, and it is the first to model future demand while taking population ageing into account.

Demand for emergency health care services among older patients is driven by many factors. Older patients often present to emergency departments with more complex

2 Total numbers of emergency transportations and transportation rates by age group, Melbourne (1994–95, 2007–08 and 2014–15 financial years)

	1994–95	2007–08	2014–15 forecasts	
	Observed	Observed	Linear model	Log-linear model
Population (million) ^{23,24}	3.27	3.92	4.24	4.24
No. of transportations	104 028	225 865	330 332	382 260
Rate per 1000 people				
All ages (crude)	31.8	57.6	77.9	90.2
0 to 14 years	10.7	21.2	27.2	34.0
15 to 44 years	18.3	34.8	48.1	53.5
45 to 69 years	33.6	53.4	64.6	73.3
70 to 84 years	147.0	211.2	255.5	283.9
≥ 85 years	247.6	474.0	651.0	843.7

3 Emergency transportation rates by sex and age group, relative to rates for the financial year 1994–95, Melbourne (1994–95 to 2007–08 financial years)



clinical conditions than younger patients.^{6,7} The most commonly reported reasons for transportation of older patients in our study were similar to those identified previously^{2,25,28} and no specific condition was responsible for the increasing ambulance use; falls, chest pain, breathing problems and light-headedness have been recognised as ailments associated with seeking health care.²⁹ Reduced capacity to care for older relatives and an increasing proportion of the older population living alone,³⁰ alongside reduced access to primary health care,^{31,32} can leave older patients with few alternatives for accessing health care, particularly outside normal working hours. Recent improvements in health awareness and increasing community expectation may also be factors.³³ In addition, limited price signals (low or no cost) could drive ambulance use by older people.¹⁶ In Melbourne, funding arrangements via the government for a low-cost (\$70) annual subscription ensure that the majority (86%) of patients transported have no out-of-pocket expense, and pensioners are entitled to free transport.

Ambulance services in the UK and Australia have taken steps to combat rising demand.^{34,35} Our study showed that introduction of a referral service reduced the rate of transportations but did not slow the steady increase over time. Although the referral service is diverting an increasing number of emergency requests to alternative resources, growth rates in transportation have returned to the historical norm. This shows that service providers and funding

agencies across the continuum of emergency health care need to prioritise working together to develop a coordinated whole-of-system approach, including innovative models of out-of-hospital patient-centred care. Other demand management strategies that have been introduced include the UK's NHS Direct and Victoria's NURSE-ON-CALL and after-hours general practitioner clinics, but these have had little impact on reducing demand on emergency resources.^{36,37} The effects of other strategies that have been implemented — including outreach programs such as hospital-in-the-home and hospital-in-the-nursing-home, mobile specialist teams, and urgent-care walk-in clinics — are yet to be rigorously evaluated.^{38,39}

As numbers and rates of presentations of older patients with complex illnesses and medication regimens increase, the training of emergency health care workers must

ensure that they are equipped to meet the special care needs of older patients. This includes acknowledgement of limitations to care, especially with respect to aggressive treatment being inappropriate in very elderly and palliative-care patients.³⁹ Service providers in the UK and Australia have recently introduced non-transportation protocols that extend paramedics' duties to "treat and leave" patients at their place of residence. In addition, UK service providers have begun conveying patients to alternative, more appropriate health services, instead of emergency departments.^{40,41} Evaluation of the safety and efficacy of these alternative services is ongoing.⁴²

A strength of our study is its population-based and longitudinal nature, which enabled analysis of 2.27 million emergency transportations over 14 years. The only other longitudinal study that we are aware of examined call rate data from the sole provider of ambulance services in London for three 1-week periods between 1989 and 1999.³ A limitation of our study is that it was not possible to identify the number of repeated transportations of same individuals, as the data were de-identified. Also, the predictions are based on past trends in transportation and demographics and, as such, rely on the same trends prevailing over the forecast period.

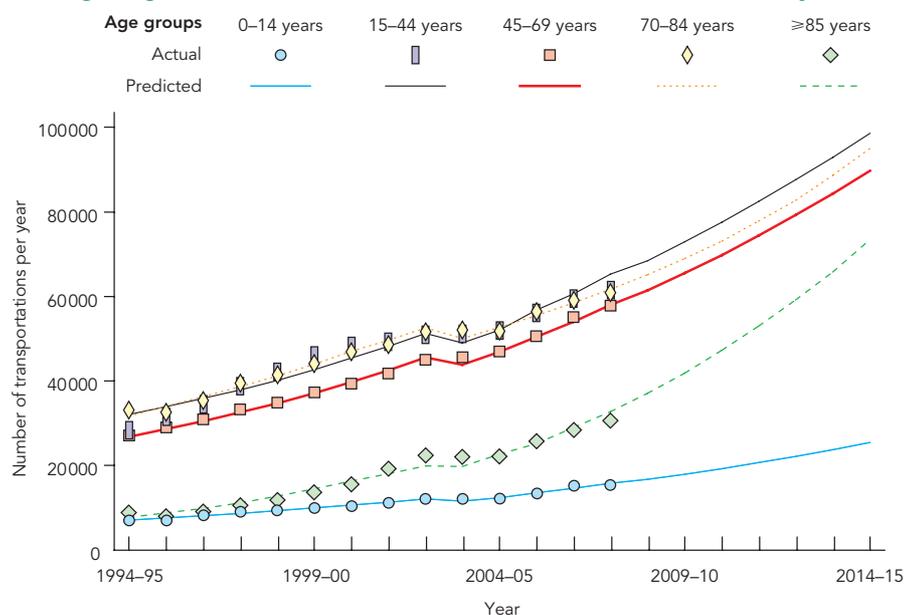
Our findings show a persistent rise in emergency transportations in Melbourne from 1994–95 to 2007–08, after adjustments for population growth and ageing. By 2014–15, the absolute increase is likely to be substantially greater among older patients, which will have a dramatic impact on the continuum of emergency health care. In a climate of global financial constraint, we believe our results indicate an urgent need for a coordinated response by policymakers and service providers to this increasing demand.

4 Predicted emergency transportation rates and numbers of transportations in the financial year 2014–15 by age group using log-linear model, Melbourne

Age group	Rate per 1000 people (95% CI*)	No. of transportations (95% CI*)
0–14 years	34 (30–38)	25 430 (22 729–28 132)
15–44 years	54 (51–57)	98 582 (93 065–104 100)
45–69 years	73 (69–77)	89 794 (84 571–95 017)
70–84 years	284 (268–300)	95 004 (89 740–100 268)
≥ 85 years	844 (770–917)	73 450 (67 236–79 663)
All ages	—	382 260 (357 341–407 180)

* 95% CIs are based on prediction model only, using the bootstrap method, as estimated precision of projected population estimates is not available. ◆

5 Actual and predicted numbers of emergency transportations by age group using a log-linear model, Melbourne (1994–05 to 2014–15 financial years)



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COMPETING INTERESTS

None identified.

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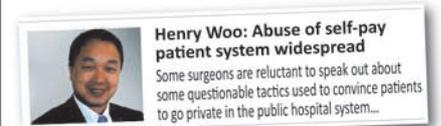
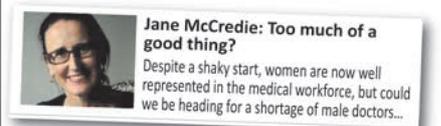
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4.4 SUMMARY

This is the first population-based longitudinal analysis of emergency ambulance transportations nationally and internationally. It is the first study to identify the increasing and accelerating rate of emergency transportations of very elderly patients (aged ≥ 85 years) compared with other age groups. It is also the first study to model future demand taking population ageing into account.

The issue of increasing demand for emergency health care services is seen by the community as being an important problem, as evidenced by the attention received from the academic literature^{73 74} and by the media following publication of this ambulance study. A sample is located in Appendix 3.

The implication of these results is that current model of out-of-hospital emergency health care may not be sustainable in the future. The forecast increase in use of emergency ambulances by older age groups in an ageing population will place an increasing burden on emergency care, including presentations to ED and admissions to hospital. The next Chapter investigates the longitudinal trends in ED attendances over a 10 year period.

CHAPTER 5: TRENDS IN EMERGENCY DEPARTMENT PRESENTATIONS: 2000-2009

5.1 INTRODUCTION

The trends in emergency ambulance transportations over a 14 year period were analysed in the previous study. The continuing and significant rise in the number and rate of transportations identified undoubtedly impacts on emergency department (ED) services given that the ED is the common destination for emergency ambulances.

The systematic review in Chapter 2 reported on the rise in ED presentations, with international and Australian annual rates ranging from 3% - 6%⁷⁵⁻⁷⁸ and up to 7%^{6 42} respectively. Government agencies publish annual reports detailing numbers of presentations and some studies report on problems associated with rising demand for ED services. However changes in ED utilisation have not been examined longitudinally in any peer-reviewed population-based studies.

This next study aims to examine the scope of ED usage across metropolitan Melbourne, through the analysis of ten years of data collected by the Victorian Department of Health. This investigation is reported in publication entitled '*Demand at the ED front door: Ten-year trends in Emergency Department presentations.*'

5.2 METHODS

5.2.1 PREPARATION OF DATA SET

Data for all ED presentations to all metropolitan Melbourne public hospital EDs were provided by the Department of Health in separate financial year files for the 10 year period, July 1999 / June 2000 to July 2008 / June 2009. Presentations to specialist maternity hospital and the Eye and Ear Hospital EDs were excluded.

Each data file detailed demographic and clinical details of individual patients by date of ED presentation. Demographic and clinical factors for all presentations were categorised according to: age group, gender, referral source, and type of transport to ED; clinical acuity by triage category, clinical diagnosis; ED length of stay (ED LOS) and ED discharge destination. Differences in the VEMD categories and definitions over the 10 years necessitated unification of the coding of all categories, across each 12 month period prior to analysis of the entire data set.

The number of ED presentations over the ten year time period available for analysis was N=7,093,185. Each data set ranged from 170 to 275 megabytes. This rendered collation of all files together into a single data set not possible, due to the limitations of computer memory capacity and the processing ability of the software program used for analysis.

To overcome this, the annual files were reduced in size by 'grouping the data', by summarizing each 12 month period into sub sets / groups of patients by 5-year age groups, gender, preferred language, referral source, means of arrival at the ED, triage category, principal clinical reason for attendance, ED length of stay and discharge destination from ED.

For example, a sub set / group of patients could comprise the number of male patients in each year who were aged 15 -19 years, spoke English, were referred by their family, transported by a family car, were triaged as ATS category 3, were diagnosed by the ED physician as presenting with an injury, had an ED LOS of 4 to < 8 hours, and were discharged directly home from ED.

By grouping the data in this manner, it was possible to merge the ten annual files together into a single data file to enable analysis of presentation rates and modelling the effects of these factors over time. Table 3 outlines the variables (factors) and categories recoded for the analysis.

Table 3: Factors/ categories included in analysis

Variable	Categories
Referral source	Self/family/friends Local medical officer Specialist Other health professional/health service Community Other service
Transport arrival	'Walk-ins'(including those arriving by private vehicle) Emergency ambulance (including helicopter) Community services Non-emergency ambulance Undertaker
Clinical urgency ^{79 80}	Resuscitation Emergency Urgent Semi-urgent Non-urgent' Dead on arrival
Primary clinical diagnosis	ICD-10-AM diagnoses ⁸¹
ED LOS	<4 hours 4 to <8 hours 8 to<12 hours 12 to <24 hours ≥24 hours
ED disposition	discharge home admission to hospital Admission to Short-Stay Observation Units Transfer to another hospital Left 'at risk'

The data dictionary is presented in Appendix 2.

5.2.2 RATES OF ED PRESENTATION

ED presentation rates were initially calculated as a crude unadjusted rate per 1000 persons for each year, with the total population numbers as the denominator. The rates were then adjusted for changes in age structure using the population data, as described in Chapter 3.

The VEMD was population-based data, so it followed a Poisson distribution; therefore log-linear regression was used to model the effects of changes in demographic structure on the rates of ED attendance over the study period.

5.2.3 TREND ANALYSIS

Changes in patterns of ED utilisation over time were examined by using the grouped data set, discussed above in Section 5.2.1. The individual annual data files were then analysed, to enable more detailed investigation of each of the variables/categories summarised in Table 3. This analysis is discussed in the publication that follows.

5.2.4 MODELLING OF PREDICTORS OF LENGTH OF STAY

ED length of stay (LOS) increased over the study period for more acutely unwell patients. The effects of specific predictors were modeled on an ED LOS of <4 hours and ED LOS \geq 4 hours at three time points. The data for 1999/2000, 2003/2004 and 2008/2009 were merged together (N=2,081,275 patients). Random effects logistic regression was used to model the effects of age, gender, mode of arrival, clinical acuity and discharge destination from the ED on Length of Stay.

The model developed comprised:

```
xtlogit los01 i.tperiod ib(35).agegp i.Sex i.arr01 ib(4).triage
i.eddisp01, i(newid)
```

This model indicated a LOS ≥ 4 hours was associated with:

- increasing age
 - patients aged ≥ 85 years were 2.18 times (95% CI 2.13 to 2.22) as likely as those aged 35 to 59 years to have an ED LOS ≥ 4 hours
- gender
 - females were 1.15 times (95%CI 1.14 to 1.16) as likely as males to remain in the ED for ≥ 4 hours
- arrival by emergency ambulance
 - patients arriving by emergency ambulance were 1.75 times (95%CI 1.73 to 1.76) as likely as patients arriving by other types of transport to have an ED LOS ≥ 4 hours
- being admitted to hospital
 - patients admitted to hospital (including a short stay observation unit) were 5.9 times (95%CI 5.8 to 6.1) as likely as patients discharged directly from ED home or transferred to another hospital, to remain in ED for ≥ 4 hours

The model is detailed in Table 4 of the publication that follows.

5.3 PREPARED MANUSCRIPT: DEMAND AT THE ED FRONT DOOR: TEN-YEAR TRENDS IN EMERGENCY DEPARTMENT PRESENTATIONS

CO-AUTHOR DECLARATION FOR PUBLICATIONS TO BE INCLUDED IN THESIS

Monash University

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Declaration by candidate

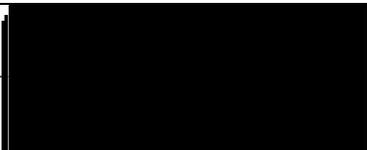
In the case of the publications in Chapter 5, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for overall study concept design, literature review, coding and recoding of variables and all preparation of datasets for analysis, development of Stata analysis codes, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	80

The following co-authors contributed to the work:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Andrea J Curtis	Contributed to editing of the manuscript	N/A
Damien J Jolley	Contributed to interpretation of results and editing of manuscript	N/A
Johannes U Stoelwinder	Contributed to editing of the manuscript	
John J McNeil	Contributed to the study design and editing of the manuscript	N/A
Peter A Cameron	Contributed to editing of the manuscript	N/A

Candidate's
Signature

	Date
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Declaration by co-authors

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- (3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
- (4) there are no other authors of the publication according to these criteria;
- (5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
- (6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location	Department of Epidemiology and Preventive Medicine Monash University
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Co-Authors signatures	Date
	27 October 2011
	26 October 2011
	26 October 2011
	28 November 2011
	26 October 2011

Demand at the ED front door: Ten-year trends in Emergency Department presentations

Lowthian JA, Curtis AJ, Jolley DJ, Stoelwinder JU, McNeil JJ, Cameron PA

Abstract

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

Design and Setting: Population-based retrospective analysis of Department of Health public hospital ED data: 1999/2000 to 2008/2009, metropolitan Melbourne.

Outcome Measure(s): Presentation numbers, presentation rates/1000 persons, ED LOS

Results: ED presentations increased from 550,662 in 1999/2000 to 853,940 in 2008/2009. This corresponded to a 32% rise in rate of presentation (95%CI 29% to 35%), an average annual increase of 3.6% (95%CI 3.4% to 3.8%) after adjustment for population changes.

Almost 40% of all patients remained in ED \geq 4 hours in 2008/2009, with LOS increasing over time for more acute patients.

Likelihood of presentation rose with increasing age, with people \geq 85 years 3.9 times as likely to present as those 35-59 years (95%CI 3.8 to 4.0). The volume of older presentations more than doubled over the decade. They were more likely to arrive by emergency ambulance and more acutely unwell than 35-59 year olds; with 75% having LOS \geq 4 hours and 61% requiring admission in 2008/2009.

Conclusions:

The rise in presentation numbers and presentation rates per 1000 persons 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. The proposed 4 hour targets in 2012 may be unachievable given these trends unless there is significant redesign of the whole system.

Demand at the ED front door: Ten-year trends in Emergency Department presentations

Lowthian JA, Curtis AJ, Jolley DJ, Stoelwinder JU, McNeil JJ, Cameron PA

Demand for emergency healthcare 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 This compromises ED performance with overcrowding,⁵ increased waiting times and ED length of stay (LOS),⁶ ambulance diversion, and a threat to patient safety with an increased risk of adverse events when overcrowding is present.⁷

Government agencies publish annual reports of ED performance including presentations numbers,^{1,3,4} and problems associated with rising demand are well documented in the peer-reviewed literature and media.⁸ However there are few longitudinal analyses of routinely collected data. Therefore, we aimed to (i) measure the volume and age-specific rates of ED presentations ; (ii) measure ED LOS; and (ii) investigate characteristics in 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 ten years ending June 2009. This study was approved by Monash University's Human Research Ethics Committee and the Victorian Department of Health.

Data

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 inter-facility comparability. The analysis included data from metropolitan Melbourne EDs, and excluded specialist maternity and Eye & Ear hospitals. Population data published annually by the Australian Bureau of Statistics were used to calculate presentation rates by age and gender.¹⁰

Analysis

Data were obtained in financial year files from July 1999/June 2000 to July 2008/June 2009. Demographic and clinical factors for all presentations were categorised according to age group, gender, referral source, and type of transport to ED, triage category, clinical diagnosis, ED LOS and discharge destination (Box).

Annual age- and gender-specific presentation rates per 1000 persons were calculated 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 gender on ED presentations. We used descriptive statistics to compare trends for 1999/2000 and 2008/2009 in age, gender, referral source, transport type, triage category, primary diagnosis, ED LOS and discharge destination.

Changes over time in median ED LOS by triage category and age were examined, and log linear regression modelled effects of age, gender, mode of transport, triage category and admission/discharge from ED on ED LOS over time. Confidence intervals were generated to quantify precision of estimates. Stata version 11 was used for all analyses (StataCorp, College Station, Texas, USA).

RESULTS

Rising demand

Increase in Presentations: From 1999/2000 to 2008/2009, there were greater than 7 million presentations to metropolitan Melbourne EDs. The crude increase was 55%, the number of presentations rising from 550,662 in 1999/2000 to 853,940 in 2008/2009. Population growth was 19% for this period. The crude rate of ED presentation across all ages and gender rose from 163 in 1999/2000 to 212 per 1000 person-years in 2008/2009.

Age-specific presentation numbers and rates also increased. Median age rose from 31 in 1999/2000 to 34 years in 2008/2009. Although the increases across each age group were of similar magnitude, the highest absolute rates occurred amongst the youngest and oldest age groups (Figure 1). The presentation rate for people ≥ 85 years was 594/1000 in 2008/2009, compared with 438/1000 ≥ 85 years in 1999/2000. In 2008/2009 this age group comprised 4.7% of all ED presentations, whilst representing 1.7% of the population.

Effects of population change: Log-linear regression showed a 32.2% (95%CI 29.2% to 35.2%) increase in presentation rates per 1000 persons over the decade after adjustment for population changes. This represents an average annual increase of 3.6% (95%CI 3.3% to 3.8%). Females were 14.2% less likely to present than males (95%CI 13.1% to 15.4%). The risk of presentation rose with increasing age, with those ≥ 85 years 3.9 times (95%CI 3.8 to 4.0) as likely as those aged 35-59 years to attend a metropolitan ED in 2008/2009 (Table 1).

Descriptive Analysis

Table 2 summarises the trends that have occurred in presentations to metropolitan Melbourne public hospital EDs over the decade.

Referral Source: The number of self-referred presentations rose by 68%. Self-referrals increased across all age groups, with a 2.3 fold increase in those ≥ 85 years.

Arrival mode: Most presentations (73%) in 2008/2009 were classified as 'walk-ins'. Although fewer than 25% arrived by emergency ambulance, this represented an increase in absolute numbers of 60%. Likelihood of arriving by ambulance rose with increasing age, with a two-fold increase in those ≥ 85 years.

Clinical acuity: Throughout the study period, over half the presentations were triaged as Australasian Triage Scale (ATS) 4/5⁹ (Box 1); the largest volume of patients 20-59 years. However, the group of patients that increased most was ATS 2/3 (emergency/urgent), comprising 43% of all presentations in 2008/2009. Forty-five percent of all patients ≥ 85 years were triaged into more acute categories.

Clinical Diagnosis: There were no significant changes over time in primary diagnoses, with external causes due to injury or poisoning, infectious and parasitic diseases, and respiratory, circulatory or digestive problems, most common.

ED Length of Stay (LOS): The majority of all patients were discharged from ED within 4 hours of arrival in 2008/2009; with almost 40% having LOS \geq 4 hours. Table 3 shows median LOS increased for more acutely unwell patients (ATS 1/2/3), with ATS 1's median LOS rising from 3.9 hours in 1999/2000 to 5.1 hours in 2008/2009. Less urgent patients experienced a reduction in LOS, with ATS 4 and 5 having a median LOS of 2.8 and 1.6 hours in 2008/2009, respectively. Patients presenting with illness had longer median LOS compared to those attending with injury. Median LOS rose with increasing age and within each ATS (Figure 2), with 75% of patients \geq 85 years having a LOS of \geq 4 hours in 2008/2009. Fixed effects modelling (Table 4) indicated a LOS \geq 4 hours was associated with increasing age, being female, emergency ambulance arrival and admission.

Total hours of ED LOS increased for admitted patients by 79%, from 44,442 to 80,054 ED bed-days occupied in 2008/2009 (Table 2). In comparison, ED bed-days occupied for discharged patients rose by 43% over the study period.

ED disposition: Over 62% of patients were discharged home directly in 2008/2009. The volume of patients admitted (including to a Short Stay Observation Unit-SSOU) rose by 79% over the decade, the rate increasing from 36 to 54.5 per 1000 person years in 2008/2009. Likelihood of admission was greater with increasing age (61% of all patients \geq 85 years), including 22% transferred to a SSOU and 39% to other wards in 2008/2009 (Figure 3). This compares with 25% of patients aged 20-59 years being admitted, and 78% discharged in 2008/2009.

The proportion of people leaving ED 'at risk' (without being seen or before clinical approval) increased by 84%; representing 6.6% of all presentations in 2008/2009, with the largest proportion of people aged 20-34 years, a three-fold increase over the decade.

DISCUSSION

We confirmed a persistent rise in demand across metropolitan Melbourne, evidenced by an absolute increase of 55% in volume of presentations over the decade to 2008/2009. Older people presented at the highest per capita rate, with 60% of the population \geq 85 years in 2008/2009 presenting for emergency care. The pressures on EDs are evident with increases in LOS and higher frequencies of admissions of 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. This 55% increase in the volume of ED patients surpasses the UK's 34% rise.¹ However, Melbourne's presentation rate at 212/1000 persons in 2009 is lower than the UK's 305/1000 persons.

Population ageing: Our finding that per capita increase was highest in people \geq 85 years concurs with other studies.¹¹⁻¹³ The results are also consistent with our recent study that demonstrated increasing and accelerating demand by the elderly for emergency ambulances.¹⁴ Older patients had longer LOS and were more likely to be admitted than middle-aged patients. An ED visit for an older person is a sentinel health event that can lead to substantial functional decline and other adverse

outcomes.¹⁵ Given projected trends in population ageing, this is likely to be a continuing phenomenon that will have a dramatic impact on all aspects of emergency and hospital care.

Primary care access: In 2008/2009, most patients were triaged as semi-urgent/non-urgent, with almost 50% of working age (20-59 years). This age group was predominantly self-referred, arrived by their own means, were less acute and not admitted, suggesting they could have been managed appropriately in community-based settings.

There was a rapid increase in patients who left 'at risk'; averaging 6.6% of all presentations in 2008/2009. Most were aged 20-34 years, more likely triaged as ATS 4/5 with LOS<4hrs; implying lower urgency. This 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 Four 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 GP accessibility and increasing GP co-payments¹⁸ Furthermore, EDs may appeal to people of working age, with the convenience of 24-hour hospital-based specialised multidisciplinary healthcare with no co-payments.¹⁹

Impact on patient safety: Over the study period ED LOS increased for more urgent and admitted patients, suggesting much of 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 21} 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 implementation of the Four Hour National 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 four hours.^{22 23} The increase in LOS suggests this target may not be achievable in the current system of care, in the 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

Demand Management Strategies: Governments and service providers have progressively responded to demand for emergency healthcare 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, SSOUs and medical planning units.²⁴ Ambulance services have also introduced strategies intended to divert need for transportation. However, we confirmed a continuing rise in ED presentations and also in emergency ambulance transportations.¹⁴ Therefore we question whether current models of emergency and primary care are meeting community needs at times of acute illness. With population ageing, demand for both ambulance and hospital services will continue to rise.

Increasing efficiency alone is unlikely to meet this demand. Fundamental restructure of our models of care are 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 the elderly also need discussion.

The strength of this population-based study is that it is 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 working in an environment fraught with multiple distractions as previously reported.²⁵ We have attempted to identify factors underpinning the increase; however not all the elements of demand are identified by routinely collected data.

Conclusion

There has been a continuing rise in the number and rate of ED presentations particularly by older patients. With population ageing, demand for both ambulance and hospital services will continue to rise. It is clear that current models of emergency and primary care are failing to meet community needs. This is a major cause for concern for the health system considering the investment to date in many interventions implemented to target demand. Information about many patient or health service related factors thought to affect ED demand is not routinely captured. These include GP access, expectations for timely care, and the convenience of a 24 hour 'one-stop shop'. Urgent clarification of the impact of such factors is required to provide the evidence-base upon which to design alternative strategies to manage demand.

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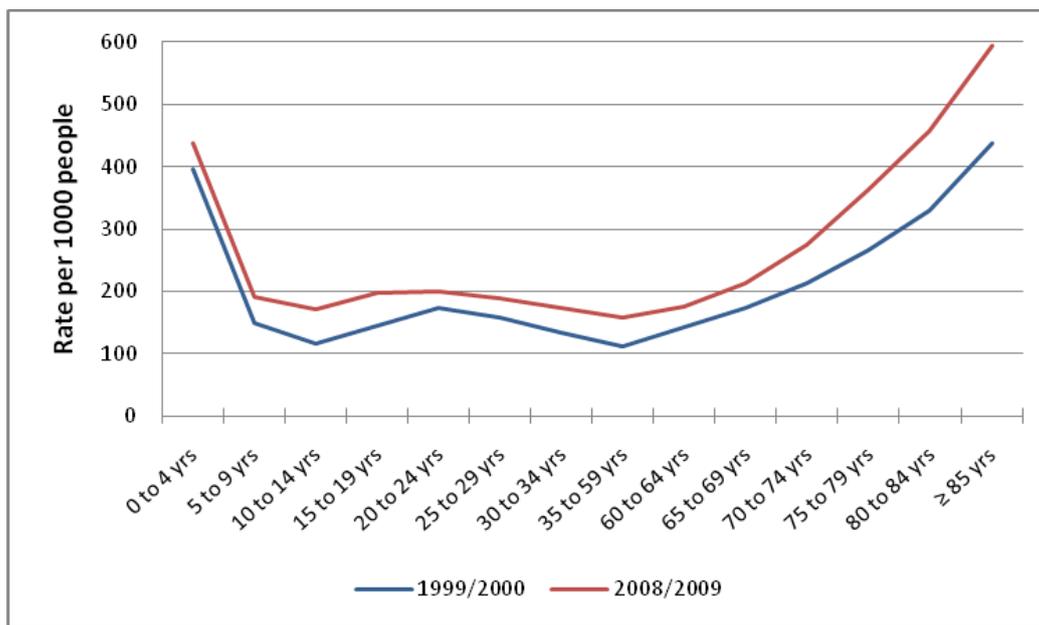
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Box: Factors/ categories included in analysis

Variable	VEMD Categories
Referral source	Self/family/friends Local medical officer / Specialist
Transport arrival	Emergency ambulance (including helicopter) 'Walk-ins' - arrival by private vehicle or community service
Triage Category <i>Australasian Triage Scale</i>	ATS 1:Resuscitation ATS 2:Emergency ATS 3: Urgent ATS 4: Semi-urgent ATS 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' (<i>without being seen or without approval of ED clinical staff</i>)

Figure 1: Presentation rates per 1000 people by age group to public hospital EDs, Melbourne 1999/2000 to 2008/2009 (excl specialist maternity & Eye & Ear Hospitals) (Adjusted for age and time)



(Source VEMD)

Table 1: Adjusted log-linear model looking at effects of age on public hospital ED presentations, Melbourne 2000 to 2009 (excl specialist maternity & Eye & Ear Hospitals)

Metropolitan public hospital ED presentations		2000 to 2009	95% CI (p<0.000)
Age group	0 to 4 years	3.2	3.19 to 3.38
	5 to 9 years	1.30	1.26 to 1.34
	10 to 14 years	1.05	1.02 to 1.09
	15 to 19 years	1.26	1.22 to 1.30
	20 to 34 years	1.3	1.28 to 1.33
	35 to 59 years	1.0	-
	60 to 69 years*	1.4	1.4 to 1.5
	70 to 74 years*	1.8	1.8 to 1.9
	75 to 79 years*	2.3	2.3 to 2.4
	80 to 84 years*	2.9	2.8 to 3.0
	≥ 85 years*	3.9	3.8 to 4.0

*using 35 to 59 year age group as a comparator
Adjusted for the effects of age, time & gender

(Source: VEMD)

Table 2: Trends in absolute numbers of presentations to public hospital EDs 1999/2000 to 2008/2009 Melbourne
(excl specialist maternity & Eye & Ear Hospitals)

		1999/2000 n (%)	2008/2009 n (%)	Difference	% Change
No. EDs		16	18 [@]	2	12
Total no. presentations (N)		550,662	853,940	303,278	55
Total population (million)		3.38	4.02	640,242	19
Age	mean	35.3 yrs	37.7 yrs	2.4 yrs	8
	median	31 yrs	34 yrs	3 yrs	10
Gender	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 (76)	619,798 (73)	204,238	49
ATS Triage category					
	1 (Resuscitation)	6,596 (1)	7,352 (1)	756	12
	2 (Emergency)	37,135 (7)	87,753 (10)	50,618	136
	3 (Urgent)	164,507 (30)	280,433 (33)	115,935	70
	4 (Semi-urgent)	276,213 (50)	398,642 (47)	122,442	44
	5 (Non-urgent)	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 hrs		342,084 (62)	517,103 (61)	175,019	51
ED bed-days occupied					
	<i>Discharged patients</i>	56,541	81,102	24,561	43
	<i>Admitted patients</i>	44,662	80,054	35,612	79
ED discharge destination					
	Discharge home	371,559 (68)	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

*Short Stay Observation Units introduced from 2001/02

(Source: VEMD)

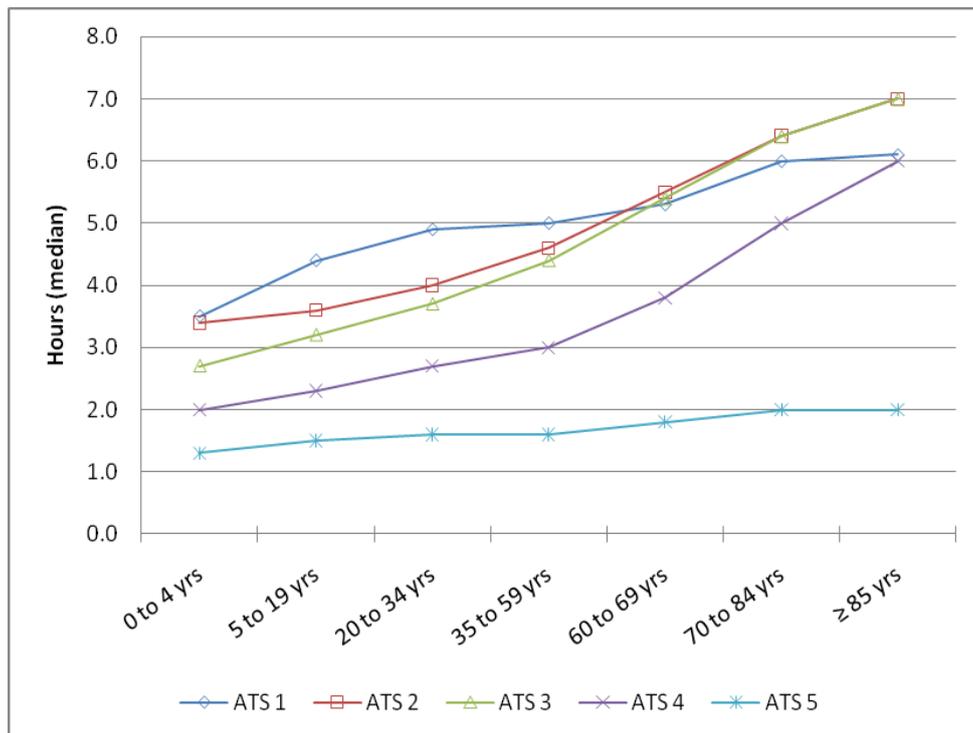
Table 3: Trends in the proportion of all patients ED Length of Stay (LOS)<4hrs, and overall median LOS by triage category, metropolitan Melbourne, 1999/2000-2008/2009 (excl specialist maternity & Eye & Ear Hospitals)

Year	1999/2000			2008/2009		
	n	% with LOS<4hrs	ED LOS - hours median	n	% with LOS<4hrs	ED LOS - hours median
Overall	550,662	62.1	3.1	853,940	60.6	3.3
ATS 1	6,596	51.3	3.9	7,352	37.3	5.2
ATS 2	37,135	43.1	4.6	87,753	41.5	4.8
ATS 3	164,507	52.0	3.9	280,433	47.8	4.2
ATS 4	276,213	65.4	2.9	398,642	68.5	2.8
ATS 5	64,672	84.9	1.8	77,447	88.2	1.6

(Source: VEMD)

Figure 2: Emergency Department median Length of Stay (hours) for all presentations by age group, Melbourne public hospitals 2008/2009

(excl specialist maternity & Eye & Ear Hospitals)



(Source: VEMD)

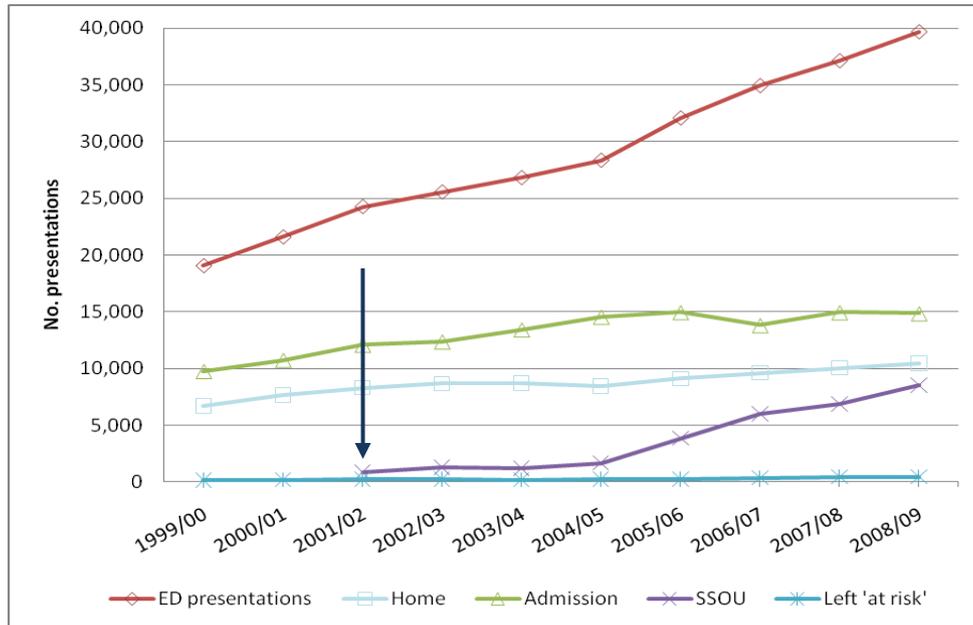
Table 4: Multivariate model of factors associated with an ED LOS \geq 4 hours, Melbourne public hospitals 1999/2000-2008/2009 (excl specialist maternity & Eye & Ear Hospitals)

ED LOS \geq 4 hours *		Odds ratio	95% CI ($p < 0.000$)
Age group	0- 4 yrs	0.34	0.34 to 0.35
	5-19 yrs	0.45	0.45 to 0.46
	20-34 yrs	0.78	0.77 to 0.79
	35-59 yrs	1.0	-
	60-69 yrs	1.37	1.35 to 1.39
	70-84 yrs	1.76	1.74 to 1.79
	\geq 85	2.18	2.13 to 2.22
Sex	Male	1.0	-
	Female	1.15	1.14 to 1.16
Arrival mode	Emergency ambulance	1.75	1.73 to 1.76
	Walk-In	1.0	-
Triage category	ATS 1	0.53	0.51 to 0.55
	ATS 2	1.21	1.19 to 1.22
	ATS 3	1.38	1.37 to 1.39
	ATS 4	1.0	-
	ATS 5	0.41	0.40 to 0.42
Disposition from ED	Not Admitted	1.0	-
	Admitted [#]	5.9	5.8 to 6.1

*adjusting for the effects of age group, sex, mode of arrival, clinical acuity, and ED disposition
[#] including Short Stay Observation Unit

Source: VEMD

Figure 3: Discharge destination for patients aged ≥ 85 years from public hospital EDs, Melbourne 1999/2000 to 2008/2009 (excl specialist maternity & Eye & Ear Hospitals)



↓ Denotes introduction of Short Stay Observation Units (SSOUs)

(Source: VEMD)

5.4 SUMMARY

This longitudinal population-based study confirms a persistent and significant rise in demand for ED services across all age groups in metropolitan Melbourne. The increases in ED length of stay and higher frequencies of admissions of older people over the ten year period studied are evidence of the pressures facing EDs and the wider acute hospital sector.

The results indicate a significant increase in the number of patients presenting to EDs transported by emergency ambulances, which parallels with the results of the emergency ambulance transportation study in Chapter 4. In addition, this ED study demonstrates that older patients have had a similar dominant effect on overall utilisation of ED services to that identified with utilisation of emergency ambulances.

This ED study showed older patients are disproportionately represented amongst ED presentations on a per capita basis, have longer ED lengths of stay and are at an increased risk of admission to hospital.

The elderly are also reported to be more likely to re-attend the ED,⁸² therefore all aspects of emergency and acute hospital care will be further affected by population ageing into the future. For this reason, further analysis was undertaken of the VEMD to further describe the trends associated with ED attendance by older patients. This study is reported in the following Chapter entitled '*Who are our older emergency patients?*'

CHAPTER 6: WHO ARE OUR OLDER EMERGENCY PATIENTS?

6.1 INTRODUCTION

The studies in Chapters 4 and 5 identified a growing propensity by the elderly to use emergency ambulance and ED services as sources of acute healthcare. This is in conjunction with a relative increase in both the proportion and numbers of older people in the population. With the knowledge that older patients are more likely to re-present more frequently to ED,^{82 83} further detailed examination of the trends in ED utilisation by older age groups is required.

The next study investigates and describes the longitudinal patterns associated with ED presentation by older people aged ≥ 70 years. The trends in ED utilisation are compared with those of younger adults aged 15-69 years. Considering the current demography of our ageing population,⁸⁴ this next study has defined older patients as those aged 70 years or more. The results are reported in the following manuscript prepared for submission *Emergency demand and re-presentations by older patients - longitudinal trends 2000 to 2009*.

6.2 PREPARED MANUSCRIPT: EMERGENCY DEMAND AND RE-PRESENTATION BY OLDER PATIENTS – LONGITUDINAL TRENDS 2000 TO 2009.

CO-AUTHOR DECLARATION FOR PUBLICATIONS TO BE INCLUDED IN THESIS

Monash University

Lowthian JA, Stoelwinder JU, McNeil JJ, Cameron PA. Emergency demand and re-presentations by older patients - longitudinal trends 2000 to 2009

Declaration by candidate

In the case of the publications in Chapter 6, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for overall study concept design, literature review, coding and recoding of variables and all preparation of datasets for analysis, development of Stata analysis codes, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	80

The following co-authors contributed to the work:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Johannes U Stoelwinder	Contributed to editing of the manuscript	N/A
John J McNeil	Contributed to the study design and editing of the manuscript	N/A
Peter A Cameron	Contributed to editing of the manuscript	N/A

Candidate's Signature

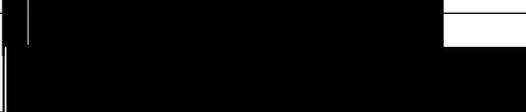
	13 December 2011
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Declaration by co-authors

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- (3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
- (4) there are no other authors of the publication according to these criteria;
- (5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
- (6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location Department of Epidemiology and Preventive Medicine,
Monash University

Co-Authors signatures	Date
	26 October 2011
	28 November 2011
	26 October 2014

Emergency demand and re-presentations by older patients - longitudinal trends 2000 to 2009

Judy Lowthian, Johannes Stoelwinder, John McNeil, Peter Cameron

Abstract

Background: Population ageing is projected to have a major impact on health service utilisation, and the fastest growth in the numbers and rate of Emergency Department (ED) presentation is by older patients. The aim of this study is to describe the trends in ED attendances by older adults aged ≥ 70 years and compare them with those of younger adults aged 15-69 years.

Methods: Retrospective analysis of the population-based Victorian Emergency Minimum Dataset for metropolitan Melbourne was conducted for the 10 year period to 1 July 2008/30 June 2009. The pattern of ED utilisation by older and younger adult patients was compared. Patients aged ≥ 70 years were defined as older adults, and 15-69 year olds were defined as younger adults.

Results: ED presentation rates rose with increasing age, with 393/1000 older adult presentations, compared with 175/1000 younger adult presentations in 2008/2009. The number of older adults increased by 61% compared with 55% growth in younger adult numbers over ten years.

Twenty-seven percent of the increase in presentations by older adults was driven by a cohort who re-presented to ED ≥ 3 times in 2008/2009. The number of patients re-presenting ≥ 3 in 2008/2009 doubled over the 10 years. This group contributed to 23% of all older adult ED presentations.

ED length of stay increased with age over the study period, 69% older adults remaining in ED for ≥ 4 hours compared with 39% younger adults. The number of older adults admitted doubled, with 552/1000 presentations admitted to a ward or short-stay observation unit, compared with 228/1000 younger adults admitted in 2008/2009.

Conclusions: Older patients with an increased propensity to re-present to ED are a major and growing contributor to emergency demand. This indicates an urgent need to identify the clinical, social and health system related risk factors for re-attendance by specific patients.

Emergency demand and re-presentations by older patients - longitudinal trends 2000 to 2009

Judy Lowthian, Johannes Stoelwinder, John McNeil, Peter Cameron

Demand for healthcare is rising across the developed world, with reports that Australian hospitals are burdened by increased Emergency Department (ED) attendances of up to 6% annually.¹ Over the 10 years to 2008/2009, presentation rates to metropolitan Melbourne EDs have averaged a 3.6% average annual increase beyond that which can be explained by demographic change.² The fastest growth is in people aged 65 years and older,³⁻⁷ who are estimated to represent 18% of all presentations.⁸ Utilisation of ED resources by older patients is substantial, as they present with more complex clinical conditions, consume more resources, have longer ED stays, are more likely to be admitted to hospital, and have longer hospital stays.⁹ They also have a higher rate of return visits to the ED than their younger counterparts.⁴

Population ageing and expectations about care for older patients have been identified as key contributing factors.¹⁰ A recent 14 year study showed that more than 50% of the population aged ≥ 85 years currently present to metropolitan EDs by emergency ambulance; and it is predicted up to 85% of this age group will be transported by ambulance to over the next 5 years.¹¹ Combined with the knowledge that older people have an increased risk of ED attendance and hospital admission;⁴ this will have a dramatic impact on all aspects of emergency and acute hospital care. Therefore, we aimed to describe the trends in utilisation of EDs by older adults aged ≥ 70 years, and compare these patterns with those of younger adults aged 15-69 years, throughout metropolitan Melbourne across the decade ending 1 July 2008/30 June 2009.

Methods

Study Design and Setting: A retrospective cohort study was conducted using routinely collected data describing public hospital ED presentations across metropolitan Melbourne for the ten year period ending 1 July 2008/30 June 2009. Melbourne is a State capital in south eastern Australia covering an area of 8,806 square kilometers, with a population of 4.02 million in 2009.¹² This study was approved by the Monash University Human Research Ethics Committee and the Victorian Department of Health.

Data: The Victorian Department of Health provided de-identified data from the Victorian Emergency Minimum Dataset (VEMD)¹³ for this study. This dataset contains demographic, administrative and clinical data recording patient-level presentations to Victorian public hospitals with 24-hour EDs. Individual hospitals collect data using standard definitions and protocols to ensure comparability between facilities. This analysis included data from metropolitan Melbourne EDs excluding specialist maternity and the 'Eye & Ear' hospitals. Population data published by the Australian Bureau of Statistics (ABS) were used to calculate presentation rates across the study period by age and gender.¹²

Analysis: Data were in financial year files from July 1999/June 2000 to July 2008/June 2009. Considering the current demography of an ageing population,¹⁴ older adults are defined as aged ≥ 70 years, and younger adults aged 15-69 years.

Demographic and clinical factors were categorised by gender, type of transport to ED, clinical acuity, clinical reason for attendance, ED length of stay (LOS) and discharge destination from ED. Time trends in the numbers of patients and numbers of presentations to EDs were estimated using descriptive statistics. Annual age and gender specific presentation rates per 1000 persons were calculated adjusting for population change over time. Changes in arrival mode, clinical urgency and primary presenting clinical conditions, ED LOS, ED discharge destination, and re-presentation numbers within a 12 month period of older and younger adults were compared over the study period. Regression methods were used to model the effects and interaction on hospital admission from ED of older adults of age and gender, arrival by emergency ambulance, clinical acuity and ED LOS. Confidence intervals were generated to quantify precision of estimates. Stata version 11 was used for all analyses (StataCorp, College Station, Texas, USA).

Results

In 2008/2009, a total of 85,029 older adults made 141,775 ED presentations, accounting for 16.6% of ED presentations by all age groups.

Attendance patterns of older and younger adults:

The absolute number of presentations by older adults increased by 72% over the decade, compared with 59% growth in the younger adult age group. Presentation rates increased in both age groups between 1999/2000 to 2008/2009, from 278 to 393 per 1000 persons aged ≥ 70 years and from 133 to 175 per 1000 persons aged 15-69 years.

Of note was the increase in numbers of individual older adults who re-present to EDs within a 12 month period, compared with younger adults. Table 1 summarises the growth in the number of patients attending for a single visit and re-attending more frequently within a 12 month period. The number of older adults presenting to EDs within a 12 month period increased more than the number of younger adults over the study period. Seventy-six percent of younger adults presented on a single occasion during the 12 months to 30 June 2009, accounting for 53% of their total attendances. This was in comparison to 65% of older patients presented on a single occasion which comprised just 39% of their presentations in the same time period. Importantly, 7% of older adults returned to ED a further three or more occasions, contributing to 23% of visits by this age group in 2008/2009. (Range: 4 - 424 presentations in 2008/2009).

Characteristics of older and adults in terms of mode of arrival, level of acuity, length of stay (LOS) in ED, and ED discharge destination are summarised in Table 2. In 2008/2009, 55% of older presentations were transported to ED by an emergency ambulance, compared to 21% of the younger age group. ED LOS increased with age, with 69% of older adults remaining in ED for ≥ 4 hours compared with 39% younger adults in 2008/2009. The number of admissions from ED of older adults doubled over the decade, with 552/1000 ED presentations by older adults admitted to a ward or short-stay observation unit*¹ (SSOU), compared with 228/1000 admitted ED presentations by younger adults in 2008/2009.

*¹ SSOUs are observation units collocated within EDs, introduced as a demand management strategy in 2001/2002

Older adults:

The 72% increase in the annual number of presentations by older adults was just over three times the rate of growth of this age group within metropolitan Melbourne's population for the same time period. Whilst contributing to 16.6% of all ED presentations in 2008/2009, older adults comprised just 9% of the population. As shown in Table 3, the numbers and rates of attendance rose with increasing age and over the study period.

Clinical acuity and conditions: Over 75% of older adults were triaged as urgent or semi-urgent (Australasian Triage Scale [ATS¹⁵] Categories 3/4). The ATS is an ordinal scale from one to five, with one assigned to the most urgent clinical category. The most common clinical conditions in this older age group were chest pain, pneumonia and urinary tract infections.

ED Length of Stay (ED LOS): Over 69% of this cohort spent longer than 4 hours in the ED in 2008/2009. ED LOS rose with increasing age over the decade, with a median LOS of 6.5 hours in patients aged ≥ 85 years in 2008/2009. ED LOS increased over study period for more acutely unwell patients (ATS categories 1, 2 and 3); however ED LOS declined over time for lower acuity older patients (ATS categories 4 and 5), as shown in Table 4.

Hospital Admission: The numbers of older adults admitted to hospital more than doubled over the ten years, with 56% of all presentations aged ≥ 70 years admitted to hospital (including to a SSOU) in 2008/2009, with just 35% discharged home directly from ED. The trends in disposition over time revealing the rapid increase in discharge to a SSOU are represented in Figure 1.

Random effects regression indicated a 15.3% increase (95%CI 12.7% to 18%) in the number of presentations by this age group admitted to hospital from the ED, after adjusting for age, gender, arrival mode, clinical acuity and length of stay in the ED over the study period. This equated to an average annual increase of 3.9% in ED presentations admitted to hospital (95% CI 3.7% to 4.1%), compared with those discharged directly from ED. Women were less likely than men to be admitted to hospital, compared with being discharged directly home from the ED. As shown in Table 5, admitted patients were more likely to have arrived by emergency ambulance, be triaged as more acutely unwell, and have a longer LOS in ED compared with patients who were discharged directly home.

Discussion

This study has confirmed a disproportionate increase in the number of older adults seeking emergency healthcare from acute public hospitals in metropolitan Melbourne over a ten year period. Notably, this rise in demand was driven by a significant and growing proportion of return visits within a 12 month period. To our knowledge this is the first population-based study of patient-level data to identify the contribution of re-presentations by a cohort of older individual patients to emergency demand.

This increase in demand is in contrast with the results of a recent Australian study which reported a decline in ED presentations to a single metropolitan ED by older people over a five year period in Brisbane.¹⁶ The study authors reported area-specific demographic changes may have contributed to this unexpected finding; however this was not adjusted for the analysis. An additional contributory factor alluded to by the Brisbane authors, was the introduction of two aged care multidisciplinary interventions designed by the Brisbane ED to reduce presentations by older patients.

State Government funded services have been implemented across Melbourne since 2001, including the ED Care Coordination Program for older patients.¹⁷ Interestingly, the number and rate of attendances in our study rose incrementally over the study period despite these interventions. It is possible that diminished access to primary care services underpins some of the increase in demand shown by this current study.¹⁸ Additionally, it could be speculated that EDs may be an increasingly preferred source of timely accessible healthcare, with the additional benefits of providing a 'one-stop' multidisciplinary specialist diagnostic and treatment service.^{19 20}

The persistent growth in presentations and re-presentations suggests a need for investigation of the effectiveness of such programs. It is recognised that an ED visit in this age group is a sentinel event that can lead to substantial functional decline and other adverse outcomes.²¹ Therefore, considering the patterns of re-presentation identified in our study, we recommend further research into following up older patients after they present to ED. This would provide valuable insight into the factors underpinning the clinical, psychosocial and health system risk factors for attendance and repeat presentations. As

such this would inform the development and evaluation of targeted evidence-based solutions for meeting the acute healthcare needs of this population, specifically those at risk of re-presentation.

The strength of this study is that it is population-based, comprising analysis of more than one million ED presentations by patients aged ≥ 70 years over a 10 year period. However this study was based on routinely collected data in a large city, so the findings may not be generalisable to non-urban regions. In addition, data quality and consistency cannot be guaranteed.^{22 23}

Conclusion

There has been an incessant rise in demand for emergency healthcare from older adults observed over a prolonged period. With population ageing these results have important policy implications. The growth identified in the number of individual patients re-attending for acute care implies that current models of acute care are not meeting the growing needs of this age group. This suggests a requirement for the redesign of acute community-based and/or hospital care models to manage ongoing demand. In the meantime, we need to ensure that our emergency health workforce is equipped with the skills necessary to evaluate and facilitate appropriate referrals to manage the medical and social needs of older patients. Proactive management of demand by older patients is a high priority to sustain the functioning of EDs and patient flow through the acute episode of care.

(1996 words)

Acknowledgements

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Table 1: Frequency of presentations and re-presentations made by older and younger adults to public hospital EDs, Melbourne, 1999/2000-2008/2009 (Source VEMD *excl specialist maternity & Eye & Ear Hospitals*)

15 to 69 years old age group						
Year ending 30 June	2000		2009		% change (2000-2009)	
	No. patients (% total)	No. ED visits (% total)	patient no's (% total)	No. ED visits (% total)	patient no's	ED visits
No. ED presentations	-	322,846	-	513,033	-	59
No. individual patients	231,142	322,846	357,901	513,033	55	59
No. patients attending X1	180,121(78%)	180,121(56%)	271,962(76%)	271,962(53%)	51	51
No. patients attending X2-X3	42,953(19%)	95,670(30%)	72,138(20%)	161,070(31%)	68	68
No. patients attending ≥X4	8,068(3%)	47,055(14%)	13,801(4%)	80,001(16%)	71	70

≥ 70 years old age group						
Year ending 30 June	2000		2009		% change (2000-2009)	
	No. Patients (% total)	No. ED visits (% total)	No. patients (% total)	No. ED visits (% total)	patient no's	ED visits
No. ED presentations	-	82,357	-	141,775	-	72
No. individual patients	52,881	82,357	85,029	141,775	61	72
No. patients attending X1	36,982 (70%)	36,982(45%)	55,362 (65%)	55,362(39%)	50	50
No. patients attending X2-X3	12,837(24%)	29,098(35%)	23,652(28%)	53,834(38%)	84	85
No. patients attending ≥X4	3,062(6%)	16,277(20%)	6,015(7%)	32,579(23%)	96	100

Table 2: Comparison of public hospital ED presentations by younger and older adults, metropolitan Melbourne: 1999/2000 – 2008/2009 (Source VEMD *excl specialist maternity & Eye & Ear Hospitals*)

		1999/2000	2008/2009	% change
		No.	No.	
Total ED presentations	All ages	550,662	853,940	55
	15 to 69 yrs	322,846	513,033	59
	<i>rate/1000 persons</i>	133	175	
	≥ 70 yrs	82,357	141,775	72
	<i>rate/1000 persons</i>	278	393	
Mean age	(median)			
	15 to 69 yrs	37.9 yrs (35 yrs)	38.6 yrs (37 yrs)	2
	≥ 70 yrs	79.5 yrs (78 yrs)	80.5 yrs (80 yrs)	1
Female gender				
	15 to 69 yrs	150,664 (47yrs)	246,790 (48 yrs)	64
	≥ 70 yrs	45,312 (55 yrs)	76,917 (54 yrs)	70
Arrival mode no.				
Walk-Ins				
	15 to 69 yrs	246,368	384,314	56
	≥ 70 yrs	33,369	52,561	57
Ambulance/Air				
	15 to 69 yrs	69,776	105,551	51
	≥ 70 yrs	47,643	78,246	64
Clinical Urgency: Triage category no.				
ATS 1				
	15 to 69 yrs	4,046	4,664	15
	≥ 70 yrs	2,026	2,096	3
ATS 2				
	15 to 69 yrs	22,425	54,370	142
	≥ 70 yrs	9,563	21,505	125
ATS 3				
	15 to 69 yrs	95,255	165,919	74
	≥ 70 yrs	30,677	58,589	91
ATS 4				
	15 to 69 yrs	165,478	235,338	42
	≥ 70 yrs	35,829	52,577	47
ATS 5				
	15 to 69 yrs	34,611	51,762	49
	≥ 70 yrs	3,789	5,706	28
ED LOS ≥ 4 hours no	(% total)			
	15 to 69 yrs	128,750 (39.9%)	197,941 (38.6%)	54
	≥ 70 yrs	56,919 (69.1%)	98,351 (69.4%)	73
Disposition from ED				
Home				
	15 to 69 yrs	225,996	336,117	49
	<i>Rate/1000 presentations</i>	700	655	
	≥ 70 yrs	33,308	51,062	53
	<i>Rate/1000 presentations</i>	404	360	
Admitted to hospital[#]				
	15 to 69 yrs	62,042	117,033	89
	<i>Rate/1000 presentations</i>	192	228	
	≥ 70 yrs	38,599	78,296	103
	<i>Rate/ 1000 presentations</i>	469	552	

[#]includes Short Stay Observation Unit

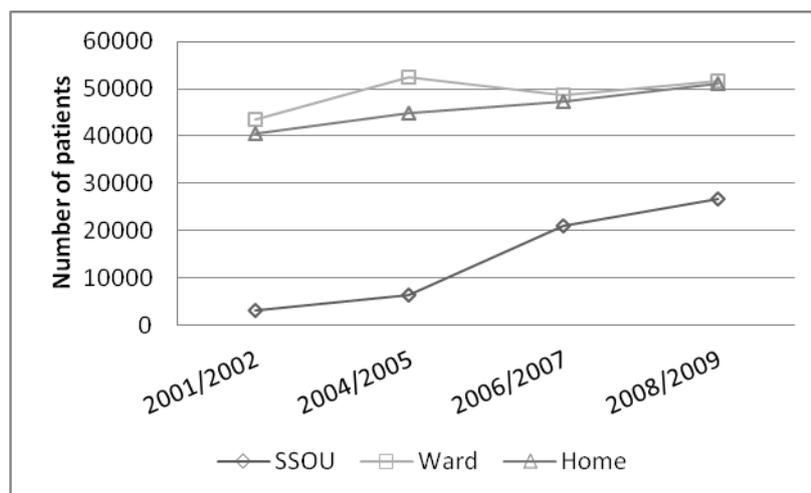
Table 3: Frequency of ED presentations and rate/1000 older persons, metropolitan Melbourne 1999/2000 to 2008/2009
(Source VEMD excl specialist maternity & Eye & Ear Hospitals)

Age group	1999/2000		2008/2009		% change rate difference	
70 to 74 years	23,121		32,416		40	
rate/1000 persons		213		275		62
75 to 79 years	23,026		35,045		52	
rate/1000 persons		265		363		98
80 to 84 years	17,148		34,639		102	
rate/1000 persons		331		457		126
≥ 85 years	19,062		39,675		108	
rate/1000 persons		438		594		157

Table 4: Length of ED stay (median hours) by triage category and age, 1999/2000 to 2008/2009 (Source VEMD excl specialist maternity & Eye & Ear Hospitals)

	ATS 1		ATS 2		ATS 3		ATS 4		ATS 5	
	2000	2009	2000	2009	2000	2009	2000	2009	2000	2009
70 to 74 yrs	4.4	5.6	5.9	6.1	5.8	6.0	4.9	4.5	2.4	2.0
75 to 79 yrs	5.0	6.0	6.1	6.5	6.0	6.4	5.4	5.0	2.4	1.9
80 to 84 yrs	5.2	6.3	6.7	6.7	6.2	6.8	5.8	5.6	2.7	2.1
≥ 85 yrs	4.9	6.0	7.0	7.0	6.4	7.0	6.2	6.2	3.4	2.0

Figure 1: Disposition from ED of older adults 2001/2002 to 2008/2009 (Source VEMD excl specialist maternity & Eye & Ear Hospitals)



SSOU Short Stay Observation Unit

Table 5: Multivariate model of the effects of arrival by emergency ambulance, clinical acuity, and ED length of stay on the likelihood of admission compared with direct discharge from ED, of older patients (aged ≥70 yrs), metropolitan Melbourne EDs 1999/2000 to 2008/2009 (Source VEMD excl specialist maternity & Eye & Ear Hospitals)

N=1,022,905 presentations no. individual patients =347,867 1999/2000 - 2008/2009		Odds Ratio	95% CI (p<0.000)
Arrival by emergency ambulance *		1.68	1.66 to 1.69
Triage level ^			
	ATS category 1	2.69	2.58 to 2.82
	ATS category 2	1.99	1.96 to 2.02
	ATS category 4	0.48	0.47 to 0.49
	ATS category 5	0.21	0.20 to 0.21
ED LOS#			
	4 to <8 hrs	3.56	3.51 to 3.59
	8 to < 12 hrs	7.3	7.2 to 7.4
	≥12 hrs	13.7	13.5 to 14.0

* compared with arrival by other means

^ compared with ATS category 3

compared with ED LOS <4hours

6.3 SUMMARY

This longitudinal population-based study confirms a disproportionate increase in the numbers of older adults aged ≥ 70 years seeking emergency healthcare from acute public hospitals in metropolitan Melbourne over a ten year period. The rise in utilisation of EDs by these patients was partly driven by a significant and growing proportion of return visits within a 12 month period.

It is not possible to fully understand all the factors associated with the increase in utilisation of emergency health services from routinely collected data. It is therefore reasonable to seek further information from patients as a primary data source. Chapter 7 explores some of these factors through a series of interviews with patients attending a large metropolitan ED. As the previous studies have confirmed a considerably greater increase in utilisation of emergency ambulance and emergency hospital services by older age groups, these interviews focus on patients aged 70 years and over, and whether reduced accessibility to primary care, social isolation, and the convenience of a specialist based 'one-stop-shop' are contributing factors for older patients seeking healthcare.

CHAPTER 7: OLDER PATIENTS SEEKING ACUTE CARE FROM THE EMERGENCY DEPARTMENT

7.1 INTRODUCTION

Quantitative evidence of the contribution of the elderly to the rise in demand for emergency ambulance and ED services was demonstrated in the three previous studies. Persons aged 70 years and over compose a growing proportion of the population. The study in Chapter 6 showed the number of presentations and re-presentations by this age group has increased, and it is plausible this will continue as the population ages.

We need to explore whether some of this older cohort seek care from EDs for reasons other than an acute medical emergency. Therefore this next study seeks to understand the older patient's point of view in order to further inform this thesis.

The next study explores whether some of the postulated factors such as accessibility to primary care, social support, and expectations for timely care, influence the decision of patients with lower clinical acuity to attend the ED. The hypothesis for this study is that some older community-dwelling patients with lower acuity present to ED, although their healthcare may be delivered more appropriately and cost-effectively in the community. Given the accelerated increase in utilisation of emergency health care services by older people, the focus in this study is specifically on patients aged 70 years and over, with information gathered from them whilst attending at a large metropolitan ED in Melbourne. This study is described in the following manuscript submitted for publication '*Why older patients with lower clinical acuity choose to attend the Emergency Department*'.

7.2 PREPARED MANUSCRIPT: WHY LOWER ACUITY OLDER PATIENTS CHOOSE TO ATTEND THE EMERGENCY DEPARTMENT

CO-AUTHOR DECLARATION FOR PUBLICATION INCLUDED IN THESIS

Monash University

Lowthian JA, Smith C, Smit D, Stoelwinder JU, McNeil JJ, Cameron PA. Why older patients with lower clinical acuity choose to attend the Emergency Department.

Declaration by candidate

In the case of the publication in Chapter 7, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for literature search, development of the interview tool, recruitment of all participants, analysis of data, and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	85

The following co-author contributed to the work:

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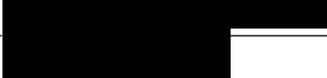
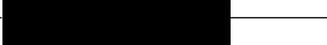
	13 December 2011
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Declaration by co-author

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- (3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
- (4) there are no other authors of the publication according to these criteria;
- (5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
- (6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

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	26 October 2011
	7 December 2011
	26 October 2011
	28 November 2011
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Why older patients with lower clinical acuity choose to attend the Emergency Department

Lowthian JA, Smith C, Stoelwinder JU, Smit DeV, McNeil JJ, Cameron PA

Abstract

Objectives: To determine the non-clinical factors associated with Emergency Department (ED) attendance by lower acuity older patients.

Design, Participants and Setting: A descriptive study comprising structured interviews with lower acuity community-dwelling patients aged ≥ 70 years presenting to a tertiary metropolitan Melbourne public hospital ED.

Outcome Measures: Demographic and clinical characteristics, self-reported feelings of social connectedness, perceived accessibility to primary care and reason for attending ED.

Results: 100 patients were interviewed: mean age 82 years, 56% female, 57% lived alone; 73% presented during business hours, 58% arrived by ambulance, 80% presented for an illness, and 65% were discharged home within 48 hours.

Fifty-six percent of patients reported feeling socially disconnected, comprising 49% living alone compared with 65% who lived with their spouse/family.

All patients attended a regular General Practitioner, 31% reporting regular review appointments. Thirty-five percent reported waiting-times >2 -3 days for urgent problems; 59% stated accessing care 'after hours' without attending ED as difficult, with 20% having attended ED 3-6 times in the previous 12 months.

Reasons for attending ED were referral by a third party, difficulty with accessibility to primary care, patient preferences for timely care, and fast track access to specialist care.

Conclusions: Most older patients presented to ED due to perceived access block to primary or specialist services, alongside an expectation of more timely and specialised care. This suggests that EDs should be re-designed and/or integrated community-based models of care developed, to meet the specific needs of this age group who have growing demand for urgent care.

Why older patients with lower clinical acuity choose to attend the Emergency Department

Lowthian JA, Smith C, Stoelwinder JU, Smit DeV, McNeil JJ, Cameron PA

Demand for emergency department (ED) services has risen by 55% across metropolitan Melbourne over the decade to 30th June 30, 2009. ¹ The biggest rise in presentations is by patients aged ≥ 70 years. This impacts greatly on acute hospital services, as older patients present with more complex clinical conditions, consume more resources, have longer ED stays, are more likely to be admitted, and have longer hospital stays. ² As this older proportion of the population continues to rise, there will be a persistent increase in demand for emergency care and hospital admission unless practical strategies to manage this demand are put in place.

Amongst this older cohort is a group with lower acuity that could possibly be treated elsewhere. ³ A variety of reasons for why they present to ED have been speculated, including reduced accessibility to primary care, social fragmentation of the extended family and increased expectation for timely care; however these are yet to be quantified. ⁴ These non-clinical factors are not captured by the usual information collected at the time of ED presentation or by administrative data.

In this context, we aimed to determine the non-clinical reasons for why older low acuity community-based patients seek emergency health care.

METHODS

Study Design and Setting

A descriptive study of 100 patients attending the Alfred Hospital's ED was conducted using a structured interview from June - August 2011. This interview format was chosen because the frenetic nature of an ED does not provide the environment for a more open exploratory format. The Alfred is a tertiary metropolitan Melbourne public hospital comprising 8 trauma/resuscitation bays, 17 ED and 8 fast track cubicles, 12 emergency short stay beds, plus additional capacity with 2 plaster/procedure rooms and corridors. The Alfred receive ~55,000 ED presentations per year. Interviews were conducted on week days between the hours of 0800 to 1730. Approval for this study was granted by the Human Research Ethics Committees of the Alfred Hospital and Monash University.

Participants

Eligible patients were community-dwelling aged ≥ 70 years; with lower clinical acuity, classified as Categories 3-5 on the Australasian Triage System (ATS) of 5 categories, determined by emergency physicians to be medically stable; and who provided informed consent. Exclusion criteria included patients from residential nursing care facilities, cognitive impairment, non-English speaking patients without family members to act as interpreters, and patients in distress. Interviews were conducted in ED after the patient's initial medical care needs were addressed.

Interview instrument

The structured interview tool was developed (see Appendix) using questions from publically available surveys on health service utilisation⁵⁻⁷ and included the Duke Social Support Index, a validated questionnaire of social interaction, support and connectedness.⁸ Interview questions were reviewed by a panel of emergency physicians and allied health professionals, and tested for face validity with a sample of ten eligible patients. Interviews were conducted by an experienced allied health professional researcher.

Outcome Measures

Main outcome measures included reasons for choosing ED for the current clinical condition, reported accessibility to primary care and self-reported feelings of social connectedness. Demographic, clinical and discharge information were also collected from the medical record.

Data Analysis

Data from closed-ended questions were coded and entered into a de-identified database for analysis using Stata 11 (StataCorp, College Station, Texas, USA). Free text responses were transcribed verbatim during the interviews. Two members of the research team (JL and CS) independently reviewed and collated the narratives using a qualitative thematic framework⁹ with the assistance of NVivo 9.1 software (QSR International Pty Ltd). An independent physician (PL) categorised the responses separately. Emerging findings were discussed and themes negotiated and agreed upon. Interpretations were checked by the research team comprising emergency clinicians and epidemiologists.

RESULTS

A total of 100 interviews of 125 eligible patients were completed during the 9 week study period, equating to an 80% recruitment rate. Table 1 describes the demographic and clinical characteristics associated with the ED attendance. The average age was 82 years, with 56% female. Seventy-three percent presented during business hours; 58% arrived by ambulance; 50% were triaged as ATS 3 presenting with an illness (80%) or fall-related injury (20%); and 65% discharged home from hospital within 48 hours. The majority of ambulance arrivals (62%) were discharged home. Sixty-five percent of patients were discharged directly home within 48 hours of arrival; and 38% who arrived by ambulance were admitted or transferred to another hospital.

Social Support

Overall, 56% of patients reported feelings of being socially disconnected. This comprised 66% feeling dissatisfied with their level of social interaction with others, and 35% dissatisfied with the level of social support from family and friends. Of the 43 patients not living alone, 28 resided with their spouse, 14 with adult children and family, and one with a group of international student boarders.

Of the patients not living alone 65% still reported feelings of social disconnectedness, compared with 49% of patients who lived alone. These feelings were underpinned by dissatisfaction with levels of social interaction with others. Patients living with their spouse or adult children were 60% less likely

to feel satisfied with their level of social interaction than those who lived alone (OR=0.42; 95%CI 0.17 to 0.99, p<0.05). Even patients living with family made comments such as “*my friends are quite elderly or have passed on*”, “*I keep to myself*”, “*I don’t get out much*”, “*my children are wonderful, but I don’t wish to bother them as they are so busy*”.

Twenty percent of patients reported using the ED as a source of healthcare an additional 3 to 6 times in the previous 12 month period. This group comprised 10 of the 57 patients (18%) who lived alone, and 10 of the 43 patients (22%) who lived with a spouse or others.

Support and services received by the patient’s General Practitioner (GP)

All patients attended a regular GP with 31% reporting a review schedule ranging from weekly to 3 monthly appointments. As summarised in Table 2, the majority of patients (65%) reported they could be seen the same/next day for an urgent problem; however stated this would not necessarily be with their GP, rather with another GP within the practice. Fifty-nine percent stated access to ‘after hours’ medical care without attending an ED would be difficult; however 48% percent were aware their practice offered an alternative ‘after hours’ service including a locum service.

Themes underpinning ED attendance

Exploration of responses to questions about (i) why the ED was chosen for the current problem and (ii) the support and services received by GPs exposed several themes and sub-themes underpinning reasons for ED attendance. Primary themes included difficulties with accessibility to primary care (21%), referral by a third party (22%), patient or family preferences for care (24%) or fast track access to specialist care (33%). These themes are defined in the Box with examples of patient quotations. During the interviews, a number of secondary themes emerged from comments made about the support and services provided by GPs regarding why the ED is considered an alternative source of healthcare, including unavailability/dissatisfaction with GP appointment waiting times, patient perceptions about the GP’s role, dissatisfaction with the GP, convenience of the ED as an alternative source of health care and institutional preference to attend a hospital for the current condition. These sub-themes are outlined in Table 3.

DISCUSSION

In the context of continuing demand for hospital-based emergency healthcare principally driven by older people ¹, this study affords us with an understanding of the motivation of an older cohort of low acuity patients to use the ED as a source of healthcare. In addition, it presents interesting insights into these older patients’ perspectives about the support and services provided by their GP, and an expectation for timely care. The study also provides information about diminished levels of social interaction underpinning feelings of being socially disconnected within a cohort of older patients seeking healthcare at an ED. To our knowledge this is the first such study to seek older emergency patient’s perspectives.

Social Support

Over half of the cohort reported feelings of disconnectedness, a greater proportion of patients who resided with their spouse or adult children feeling disconnected. Our finding that a greater

proportion who lived with a spouse or others felt more socially disconnected than those who lived alone was not anticipated. The foundation of this feeling was reported to be diminished levels of social interaction. A possible explanation could be that older people living alone due to being widowed, divorced or never having married, may have a tendency to actively seek social interaction with family, friends or the community; whereas those who live with their spouse or reside with other family members may be less likely to seek social contact outside the home environment. In addition, older people residing with children following death of their spouse may do so because of family concern for their social wellbeing.

Loneliness¹⁰⁻¹² and lack of family support¹³ has been previously linked as a risk factor for ED presentation in studies from the United States (US). Further investigation with a comparative study is warranted to determine if social disconnectedness is associated with ED presentation by older people in an Australian cohort; and whether such feelings are associated with underlying factors such as depression which may be amenable to intervention.

Patient preferences for care

The themes that emerged underpinning the reasons for attending ED suggest the presence of patient or family inclinations for care. These included unacceptable waiting times for their own GP, GP dissatisfaction, and the convenience of a 'one stop shop' that offers specialist care within an institution of high repute.

This older cohort reported reasonable accessibility to services within their primary provider's practice; the majority (88%) reporting potential for an appointment in their general practice within 2-3 days for what they perceived to be an urgent problem. However this did not meet their expectations of timeliness of GP availability, with patients verbalising frustration with waiting times for appointments to see their individual GP. Even though the majority of patients in our study presented to ED during business hours, many volunteered their dissatisfaction that their GP worked part-time, or was unavailable after business hours. Of interest was their discontent about being seen by an unfamiliar doctor within their general practice, yet they were not apparently deterred by the prospect of seeking care from an unfamiliar doctor in ED.

Difficulties accessing GPs has been cited by patients as the primary reason for ED presentation in other studies.^{12 14-17} However the 'access block' to primary care observed in this cohort appeared to be related to patient expectations for timely care with their preferred provider, even though other options were available within their general practice. This could be related to a societal change in expectations for care when it is most convenient for patients or their family.

It was also apparent there was delay in seeking healthcare by this cohort; 53% reported their medical condition having been present for more than 2-3 days, including 37% being unwell for ≥ 7 days. The phenomenon of 'toughing it out' before seeking care has been described previously.¹⁸ This help-seeking behavior relates to patients hoping problems will soon resolve. In addition, it is possible patients did not alert family members about their condition based on comments such as '*they are so busy with their own families*'. This could have delayed the choice to seek medical attention, and once family members became involved, genuine concern about such delay resulted in preference to attend hospital rather than the GP.

Preference for seeking care at a hospital with an undertone of loyalty to the institution, together with the convenience of a 'one-stop' specialised diagnostic facility was a common sub-theme. These factors have been cited previously as the predominant reasons for attending an ED in studies conducted in the US,^{18 19} Canada¹⁷ and the United Kingdom.^{20 21} In addition, patient perceptions similar to that observed in this study about the role and capabilities of GPs have been reported elsewhere.¹⁴

Fast track referral for access to specialist care

A proportion of patients attended ED following referral from their GP, which maybe an indication of 'access block' to specialist care due to lengthy waiting lists in both public and private sectors. It may also suggest a desire to transfer responsibility on the doctor's behalf, either because of time pressures associated with busy general practices or medico legal concerns about diagnosis of the undifferentiated patient.

Waiting times for elective surgery are well reported by the government,²² media²³ and peer-reviewed literature;^{24 25} however details about GP or specialist consultations are not so readily available other than via professional association websites.²⁶ Although some work has commenced to reduce waiting times for GPs,^{27 28} timely access remains a problem, impacting on patients' choice of the ED for healthcare.^{29 30 31}

The patients referred to ED by a specialist were principally those discharged recently from hospital, presenting with signs of infection/complications related to procedures. This raises the question of whose responsibility it is to manage patients post-procedure, the service provider or an ED Clinician who is unfamiliar to the patient, their problem or recent procedure.

Study Limitations

This study encompassed active engagement of an older cohort of patients through interview to glean an understanding about associated non-clinical factors with choosing the ED as a source of healthcare relative to their current medical condition; and their perspectives about the support and services provided by their GP. The personal nature of the interviews is a limitation, but enhanced the quality of information without the limitations of a paper-based survey reliant on literacy skills. The structured interview used questions from published surveys on health service utilisation, therefore reduces any potential for bias to be introduced by the interviewer. Conducting the interviews at the time of ED attendance reduced recall bias. Independent coding of patient narratives into a thematic framework by two researchers in addition to the interviewer enhanced rigour with data interpretation, reducing the risk of researcher bias. Data saturation was achieved regarding commonality of themes and sub-themes.^{32 33} Generalisability is limited by use of a purposive sample of older low acuity patients attending an ED attached to a large metropolitan tertiary public hospital. In addition, although the interviews were conducted during working hours, 27% of interviewed patients presented to ED over a weekend or after hours, having remained in ED at the time of interview for clinical or social reasons. The information gathered provides the foundation for a large more generalisable study.

CONCLUSION

This study raises issues as to whether current models of acute care are meeting the perceived needs of older patients. The majority of this cohort attended due to perceived access block to primary/specialist services, and many had pre-conceived ideas about expectations for timely and specialised care. This provides valuable insights about the older patient and their family's perception of when and where they believe healthcare should be delivered. It confirms the need for the redesign of EDs and/or community-based models of care, to meet the specific and growing needs of this age group for urgent care.

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Table 1: Demographic and clinical characteristics associated with ED presentation

	%
Mean age - years	82 yrs
(median, range)	(82 yrs, 70-100 yrs)
70 – 74 yrs	16
75 – 79 yrs	18
80 – 84 yrs	32
85 – 89 yrs	21
90 – 94 yrs	9
95 – 100 yrs	4
Gender - female	56
Residential area (within 17 km)	83
Pensioner	86
Living status – alone	57
Independently mobile	46
In receipt of a care package	36
Referral source	
Self/family/friends	62
General Practitioner / Specialist	25
Other health worker	9
Bystander	4
ED arrival time	
After hours (Sun - Fri 1800 – 0745)	27
Business hours (Mon – Fri 0800 – 1545)	73
Arrival mode	
ambulance	58
Private car / taxi	35
Public transport	7
Clinical urgency – ATS category	
3	50
4	41
5	9
Clinical reason for presentation	
Injury (fall-related)	20
Illness	80
<i>[e.g. dizziness, unsteady on feet, abdominal pain, constipation, back pain, epistaxis, back pain, shortness of breath, chest pain]</i>	
Onset of presenting problem	
Previous 48 hours	47
2 to 3 days	16
≥ 7 days	37
Final disposition from ED	
Home	65
Admission to hospital	29
Hospital transfer	4
Respite care	2

Table 2: Support and services received by General Practitioner (patient report)

	%
Is there one doctor/doctor's group you usually attend for your medical care	100
Regularity of appointments	
As needed	69
Weekly / Fortnightly	8
Monthly	18
≥ 3 monthly	5
Waiting time for an urgent appointment	
Same / next day (with one of the doctors, not necessarily the patient's GP)	65
2-3 days	23
4-7 days	7
>1 week	5
Ease to get medical care after hours without attending an ED	
Easy	14
Difficult	59
Have never needed it	27
Provision of an after-hours service	
Provided by GP	9
Provided by a locum service	47
Did not know	44
Provision of home visits by General Practice	
	45
Co-payment for routine GP visit	
Co-payment is a deterrent to seek care from GP	22
	10
No. ED attendances in previous 12 months	
0	41
1 or 2	39
3 to 6	20

Box: Primary themes

Theme (Frequency)	Definition	Examples of patient quotations
Difficulty with accessibility to primary care (21%)	Unavailability of the GP Difficulty accessing a timely appointment Co-payments associated with GP consultation	<ul style="list-style-type: none"> • <i>He wouldn't come when my son called him, so we called '000'</i> • <i>Well, the GP was closed and we would have had to wait for the locum. But the message machine said to dial '000'. If it was a week day I would have gone to him (GP)</i> • <i>The ED is quicker than getting an appointment with the GP</i> • <i>I had a sore back for a few days, and I thought it would go away. I called my GP and he said to come here</i>
Patient /family preferences for care (24%)	Waiting time for next available GP appointment unacceptable Patient perceptions of role of primary care Dissatisfaction with GP Preference not to use the rostered locum service Institutional preference for specialist hospital care One-stop-shop / convenience factor	<ul style="list-style-type: none"> • <i>I got worse over the last couple of days. I called my GP, but couldn't wait until today's appointment with him, so I came here last night</i> • <i>The Alfred is the most suitable as the GP is only for routine problems</i> • <i>My GP only looks at my finger. He wouldn't know what was wrong or what to do</i> • <i>My GP isn't there on a Sunday. They don't work anymore than part-time and are always on holiday. I am not very satisfied.</i> • <i>Emergency (ED) is quicker than getting an appointment with the GP.</i> • <i>... will need an x-ray, so we came here as it is all under one roof... so much easier.</i> • <i>I can see everyone I need to here. I am angry that my doctor doesn't know how to fix the problem, so I come to the Alfred – they are great. This is my hospital now.</i> • <i>This is where you go. You don't go anywhere else; the GP diagnoses the wrong stuff.</i>
Referral by a third party (22%)	Referral by a GP, specialist, health professional or bystander	<ul style="list-style-type: none"> • <i>I fell in the street, and someone called the ambulance</i> • <i>I had just come out of hospital...I fainted at lunch with my girlfriends...someone called the ambulance...</i> • <i>I woke up in the morning and couldn't move... my neighbour (a nurse) checked on me at 6pm as she usually does, and I was still stuck in bed, so she called '000'</i>
Fast track access to specialist care (33%)	Referral for specialist services or hospital admission	<ul style="list-style-type: none"> • <i>I wasn't getting anywhere with my outpatient appointment, so my GP said let's try going to the ED and see if that speeds it up... and it did!</i> • <i>My doctor did blood tests...the results came back yesterday...he rang me to say he had called for an ambulance and it was on its way to bring me to hospital</i> • <i>I saw my specialist before, and he said I had a chest infection and had to come to Emergency...now they are going to admit me</i> • <i>My bowels have not been open for 10 days, so my GP sent me here</i>

Table 3: Associated sub-themes

Associated sub themes	Frequency
Primary care	58
Unavailability of GP	21
Waiting time for next available appointment unacceptable	17
Preference not to use rostered locum service	3
Patient perceptions re: role of GP	5
Dissatisfaction with GP	11
Costs associated with GP consultation	1
Specialist care	65
Patient/family referral for specialist care	4
GP/Specialist / Health professional referral for specialist care	28
Ambulance triage for specialist care	33
Health awareness	29
Presenting condition	9
Patient knowledge of own disease	6
Recent hospital discharge	9
Public health awareness	5
Institutional preference	46
Preference for specialist care in a hospital	29
One-stop-shop / Convenience factor	17
Total	197

APPENDIX: Interview Form



Understanding why people come to Emergency Departments

Interviewer: _____ Interview Date: _____ Time: _____

Interview location: ED SSOU Fast Track

Arrival date (day) _____ Arrival time (e.g. 0900, 2100): _____

Age: _____ years Gender: Male Female Postcode: _____

1. Who came with you to the ED?

alone family member / friend
 community service organisation: _____

2. Do you live alone?

Yes
 No → Who do you live with?
 spouse / partner children / other family members
 non-family members a carer
→ Are they involved in your care? Yes No
If YES, how? _____

3. Do you receive any assistance / support? Yes No
(Meals on Wheels, District Nurse, Care Package etc)

Are you on a pension? Yes No

4. Who suggested you come to the ED?

me family friend GP nurse-on-call
 other health worker: _____

5. How did you get here?

ambulance car – I drove car – someone else drove
 taxi public transport
 other: _____

6. Why did you choose the ED for this problem?

it is an emergency
 my GP was not available
 the ED is the most appropriate place for my problem
 I can see a specialist; have x-rays and blood tests here
 it is quicker than waiting for my GP
 my GP saw me and sent me here
 I rang my GP & he told me to come here
 financial reasons
 other: _____

7. When did the problem you came to the ED for, commence?

today yesterday 2-3 days ago 1 week ago >1 week ago

8. **Have you attempted to see a GP in the previous week for this problem?**
 Yes No
- If YES, how long did you have to wait?**
 the same day the next day 2-3 days
 4-5 days 6-7 days after more than a week not sure
- If NO, why not?**

9. **Is there one doctor / doctor's group you usually go to for your medical care?**
 Yes No
- If YES, do you have a regular appointment?**
 No, I only when I need to go monthly 3 monthly
 6 monthly annual
10. **How do you usually get to your medical appointments?**
 self family friend(s)
 public transport other: _____
11. **Do you use any aids for getting around?**
 motorized scooter wheelchair walking or wheelie frame
 stick I do not need any aids to help me get around
12. **How far can you walk unaided?**
 immobile or <10m around my home (<50m)
 with help of one person (>50m) unlimited (>50m)
13. **How far can you walk aided?**
 immobile or <10m around my home (<50m)
 with help of one person (>50m) unlimited (>50m)
14. **Last time you were sick or needed medical attention, how quickly could you get an appointment to see a GP?**
 the same day the next day 2-3 days 4-5 days
 6-7 days after more than a week not sure
15. **Last time you needed medical care in the evening, on a weekend, or over a holiday period, how easy or difficult was it to get care without going to an ED? Was it:**
 very easy somewhat easy somewhat difficult very difficult
 I have never needed care after business hours
16. **If you have a GP, does he/she offer an After Hours service?**
 Yes No I don't know (DNK)
- If YES, who offers the After Hours service?** GP locum service DNK
17. **If you have a GP, does he/she make home visits?** Yes No DNK
18. **When you visit your GP, are you bulk-billed?** Yes No
If NO, are you out-of-pocket? Yes No DNK
If YES (out of pocket) does this stop you from going to the GP? Yes No Maybe
19. **How many times have you attended an ED in the last 12 months (excl. this visit)?**
 none once 2-3 times 4 or 5 times >5 times unsure

20. Duke Social Support Index (DSSI)
The following questions are about the support you receive from any family and friends you may have:

20.1 **Social Interaction Scale:**

1. **Other than members of your family how many persons in your local area do you feel you can depend on or feel very close to?**
 None (1) 1 -2 people (2) More than 2 people (3)
2. **How many times during the past week did you spend time with someone who does not live with you, that is, you went to see them or they came to visit you or you went out together?**
 None (1) Once (2) Twice (2)
 Three times (3) Four times (3) Five times (3)
 Six times (3) Seven or more times (3)
3. **How many times did you talk to someone, friends, relatives or others on the telephone in the past week (either they called you, or you called them)?**
 None (1) Once (1) Twice (2)
 Three times (2) Four times (2) Five times (2)
 Six times (3) Seven or more times (3)
4. **About how often did you go to meetings of clubs, religious meetings or other groups that you belong to in the past week? (excl. church)**
 None (1) Once (1) Twice (2)
 Three times (2) Four times (2) Five times (2)
 Six times (3) Seven or more times (3)

Now, some questions about your family and friends:

20.2 **Subjective Social Support Satisfaction**

5. **Does it seem that your family and friends (ie. people who are important to) understand you?**
 Hardly ever (1) Some of the time (2) Most of the time (3)
6. **Do you feel useful to your family and friends (ie. people important to you)?**
 Hardly ever (1) Some of the time (2) Most of the time (3)
7. **Do you know what is going on with your family and friends?**
 Hardly ever (1) Some of the time (2) Most of the time (3)
8. **When you are talking with your family and friends, do you feel you are being listened to?**
 Hardly ever (1) Some of the time (2) Most of the time (3)
9. **Do you feel you have a definite role (place) in your family and among your friends?**
 Hardly ever (1) Some of the time (2) Most of the time (3)
10. **Can you talk about your deepest problems with at least some of your family and friends?**
 Hardly ever (1) Some of the time (2) Most of the time (3)

TOTAL SCORES

Social Interaction Scale	/ 12
Social Support Satisfaction	/ 18
<hr/> TOTAL	<hr/> /30

INFORMATION FROM ED MEDICAL RECORD

Triage Category _____

Disposition from ED

home to family/ friends transfer to another hospital

Admission to Alfred:

Short stay Unit MAPU Ward

Reason for admission:

clinically unstable / needs investigation

not appropriate to go home:

too late in day

no support at home

Other _____

Final disposition

Ward

Home

Other _____

The Structured Interview used in this study is in the Appendix of the prepared manuscript.

Table 4 outlines the patient quotations and the thematic classifications.

Table 4: Patient quotations and classification into themes/subthemes (with assistance of NVivo software)

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
1	GP closed, would have to wait for locum or '000'. If it was a week day I would have gone to him	Difficulty with accessibility to primary care	Unavailability of GP; Patient expectations for timely care; Preference for not using rostered locum service
2	Live-in daughter said 'he will need an x-ray, so we came here, as it is all under 1 roof... much easier'	Patient preferences	'One-stop-shop' / Convenience factor
3	My son-in-law's GP saw me and sent me here	Fast track access for specialist care	GP Referral for specialist services
4	ED is quicker than getting an appointment with the GP	Difficulty with accessibility to primary care	Patient expectations for timely care; 'One-stop-shop' / Convenience factor
5	I rang my GP who said go to ED	Fast track access for specialist care	GP referral for specialist care
6	My case manager told me to come	Referral by third party	Health professional referral for specialist care
7	I had a knee replacement 2 weeks ago, and the orthopaedic information sheet warned that pain could be infection. My GP was worried last week, and it was her day off, so I thought I should come to hospital	Difficulty with accessibility to primary care	Patient health awareness; Recent hospital discharge; Institutional preference
8	The Alfred is the most suitable as the GP is just for routine problems	Patient preferences	Patient perception of GP's role; Institutional preference
9	I saw the GP today, but the cauterisation did not stop the nose bleeding all night, so I came here	Fast track access for specialist care	Health awareness
10	I fell, so I dialed 000	Fast track access for specialist care	Institutional preference ; Health awareness ; Ambulance triage
11	I had a sore back for a few days, but I thought it would go away; I called my GP and he said to come here (but hadn't seen him)	Difficulty with accessibility to primary care	Unavailability of GP; GP referral for specialist care
12	I saw the GP and the injection he gave didn't work. He said if it was no good to go to hospital	Fast track access for specialist care	GP referral for specialist care
13	No GP is available on a Sunday, so I came here	Difficulty with accessibility to primary care	Unavailability of GP Patient expectations for timely care; 'One-stop-shop' / Convenience factor
14	I fell in the street & someone called the ambulance (who insisted on coming to hospital)	Referral by third party	Ambulance triage

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
15	I saw my GP last week as my arm was swollen & hot, & he sent me to ED then; and I am back for review	Fast track access for specialist care	'One-stop-shop' / Convenience factor for GP; GP referral for specialist care
16	I woke up in the morning & couldn't move. I didn't know what was wrong. My neighbour checked in on me at 6pm as she usually does, and I was still stuck in bed, so she called '000'	Referral by third party	Health awareness ;Patient/family referral for specialist care; Ambulance triage
17	I pushed my pendant alarm as I couldn't get out of bed - they rang '000'	Fast track access for specialist care	Health awareness; Ambulance triage
18	I saw the GP as I was bleeding, he said if it didn't work (cauterisation) & if I continued bleeding, I was to go to Sandringham ED (transfer from Sandringham as no ENT there)	Fast track access for specialist care	Health awareness; Specialist referral for specialist care
19	I woke up bleeding; my GP is on holiday, but the hospital is best for this problem	Fast track access for specialist care	Unavailability of GP; Health awareness; Institutional preference
20	I didn't feel well so I called my GP. He was away & and my next appointment was not for another 3 weeks, so I dialed '000'. I live in Williamstown, and there's nothing there, so I usually come to the Alfred	Difficulty with accessibility to primary care	Unavailability of GP; Patient preferences for timely care; 'One-stop-shop' / Convenience factor; Institutional preference; Ambulance triage
21	I had an enema in ED in May with no effect; So I called my GP & he said to come back here	Fast track access for specialist care	Patient expectations for timely care; GP referral for specialist care
22	My GP was not available (after hours)	Difficulty with accessibility to primary care	Unavailability of GP
23	I can have the whole problem sorted out here, so I didn't bother to go to GP (I would have to wait a week to get an appointment)	Patient preferences	'One-stop-shop' / Convenience factor ;Patient perception of GP's role; Patient expectations for timely care;
24	I was advised after my eye surgery last month if I had trouble, to see the eye doctor or come to hospital, and here is quicker than my GP.	Patient preferences	Recent discharge from hospital; Patient expectations for timely care; 'One-stop-shop' / Convenience factor
25	I had arm pains, so could be my heart & they say call '000'	Patient preferences	Public health awareness; Ambulance triage

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
26	My GP is always on holidays when I need her, as she was today, so I came here	Difficulty with accessibility to primary care	Unavailability of GP; Patient expectations for timely care; 'One-stop-shop' / Convenience factor
27	I am most unhappy with my GP now. I am house-sitting for my daughter so am not near my GP. Besides the GP doesn't open until 9am anyway. GPs only see you for 1 problem at a time; they watch the clock, you only get 5 minutes; and you have to make another time for a different problem	Patient preferences	Dissatisfaction with GP; Patient expectations for timely care;
28	I got worse over last couple of days; I called my GP, but couldn't wait until today's appointment with him, so I came here last night	Patient preferences	Patient expectations for timely care; Institutional preference
29	I can see everyone I need to here; I am angry that my GP doesn't know how to fix the problem - so I come to the Alfred, they are great. This is my hospital now	Patient preferences	'One-stop-shop' / Convenience factor; Institutional preference; Dissatisfaction with GP
30	The specialist at Respiratory Outpatient Clinic today said I had a chest infection so I had to come to ED.	Specialist referral for urgent care	Specialist referral for specialist care
31	All my data is here at the Alfred. I lost my balance so I called '000'	Patient preferences	Institutional preference; Ambulance triage
32	My husband was worried as my pulse was racing, so he called '000'. The ambulance man said my Blood Pressure was too high so he brought me here	Fast track access for specialist care	Health awareness; Institutional preference ; Ambulance triage
33	My NSW GP had done this procedure yesterday in Melbourne. I was in so much pain later that I called him; and he said go to ED, the GP who did this procedure sent me here as he didn't know what to do	GP referral for urgent care	Recent discharge from hospital; GP referral for specialist care
34	I don't use my GP for acute problems. I call Nurse-on-Call. The Alfred has my file & I am a volunteer here	Patient preferences	Patient perception of GP's role; Dissatisfaction with GP; Nurse-on-Call referral for specialist care; Patient institutional preference
35	My GP doesn't work today, so I came here	Difficulty with accessibility to primary care	Unavailability of GP Patient expectations for timely care; Unavailability of GP
36	I wasn't getting anywhere with my neurosurgery outpatient appointment, so my GP said let's try going to ED to see if it speeds up the process	Fast track access for specialist care	GP referral for specialist care

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
37	My GP only looks at my finger, he wouldn't know what was wrong or what to do. So we went to Sandringham ED & they sent me here to Alfred as that was where I had my finger was amputated a month ago	Patient preferences	Recent discharge from hospital; Dissatisfaction with GP; Health awareness; Specialist referral for specialist care
38	I came here as I am concerned about my GP fees. I am thinking of changing to a BB clinic.	Difficulty with accessibility to primary care	Costs associated with GP consultation
39	My GP suggested I come here, he saw me 2 days ago	Fast track access for specialist care	GP referral for specialist care
40	I could just scoot across the Park to Alfred. I had missed my usual GP appointment as I had gastro last week. So I came here today because my throat was sore	Patient preferences	'One-stop-shop' / Convenience factor; Patient expectations for timely care;
41	My GP is on holidays, so I called my doctor sister in Finland & she thought ED was a good idea	Difficulty with accessibility to primary care	Unavailability of GP; Patient/family referral for specialist care
42	This is quicker than seeing the GP- he is on holiday, and I was with my daughter who is close by to here	Difficulty with accessibility to primary care	Unavailability of GP; Patient expectations for timely care; 'One-stop-shop' / Convenience factor
43	I couldn't swear in front of a lady - I don't think much of my GP. He wouldn't come when my son called him, so we called '000' and came here	Difficulty with accessibility to primary care	Unavailability of GP; Ambulance triage; Dissatisfaction with GP;
44	My GP is away, so I saw another doctor in the practice & he sent me here (<i>anaemic from Melina</i>)	Fast track for specialist care	GP referral for specialist care
45	My chemist checked my BP, said it was high, so I should go to a hospital, so I came here. My GP doesn't talk about my problems, just gives me tablets. But my chemist checks my BP	Fast track access for specialist care	Dissatisfaction with GP; Pharmacist referral for specialist care; Institutional preference
46	It was an early morning call by my wife to '000' after I burnt myself with the kettle. I have also had a lot of falls recently	Fast track access for specialist care	Health awareness; Ambulance triage
47	This is where you go, you don't go anywhere else, the GP diagnoses wrong stuff	Patient preferences	Patient perception of GP's role; Institutional preference; Dissatisfaction with GP;
48	I had a terrible cough and back pain - they have all my history here, so I came here. My GP is on holiday anyway	Difficulty with accessibility to primary care	Unavailability of GP; Institutional preference

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
49	My GP saw me and told me to come (I was a bit dizzy) My GP is great.	Fast track access for specialist care	GP referral for specialist care
50	Patient has no recall as was intoxicated & had collapsed on the floor - her family called '000'.	Fast track access for specialist care	Health awareness ;Ambulance triage
51	My GP saw me and sent me here	Fast track access for specialist care	GP referral for specialist care
52	My GP isn't there on a Sunday; they don't work more than P/Time and are always on holiday. I am not very satisfied with my GP	Patient preferences	Unavailability of GP; Dissatisfaction with GP;
53	I called 'nurse on call', who insisted I ring '000'. I really only wanted advice and would have come today anyway. But the ambulance said I should come last night	Patient referral	Institutional preference; Nurse-on-Call referral for specialist care; Ambulance triage
54	I had really bad tummy pain, your own doctor can't help - they just look at you and send you to ED, they don't know what to do, they really just write scripts	Patient preferences	Institutional preference; Patient perception of GP's role; Dissatisfaction with GP;
55	I had chest pain for 1st time in middle of the night. I have a strong family history of heart problems. I was scared	Fast track access for specialist care	Public health awareness
56	A friend called '000' as I collapsed	Referral by third party	Ambulance triage
57	I saw my GP and he sent me here as he didn't know what was wrong: (Patient's daughter reported Mum was SOB & had recent weight loss) so her GP thought a specialist centre like Alfred could sort it out	Fast track access for specialist care	GP referral for specialist care Institutional preference
58	I went for my monthly GP appt & he was on holiday. He hadn't told me, so I came here	Difficulty with accessibility to primary care	Unavailability of GP; Patient/family referral for specialist care
59	My GP did blood tests a few days ago & they came back and said I was anaemic; so he called '000' to get me & bring me to hospital	Fast track access for specialist care	GP referral for specialist care; Ambulance triage; GP Institutional preference
60	I saw my GP, who sent me to Sandringham, who told me to come to Alfred) They thought I had a chicken bone in my throat & needed to see the throat specialist	Referral by third party	Specialist referral for specialist care
61	Fall at 4 am, patient rang daughter who called '000', who then collared him & brought to ED	Referral by third party	Ambulance triage
62	I fell at home and the bleeding wouldn't stop (lacerated eyebrow) - my neighbour called '000'	Referral by third party	Ambulance triage
63	Fall in street with loss of consciousness. Bystander called '000' [2nd ED presentation in 3/52 for a dizzy spell]	Referral by third party	Ambulance triage

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
64	The retirement village staff were concerned as I was a bit unsteady, so they called '000'	Referral by third party	Ambulance triage
65	My chest hurt for 3 days, my son was worried, as so he called 000, but my GP appointment was for 10 am today, but I am here, not there	Family preferences	Public health awareness; Patient expectations for timely care;
66	My bum was so sore, so I thought I should come to hospital (radiotherapy patient)	Patient preferences	Recent discharge from hospital ; Health awareness
67	I called my stomal nurse re: bowel problems post colostomy. She called the surgeon & he said go to ED	Referral by third party	Recent discharge from hospital; Specialist referral for specialist care
68	I had headache & nosebleed so GP sent me	Fast track access for specialist care	GP referral for specialist care; GP Institutional preference
69	I was a bit unsteady overnight. My wife thought my speech might have been slurred, so she called '000'	Fast track access for specialist care	Public health awareness; Ambulance triage
70	My GP visited me at home & said my knee was swollen, so I would need an x-ray, so told me to go to ED	Fast track access for specialist care	GP 'One-stop-shop' / Convenience factor; Institutional preference
71	I am prone to nose bleeds (a genetic condition); The GP was not open, nobody is open at night.	Fast track access for specialist care	Unavailability of GP; Patient/family referral for specialist care; Health awareness
72	Fall in a restaurant, so waiter called ambulance	Referral by third party	Ambulance triage
73	I saw my GP last week and I haven't improved, so I came here. My GP only works MW&F , so I try to make my appoints for those days, that is why I have to wait for him	Difficulty with accessibility to primary care	Unavailability of GP; Patient expectations for timely care;
74	I felt awful, I had chest pain for 3/7; I do hope it is not my heart	Fast track access for specialist care	Public health awareness; Institutional preference
75	My GP was not available - it takes a week to get an appointment, and I've been here before, it is the best	Difficulty with accessibility to primary care	Unavailability of GP; Patient expectations for timely care; 'One-stop-shop' / Convenience factor; Institutional preference
76	My bowels were not open for 10/7, so GP sent me here	Fast track access for specialist care	Institutional preference

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
77	I was dizzy after my regular back injection with Alfred specialist today, so he sent me here from his clinic	Referral by third party	Specialist referral for specialist care
78	I haven't been to the toilet for over 1 week. I came because I felt I needed hospital care but I have no private insurance. So I came here. Besides, my GP hadn't offered any help with my bowels	Patient preferences	Institutional preference; Dissatisfaction with GP
79	I came to ED last week, then saw my GP. My GP is unsure what is wrong, so sent me back here	Fast track access for specialist care	GP Institutional preference
80	I had a hypo (with loss of consciousness) - my blood sugar was 1.1 so I called '000' at 1am. [GP wait time is always 3 days, impossible after hours except locum] This was a real emergency - it's happened to me before	Patient preferences	Health awareness; Ambulance triage
81	I had my post ERCP check up today - 3 Alfred Clinic doctors didn't know why I still had pain, so they sent me to ED. The ED doctor has now told me I need my gall bladder out, so I am booked for Surgery next month	Referral by third party	Recent discharge from hospital
82	I went out to it on the toilet. My husband had to get our neighbour to help me off, and then called '000'	Patient preferences	Ambulance triage
83	I was hallucinating while staying with my sister, so I told her to call '000', its v. difficult AH, I'd have to call the locum service, or come here like I did last night	Patient preferences	Unavailability of GP; Ambulance triage; Institutional preference; Preference for not using rostered locum service
84	I fainted in ED while visiting my husband, so here I am	Referral by third party	
85	Ambulance delivery from public place, intoxicated related fall ?LOC; a FF to ED	Referral by third party	Ambulance triage
86	Ambulance delivery from public place. I felt dizzy on the train - someone called '000'	Referral by third party	Ambulance triage
87	The rehabilitation doctor was concerned I might have had a stroke a few days ago -so he sent me here to ED for a neurology opinion	Fast track access for specialist care	Specialist referral for specialist care; Specialist 'One-stop-shop' / Convenience factor
88	I am so constipated, I needed attention, so I came here by ambulance, I have a 2wkly GP appt, but...I was sick of it	Patient preferences	Patient expectations for timely care; Dissatisfaction with GP; Ambulance triage; Institutional preference
89	I use nurse-on-call, and I went to Fawkner ED 3 times over the last 2 weeks at \$250@, so this time I called '000' to come to Alfred - it's free	Patient preferences	Nurse-on-Call referral for specialist care; Institutional preference

ID	Responses to 'Why did you choose the Emergency Department for this problem?'	Primary Theme	Subthemes
90	I called my GP, but he couldn't see me, so he told me to call '000'	Difficulty with accessibility to primary care	Unavailability of GP; Ambulance triage
91	I fell at home at night and couldn't move. I had my mobile in my pocket & my neighbour was in hospital, so I rang '000'	Patient preferences	Health awareness; Ambulance triage
92	I was dizzy after gardening then fell yesterday; this morning I could not move without pain & my daughter was asleep, so I used my pendant and my case manager called and rang '000'	Referral by third party	Health professional referral for specialist care; Ambulance triage
93	I called my GP, she said 'go to ED and tell them to put a catheter in'; I was here twice this last week & they still haven't fixed it, so I'll keep coming back here until they do!	Fast track access for specialist care	Institutional preference
94	I didn't feel well and then fainted at lunch, so my friends called '000'. I had been in the Avenue Hosp. for 9 days as I felt unwell.	Referral by third party	Recent hospital discharge; Ambulance triage
95	(Melina post op) I rang my surgeon who operated 1 wk ago at Cabrini; he told me to come to Alfred ED as Cabrini weren't set up for this problem	Fast track access for specialist care	Recent hospital discharge; Institutional preference
96	Patient's wife said 'he has had a lot of kidney problem; this time he was coughing up phlegm, so I called '000'... I also need more care for him.'	Patient preferences	Institutional preference; Ambulance triage; 'One-stop-shop' / Convenience factor
97	I slipped on a step & my friends called '000'	Referral by third party	Ambulance triage
98	I rang my daughter who called the GP, but the locum message was on, so she called '000'	Difficulty with accessibility to primary care	Unavailability of GP; Patient expectations for timely care; Preference for not using rostered locum service Ambulance triage
99	I was due to have my shoulder reviewed at Clinic today, so my GP said 'call in to ED after the orthopaedic appointment' (GP wrote a full referral). I had seen my GP 4 times this last 2 weeks with SOB, but she didn't know what to do	Fast track access for specialist care	GP referral for specialist care; GP 'One-stop-shop' / Convenience factor
100	My son called the GP, but he wasn't available, so he called '000'	Difficulty with accessibility to primary care	Unavailability of GP; Ambulance triage

7.3 SUMMARY

This descriptive study set out to explore the contribution of some of factors to the rise in emergency demand proposed by the wider literature, namely reduced accessibility to primary care, social isolation, and increased expectations for timely care. The study was targeted at elderly lower acuity community-dwelling patients, as it was hypothesised their acute healthcare needs could have been delivered outside a hospital setting.

Just over one-fifth of this group of patients was referred by a bystander or health professional for emergency care because of an incident in a public place or a post-operative complication. However, almost half this cohort presented to ED because of reported difficulties with access to their preferred GP at a time that was convenient to them or their family. This was in the context of almost 90% of patients reporting availability of an appointment with their GP within a maximum of 2-3 days; and in the context of 73% presenting to the ED during usual GP working hours.

In addition, the convenience of seamless access to a 'one-stop-shop' with the availability of a multidisciplinary specialist team alongside imaging and pathology services underpinned many attendances.

Of interest was the candid nature of many patients aged over 85 years, who openly compared current primary care practice with that of 30 years ago. For example:

- *“My doctor only works part-time. If she’s not there, you have to see someone else who doesn’t know you. It is silly. They used to work like a doctor should. It’s so frustrating. It is just not right anymore.”*
- *“Your own doctor can no longer help. They now just look at you and send you home.”*

Another contributing factor to ED presentation in this cohort was related to specialist accessibility, suggesting GPs may be referring patients to the ED to bypass public sector specialist clinic waiting lists.

These findings are relevant, even though the sample size is limited, as they provide an insight into a potential change in expectations by patients, families and health professionals for timely care in an older group of lower acuity patients, of whom the majority were discharged home within 48 hours. This suggests that the health system is not meeting the expectations of this age group, who will continue to have a growing demand for acute care.

It is recommended that a further study be conducted with a larger cohort to examine the factors that influence lower acuity patients' decisions to seek care from an ED in preference to a community-based service. Additionally, interviewing or surveying primary care and specialist doctors would provide a more balanced perspective about access to timely care at times of acute healthcare needs.

CHAPTER 8: HOSPITAL ADMISSIONS THROUGH THE EMERGENCY DEPARTMENT 2000-2009

8.1 INTRODUCTION

The studies in Chapters 5 and 6 quantified an average annual increase in Emergency Department (ED) presentations of 3.6% beyond that which could be accounted for by population changes over a 10 year period. The impact of such enduring demand is further aggravated by access block⁸⁵ related to increasing numbers of patients requiring admission to short stay observation units (SSOU) within the ED and to hospital wards. Chapter 5 showed that over 25% of all presentations in 2008/2009 required admission, comprising 16% to a hospital ward and 9% to a SSOU. This is consistent with the national figures reported by the Department of Health and Ageing.⁸⁶

The sub-analysis of older patients in Chapter 6 revealed 55% of ED patients aged 70 years or more required admission, with 36% admitted to a hospital ward and a further 19% to a SSOU in the same time period. In addition, the number of older patients admitted to hospital more than doubled over the 10 years studied.

The following study was designed to examine this rise in hospital admissions from EDs from 1999/2000 to 2008/2009 and to explore possible explanations for the increase. To accomplish this required linkage of two data sets created by the Victorian Department of Health, the Victorian Emergency Minimum Dataset (VEMD) and the Victorian Admitted Episodes Dataset (VAED). The VEMD was used in the studies of ED presentations in Chapters 5 and 6. In the next study, the VAED which records the demographic and clinical details of all patients admitted to hospitals was linked to the VEMD to enable analysis of patients admitted to hospital through EDs.

This study examining emergency admissions is described in the following manuscript prepared for publication '*Trends in hospital admissions through Emergency Department 2000-2009: Rising demand from short stay patients.*'

8.2 METHODS

8.2.1 PREPARATION AND LINKAGE OF DATA SETS FOR ANALYSIS

Chapter 3 described the Department of Health administrative data source used in this study (Sections 3.4.4.1 and 3.4.6.1), comprising ten years of de-identified patient records from the VEMD⁵³ and VAED,⁸⁷ for the time period 1999/2000 to 2008/2009.

To facilitate the linkage process undertaken by the researcher in this study, the Victorian Department of Health assigned a *project specific unique identification number* for individual patients in both datasets. This was to enable the researcher to link the two data sets together, the purpose being to enrich the available data to describe the characteristics of the total acute episode of emergency care for individual patients admitted to hospital from the ED through to discharge. This *unique identifier* was created from combinations and components of individual patient's name, date of birth, sex, hospital unit record number, and Medicare number.⁸⁸ Any potential identifying variables were then removed by the Department of Health to ensure patient confidentiality, in accordance with Australian privacy law and practice.^{89 90 91} The *unique identifier* was common throughout both datasets for the ten year period, to distinguish individual patients.

Since the data were provided for this thesis, *Victorian Data Linkages (VDL)*⁹² has been established, within the Strategy, Policy and Finance division of the Victorian Department of Health's Health Strategy Unit. One of the roles of VDL is to carry out linkages of datasets such as that undertaken by the researcher.

8.2.1.1 Preparation of VEMD and VAED data sets

Both datasets were provided in annual files from July 1999/June 2000 to July 2008/June 2009. Preparation of the VEMD was described in Chapter 5 (Section 5.2.1) for the analyses outlined in Chapters 5 and 6.

Prior to linkage of the two datasets, the VAED required similar attention, with unification of the coding of all categories by the researcher, across each 12 month period of the data set. For example, the VAED included a variable representing the type of hospital admission (from the ED, other emergency admission, direct transfer from a nursing care home etc.). This data field was labelled '*Admission Source*' from 1999/2000 to 2002/2003, and was then re-labelled in the VAED '*Admission Type*' from 2003/2004 to 2008/2009. Re-coding of this variable was necessary to ensure the *admission type* was coded in a unified manner throughout the ten yearly files.

In addition, a new variable was created in each dataset by the researcher, to facilitate and optimise accuracy of the linkage process. This variable, labeled Hospital Admission Date ('*HspAdmDte*') was created in the VEMD to represent the date of discharge from ED, as recorded on the VEMD; and separately in the VAED to represent the date of hospital admission, as recorded on the VAED.

8.2.1.2 Linkage of the data sets: VEMD and VAED

Linkage is broadly described as a "technique that makes possible more complete use of health and other data by bringing together data from many sources at the level of individual persons, populations, events or places, which is often needed to fully understand a population's health".⁹²

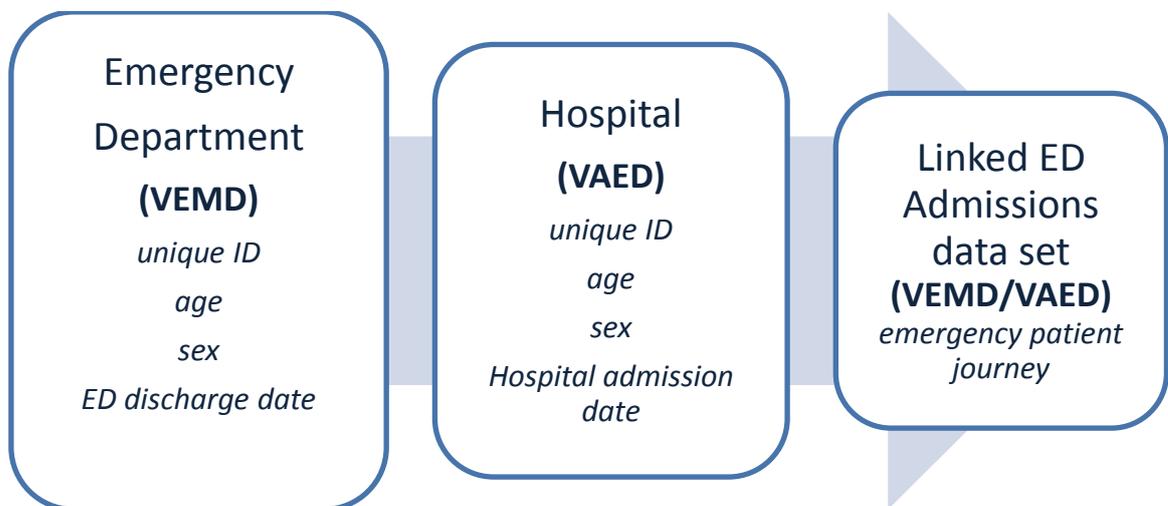
Data or Record Linkage is defined as "a method for bringing together the information contained in two or more records - e.g., in different sets of medical charts, and in vital records ... and a procedure to ensure that each individual is identified and counted only once. This procedure incorporates a unique identifying system such as a personal identification number".^{93 (pg 153) 94}

For this study, *deterministic linkage* was used to expand the information about the patient emergency journey, from ED presentation (VEMD data) through admission and discharge from hospital (VAED data). Deterministic linkage of records generates links on the basis of “complete agreement of a unique identifier or a set of common identifiers”, thereby minimising the uncertainties in the linkage of two datasets.⁹⁵

Each yearly file was linked separately. In the linkage process the VEMD was treated as the Master file, as the purpose was to develop a dataset containing patients admitted to hospital from the ED.

The **linking variables** used were the unique identifier, age, sex, and ED discharge date/hospital admission date, as shown in Figure 9.

Figure 9: The linking variables used in the dataset linkage process to develop a dataset of patients admitted from the Emergency Department



8.2.1.3 Frequency of agreement in the linkage of the two data sets

The ten annual 'linked data files' were examined following the deterministic linkage process to ascertain the frequency of agreement, otherwise known as the 'success' of the matching process. The linkage rate between the VEMD and VAED was calculated using the number of patient records that were successfully matched based on the linking variables used as the denominator, and the number of records labelled as an ED admission type as the numerator. This revealed an average matched linkage rate of 95.9% as summarised in Table 5.

Table 5: Frequency of agreement in the linkage process conducted by the researcher

Time period	Newly Linked ED admissions Dataset	VAED for all of Victoria	% records linked successfully	Final dataset
	No. records matched following the linkage	No. records coded as: <i>AdmSce/AdmTpe</i>		No. records for metropolitan Melbourne
1999/2000	191,901	189,146	98.6	144,134
2000/2001	192,182	188,123	97.9	138,145
2001/2002	216,738	214,000	98.7	160,457
2002/2003	229,756	227,701	99.1	170,578
2003/2004	245,258	218,319	89.0	176,578
2004/2005	265,757	247,780	93.2	188,339
2005/2006	371,408	272,396	95.2	205,660
2006/2007	286,120	292,583	95.4	221,857
2007/2008	310,841	296,371	95.3	227,229
2008/2009	314,091	304,512	97.0	224,229
Average % records linked			95.9	

Following this process, the ten yearly linked files were appended together to create a linked data set of 10 years of patients who were admitted to hospital through ED.

8.2.1.4 Limitations of Data Linkage

Although the frequency of agreement in the linkage was relatively high in this study, the success rate is dependent on the quality of data in each of the data sets being linked. As such, factors including missing data, duplicate records, and inaccuracies in the data contribute to sources of error in the linkage process, as well as sources of bias in the results based on linked data⁹⁶. However, each yearly file was linked separately

using variables that were likely to be consistent in each data file (*unique identifier, age, sex, ED discharge/hospital admission date*). The mean proportion of records linked was 95.9% (range 89% to 99.1%). In addition, the frequency of agreement reflected a less than 5% error rate, therefore the final data set was considered to represent the cohort of patients admitted to hospital through EDs between 1999/2000 and 2008/2009.

8.2.2 ANALYSIS

The change in the volume of admissions was calculated, as were the rates adjusting for changes in demographic structure. The data were then interrogated regarding hospital length of stay, indicating an overall median length of stay of a single day/overnight stay. Changes in length of stay were then examined more closely, as it was apparent that the growth in admissions and rate of admission over the decade was associated with a significant increase in the single day/overnight stays. Changes in clinical diagnoses were also examined.

The analysis and results are outlined in the manuscript that follows.

8.3 PREPARED MANUSCRIPT: TRENDS IN HOSPITAL ADMISSIONS THROUGH EMERGENCY DEPARTMENTS 2000-2009: RISING DEMAND FROM SHORT-STAY PATIENTS

CO-AUTHOR DECLARATION FOR PUBLICATIONS TO BE INCLUDED IN THESIS

Monash University

Lowthian JA, Stoelwinder JU, McNeil JJ, Cameron PA. Trends in hospital admissions through Emergency Departments 2000 to 2009: Rising demand from short-stay patients

Declaration by candidate

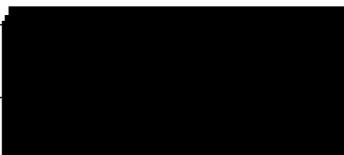
In the case of the publications in Chapter 8, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Principal author, responsible for overall study concept design, literature review, coding and recoding of variables and all preparation of datasets for analysis, development of Stata analysis codes, linkage of the VEMD with the VAED, analysis and interpretation of results, and development and writing the manuscript. Responsible author who accepts overall responsibility for the publication.	80

The following co-authors contributed to the work:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Johannes U Stoelwinder	Contributed to editing of the manuscript	
John J McNeil	Contributed to the study design and editing of the manuscript	N/A
Peter A Cameron	Contributed to editing of the manuscript	N/A

Candidate's Signature

		13 December 2011
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Declaration by co-authors

The undersigned hereby certify that:

- (1) the above declaration correctly reflects the nature and extent of the candidate’s contribution to this work, and the nature of the contribution of each of the co-authors.
- (2) they meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
- (3) they take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
- (4) there are no other authors of the publication according to these criteria;
- (5) potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
- (6) the original data are stored at the following location(s) and will be held for at least five years from the date indicated below:

Location	Department of Epidemiology and Preventive Medicine, Monash University
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Co-Authors signatures	Date
[Redacted Signature]	26 October 2011
[Redacted Signature]	28 November 2011
[Redacted Signature]	26 October 2011

Trends in hospital admissions through Emergency Departments 2000 to 2009: Rising demand from short-stay patients

Judy Lowthian, Johannes Stoelwinder, John McNeil, Peter Cameron

Abstract

Objectives

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

Design, Participants and Setting

Retrospective analysis of population-based linked Department of Health ED and hospital admission data for metropolitan Melbourne 1999/2000 to 2008/2009.

Outcome Measures

Hospital admission number and rates per 1000 population; hospital length of stay (LOS)

Results

The volume of patients admitted to hospital through EDs rose by 56% over the ten years to June 2009. This was driven by a 60% rise in the number of single day/overnight admissions, equating to a 6.1% average annual increase beyond that accounted for by demographic change (95%CI 5.2% to 6.5%). The volume of patients admitted for 2 or more days also increased, however the admission rate per 1000 persons for these longer stay patients declined over the decade by 9% (95%CI 5% to 12%).

The most frequent discharge diagnoses were injury or poisoning, and disorders of the circulatory, respiratory or digestive systems. The mortality rate for ED admissions declined over the decade.

Conclusion

A rise in hospital admissions through EDs was explained by a significant increase in single day/overnight admissions. This is likely to be related to changes in ED models of care including short stay units and increased expectations of patient safety on discharge.

Trends in hospital admissions through Emergency Departments 2000 to 2009: Rising demand from short-stay patients

Judy Lowthian, Johannes Stoelwinder, John McNeil, Peter Cameron

Background

Emergency Department (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.¹ Greater demand contributes to access block² related to increasing numbers of patients requiring hospital admission. Over 25% of all ED presentations across metropolitan Melbourne in 2008/2009 required admission, of which 17% were admitted to a hospital ward and 9% to a SSOU.¹ This is consistent with national figures reported by the Department of Health and Ageing.³ Fifty-five percent of patients aged 70 years or more were admitted, 36% to a hospital ward and 19% to a SSOU.⁴ In this context, this study set out to analyse the changes in hospital admissions from ED and to describe any associated patterns. The aims 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.

Methods

Study Design and Setting

A retrospective analysis was conducted of routinely collected discharge collected data describing the emergency episode of care from ED presentation through admission to hospital discharge across metropolitan Melbourne over the ten 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 hour EDs, and excluded specialist maternity and Eye & Ear hospitals. De-identified data were provided by the Victorian Department of Health from the Victorian Emergency Minimum Dataset (VEMD)⁵ and the Victorian Admitted Episodes Dataset (VAED).⁶ Data were provided in financial year files from July 1999/June 2000 to July 2008/June 2009. Population data published by the Australian Bureau of Statistics (ABS) were used to calculate hospital admission rates across the study period by age and gender.⁷

Single day/overnight admissions were defined as patients admitted to hospital for one night; and multi-day admissions were defined as patients admitted to hospital for ≥ 2 nights.

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. Deterministic linkage^{8 9} was used to link the two data sets to expand the data available for analysis.

Demographic and clinical factors for all patients in the linked dataset were categorised according to age group, gender, type of transport to ED, clinical acuity by the Australasian Triage Category¹⁰ (ATS), ED length of stay (LOS), ED discharge destination, principal and secondary diagnoses reflecting the medical reason for admission, time spent in the intensive care unit (ICU), interventions used for the diagnosis and/or treatment related to the episode of care, the nature of care provided during the admission, hospital LOS, and hospital discharge.

Age and gender 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 gender on the likelihood of admission. Changes in mode of transport to the ED, ED clinical acuity, ED LOS, rate of hospital admission per 1000 ED presentations, primary diagnosis upon admission and hospital discharge destination were analysed using descriptive statistics across the ten year period. Confidence intervals were generated to quantify precision of estimates. Stata version 11 was used for all analyses (StataCorp, College Station, Texas, USA).

Results

All hospital admissions through EDs: The total number of patients admitted to metropolitan Melbourne public hospitals through the ED rose by 55.6% 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 ≥ 85 years, with a 98.9% increase in volume over the study period, as shown in Table 1.

After adjustment for population changes in age and gender over the study period the overall increase in hospital admissions was 28% (95%CI 21.1% to 35.3%), equating to an average increase of 3.9% per year (95%CI 3.5% to 4.4%). Females were 16% less likely than males to be admitted (95%CI 13% to 18%). The hospital admission rate/1000 persons and the likelihood of being admitted rose with increasing age, as outlined in Tables 1 and 2.

Hospital length of stay (LOS): Further investigation revealed that the majority of patients admitted through the ED had a single day/overnight length of stay (LOS) in hospital. Further analysis revealed that the overall rise in hospital admissions over the decade was driven by

single day/overnight admissions, increasing from 53% to 65% of all admissions through ED in 1999/2000 and 2008/2009, respectively. Single day/overnight admissions increased by 92%, compared with a 15% rise in the number of multiday admissions over the study period. A comparison between hospital admission rates for patients with a single day/overnight LOS and for those with a multiday admission is summarised in Figures 1, 2 and 3.

Single day/overnight hospital admissions: Log-linear regression adjusting for the effects of age and gender indicated a total increase in single day/overnight admissions of 59.7% over the study period (95%CI 52.8% to 66.9%) with 146,543 patients admitted in 2008/2009. This equated to an average annual increase in single day overnight admissions of 6.1% per year (95%CI 5.7% to 6.5%). Females were 12.4% less likely than males to be admitted (95%CI -10.7% to -14.1%). Patients aged ≥ 85 years were 5.1 times as likely to be admitted for a single day overnight stay, as those patients aged 35-59 years (95%CI 4.8 to 5.4), as summarised in Table 3. In 2008/2009, 23% of single day/overnight admissions were aged 70 years or more.

There have been significant changes in certain diagnostic categories admitted for a single night, as summarised in Table 4. Forty-eight percent of the increase in single 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 -4.9% to -12.1%) over the time period. Females were 21.3% (95%CI -19.9% to -22.6%) less likely than males to be admitted. Table 5 illustrates that likelihood of hospital admission for ≥ 2 days rose with increasing age. Patients aged ≥ 85 years were 11.1 times as likely (95%CI 10.5 to 11.8) as those aged 35-59 years to be admitted for ≥ 2 days. Thirty-one percent 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 systems 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 mortality rate declined over the study period; from 15 to 9 deaths per 1000 ED admissions for single day/overnight patients. For multiday patients, the rate reduced from 37 to 33 per 1000 ED admissions in 1999/2000 and 2008/2009 respectively.

Discharge destination: The majority of admitted patients were discharged home - 82% of single day/overnight patients and 79% of multiday patients in 2008/2009.

Discussion

Our study has shown that the growth in the rate of emergency admissions to public hospitals via EDs across metropolitan Melbourne over the ten years to June 2009 was due to a dramatic rise in single day/overnight admissions. To our knowledge this is the first Australian study to make this distinction, and is the first to measure the increase in admissions through ED, whilst taking population changes into account. The increase in single 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.¹

A rise in the volume of emergency admissions to public hospitals has also been reported in the United Kingdom (UK) and Scotland since the mid 1990's.¹¹⁻¹³ Of note, is that we measured a 56% increase in the number of hospital admissions through ED over a ten year period to 2008/2009, which was higher than the 12% growth reported in the latter five years in the UK. The UK has also experienced significant growth in short stay admissions, defined as zero and one bed-day admissions.¹² 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.¹⁴¹⁵ Our study confirms this, with patients aged ≥ 85 years more than 5 and 11 times as likely 35-59 year olds to be admitted to hospital overnight and for ≥ 2 days respectively. It is reasonable to conclude that continuing ageing of the population is a contributing factor to the rise in ED admissions.

The increased frequency of certain discharge diagnoses that has driven the rise in single day admissions suggests major changes in the process of care for conditions such as undifferentiated chest pain, gastroenteritis and minor injuries. 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 been multiday stays previously.

The rapid rise in single day/overnight admissions may reflect a change in the models of acute care. Short stay observation units (SSOUs) 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 prior to stream-lined discharge.¹⁶

Such an increase in the volume and rate of single day overnight admissions raises the question of whether some patients could have been managed in an alternative community-based setting¹² if they had not attended ED. One could speculate that changes in the organisation of general practice over the past decade with reduced accessibility,^{17 18} lengthy waiting lists for specialist appointments may have influenced the choice to use the ED as a source of health care.¹⁹ In addition, changing community expectations for timely specialised care are also likely contributing factors.¹¹

Population ageing and the growing chronic disease burden have increased the complexity of emergency care.²⁰ 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 tools. The relentless rise in ED attendances¹ and overcrowding together with incentives created by variable payments for ED performance under Casemix funding with time-based penalties²¹ 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 patient safety is not compromised with unsafe discharge has been suggested by others.¹²

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 data sets. 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.²² However the large size of the data set used should minimise the potential for error. This study was based on routinely collected metropolitan data; hence the findings may 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. The rise in admissions was largely driven by a significant increase in single day overnight admissions, which was associated with the introduction of short stay units, together with changes in ED models of care to manage persisting demand for acute hospital-based care. It is highly likely that demand for single day emergency admissions will continue to grow in the future, unless alternative models of community based care are developed.

Ethical Approval

This study was approved by the Monash University Human Research Ethics Committee and the Victorian Department of Health.

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Table 1: Growth in numbers of admissions and rate/1000 persons through metropolitan Melbourne public hospital

Emergency Departments by age group, 1999/2000 to 2008/2009, using linked VEMD/VAED data

Age group	No. of hospital admissions through ED (rate)		% increase in volume
	1999/2000	2008/2009	
0-4 yrs	13,894	15,062	8.4
rate per 1000 persons	64	59	
5-19 yrs	15,810	21,725	37.4
rate per 1000 persons	24	29	
20-34 yrs	24,539	37,666	53.5
rate per 1000 persons	31	39	
35-59 yrs	34,586	60,516	74.9
rate per 1000 persons	30	45	
60-69 yrs	15,592	24,242	55.5
rate per 1000 persons	61	70	
70-84 yrs	29,857	45,410	52.1
rate per 1000 persons	121	157	
≥85 yrs	9,856	19,608	98.9
rate per 1000 persons	226	292	

Table 2: Adjusted log-linear model of the effects of age and gender on admission through metropolitan Melbourne public hospital Emergency Departments, 1999/2000 to 2008/2009 (N=1,856,969) using linked VEMD/VAED data

Age group	1999/2000 to 2008/2009	95% CI (p<0.000)
0 to 4 years	1.7	1.6 to 1.8
5 to 19 years	0.71	0.67 to 0.75
20 to 34 years	0.97	0.92 to 1.02*
35 to 59 years	1.0	-
60 to 69 years	1.8	1.7 to 1.9
70 to 84 years	3.8	3.6 to 4.0
≥ 85 years	7.1	6.7 to 7.5

*not statistically significant (p=0.03)

Figure 1: Hospital admissions by length of stay through metropolitan Melbourne Emergency Departments, 1999/2000 – 2008/2009, using linked VEMD/VAED data

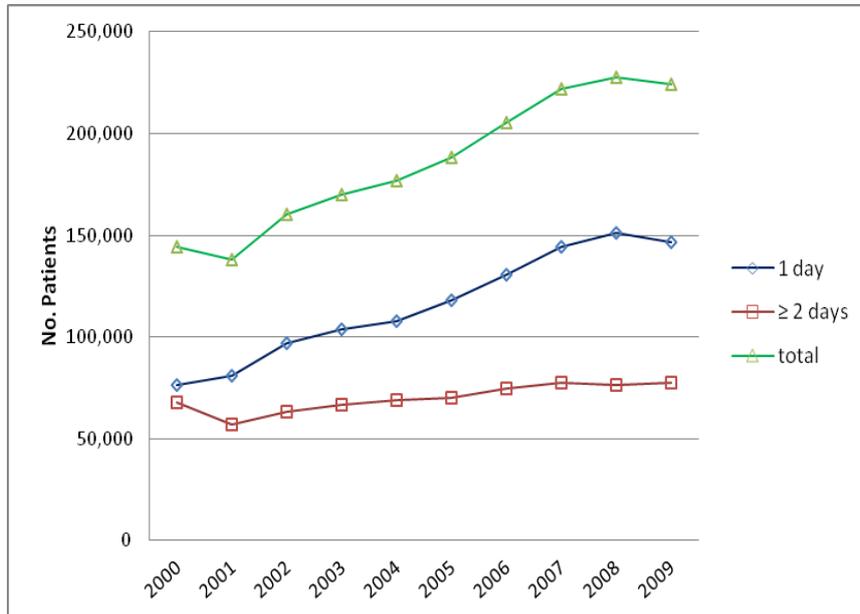


Figure 2: Hospital admission rates by age group and gender through metropolitan Melbourne Emergency Departments, 1999/2000 – 2008/2009, using linked VEMD/VAED data for patients with a single day overnight length of stay

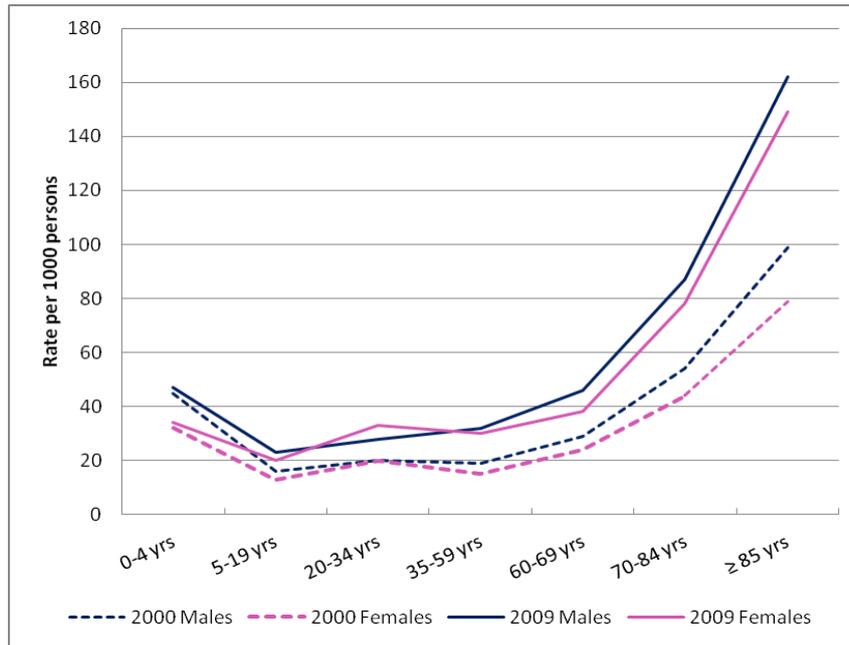


Figure 3: Hospital admission rates by age group and gender through metropolitan Melbourne Emergency Departments for patients with a hospital length of stay ≥2 days, 1999/2000 – 2008/2009, using linked VEMD/VAED data

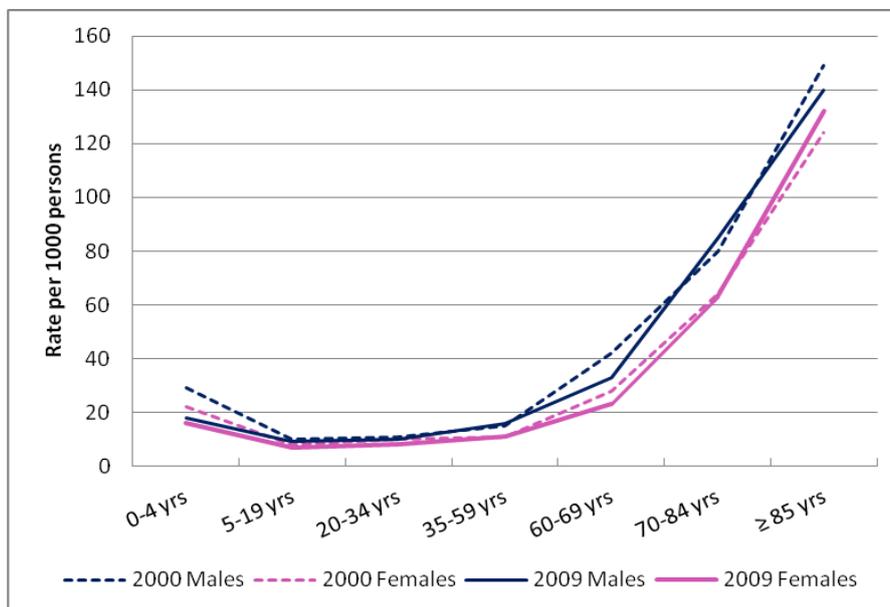


Table 3: Adjusted log-linear model of the effects of age and gender on single day admissions through metropolitan Melbourne Emergency Departments, 1999/2000 to 2008/2009, using linked VEMD/VAED data

Age group	1999/2000 to 2008/2009	95% CI (p<0.000)
0 to 4 years	1.7	1.6 to 1.8
5 to 19 years	0.73	0.69 to 0.78
20 to 34 years	1.07	1.01 to 1.14 *
35 to 59 years	1.0	-
60 to 69 years	1.5	1.4 to 1.6
70 to 84 years	2.8	2.6 to 2.9
≥ 85 years	5.1	4.8 to 5.4

*not statistically significant (p=0.02)

Table 4: Change over time by primary diagnosis single day/overnight admitted patients

	2000	2009	% change
Total No. admissions through ED	76,475	146,543	92
	n	n	
Circulatory disorders (total)	10340	20371	97
<i>Heart disease</i>			
Unstable angina	1431	1625	14
Atrial Fibrillation & flutter	876	1932	120
Acute MI	560	1332	137
Chest pain unspecified	3,413	8,799	158
<i>Cerebrovascular disease</i>			
Transient Ischaemic Attack	363	865	138
Intracerebral haemorrhage	118	172	46
Stroke	198	250	26
Cerebral infarction	122	201	65
Respiratory disorders (total)	8243	13319	62
Acute URTI unspecified	500	1098	120
Croup (acute obstructive laryngitis)	1010	639	-37
Acute tonsillitis unspecified	202	943	367
Asthma	2414	3,545	47
COPD	792	1,134	43
Pneumonia	973	1,798	85
Digestive system disorders (total)	10163	21721	114
Constipation	706	1342	90
Gastritis unspecified	250	1,276	410
Abdominal pain	3,881	7,072	82
gastroenteritis	1807	4,497	159
Viral intestinal infection	298	791	165
Genitourinary disorders (total)	4,363	9,219	111
Calculus of ureter	415	646	56
Unspec renal colic	1,008	1,287	28
UTI site not specified	845	2,233	164
Injury, poisoning & external causes	18,486	30,832	67

Table 5: Adjusted log-linear model of the effects of age and gender on hospital admissions ≥ 2 days, through metropolitan Melbourne Emergency Departments, 1999/2000 to 2008/20, using linked VEMD/VAED data

Age group	1999/2000 to 2008/2009	95% CI (p<0.000)
0 to 4 years	1.7	1.6 to 1.8
5 to 19 years	0.67	0.63 to 0.71
20 to 34 years	0.76	0.7 to 0.8
35 to 59 years	1.0	-
60 to 69 years	2.4	2.3 to 2.5
70 to 84 years	5.7	5.4 to 6.1
≥ 85 years	11.1	10.5 to 11.8

8.4 SUMMARY

The results of this study quantified a dramatic rise the numbers and rate of hospital admission from EDs over a sustained period. This is also in the context of the persistent rise in ED presentations identified in Chapter 5.

The growth in total hospital admissions from emergency departments was driven by a 60% increase in the number of single day/overnight admissions, representing an average annual growth rate of 5.9%. Although the total volume of patients admitted for two or more days increased, the rate for these longer stay patients declined over the decade by 9%.

Whilst the data cannot confirm the factors underpinning the rise in short stay hospital admissions, there are signals suggesting there has been a change in the models of care in EDs alongside increased expectations of patient safety upon discharge.

CHAPTER 9: REFLECTIONS, IMPLICATIONS AND CONCLUSIONS

9.1 INTRODUCTION

The aims of this Chapter are to highlight the findings of this program of research, interpret their overall meaning and to discuss their implications for future research and the design of emergency services.

This thesis used robust epidemiological techniques to systematically analyse the main elements of the persistent increase in demand for emergency ambulance and emergency related hospital services across metropolitan Melbourne, with a particular focus on elucidating the impact of population ageing. It makes new contributions to the evidence-base and provides a platform upon which further research can be based and service interventions targeted.

9.2 KEY FINDINGS

The key findings and the contribution of knowledge arising from this thesis are summarised in Table 6.

Table 1: Summary of Key Findings

➤ Synthesis and identification of knowledge gaps in previous literature
➤ Quantification of persisting growth in demand for all aspects of emergency patient services over a prolonged time period
➤ Accelerating demand for emergency ambulance services by the older population
➤ Quantification of increasing re-presentations to emergency departments by older patients
➤ Detection of older patients' expectations for timely acute medical care
➤ Identification of single day hospital admissions from emergency departments as a consequence of increased demand on acute hospitals
➤ Demonstrated a changing pattern of management of older ED patients with single day overnight hospital admissions

This thesis sought to address four key objectives, which were achieved as follows:

- 1. To identify and synthesise studies and service provider reports relevant to trends in the utilisation of emergency ambulance and ED services through a systematic review of the literature*

Synthesis of the literature confirmed utilisation of emergency ambulance and hospital services had increased over the past two decades throughout developed countries, with higher utilisation of services by the elderly. The reviews also indicated a deficiency of any systematic investigation of the relative contribution of the factors thought to underpin the rising demand for emergency patient services. In particular a dearth of information about factors related to the utilisation of emergency ambulances was identified.

- II. To measure the longitudinal changes in the volume and rate of transportation by emergency ambulances, presentation to EDs and hospital admission through the ED across metropolitan Melbourne*

The studies detailed in Chapters 4, 5, 6 and 8 provide evidence of persisting growth in demand in all aspects of emergency patient services , with quantification of the increase over a prolonged period through longitudinal analyses of population-based administrative data sets.

- III. To measure the contribution of changes in the demographic structure of the population to changes in emergency demand*

Although the volume and rates of usage have increased across all ages, it is evident that demand for both emergency ambulance and ED services is disproportionately driven by older age groups, with increased utilisation greater than expected from changes in demographic structure. The acceleration in emergency ambulance transportation of older patients has not been identified previously. In addition, whilst this older age group consumed more ED services than their younger counterparts, the significant growth over time in the proportion and numbers of older individuals repeatedly seeking acute care from ED identified by this thesis is new knowledge.

- IV. To explore other patient, community and health system factors associated with changes in demand*

The descriptive study of older ED patients indicated a perception of difficulty with access block to GPs and to timely specialist appointments, along with an expectation of the convenience of total care in a 'one-stop' multidisciplinary diagnostic centre. The dramatic rise in single day/overnight admissions from EDs is a health system factor contributing to the increase in demand for acute hospital services. This increase was also disproportionately driven by older age groups. It could be speculated that the introduction of short stay observation units have altered the clinical threshold to admit

patients to hospital for safety and quality reasons. This finding is novel and has not been reported previously in the peer-reviewed literature.

Increasing demand for emergency patient services has persisted despite implementation of numerous interventions designed to curb demand over the past decade. For example, the introduction of ambulance service telephone triage to divert non-emergency transportations to alternative services in Chapter 4 was identified to have a 'one-off' effect on the rate of increase of emergency transportations; and it is uncertain what introduction of paramedic capacity to treat and not transport patients has had on transportations. Allied health emergency care teams, case management services and mobile assessment and treatment teams by acute hospitals do not have appeared to have affected the growth in demand. Accessibility to improved emergency care services may have changed the general community's expectations for timely care.

9.3 KEY STRENGTHS AND LIMITATIONS

The strengths and limitations of each study presented in this thesis were discussed in the relevant chapters. This section discusses the broader merits and the limitations of the context and assumptions underlying this thesis.

A key strength of this program of research is its attempt to pull together information about the dynamics of demand through investigation of trends in the utilisation of services across the emergency continuum of care. The inquiry comprised analysis of in excess of 10 million patient episodes: 2.3 million emergency ambulance transportations, more than 7 million ED presentations and 1.9 million admissions to hospital through the ED. Such extensive data is not available in most countries.

Another merit is that the study outcomes are predominantly based on analyses of longitudinal population-based service provider data. This means the results reflect utilisation of emergency health care at a population level over a prolonged period of time. This has not been published in the peer-reviewed literature previously. The data analysed

are routinely collected by Ambulance Victoria, the Victorian Department of Health and the Australian Bureau of Statistics for administrative purposes. The overall quality of the data is verified by these agencies, as described in Chapter 3.

The other strength of this thesis is the robust nature of the epidemiological methods employed in all studies. The use of corresponding annual Estimated Residential Population data ⁴⁵ from the ABS for the administrative data studies in Chapters 4, 5, 6 and 8, enhances accuracy of the yearly rates calculated per 1000 persons, which were also used in the regression modelling undertaken in each study.

This thesis is based on rigorous methods to contribute to research into emergency demand. Other researchers wishing to undertake similar research could use these methods in their own context to expand the evidence-base. Further research will provide an opportunity to test the feasibility of these study findings in different settings.

One of the limitations is that administrative data sets do not provide all the information required to untangle the multifactorial nature of emergency demand. This renders the need for robust qualitative studies to collect information not captured by these data sets, for example: to examine the psychosocial characteristics and healthcare seeking behavioural attributes of patients who do and do not use ambulance / ED services.

In addition, limitations exist in the quality of some variables in the administrative data sets, particularly variables related to clinical conditions or diagnoses. In the case of the AV data, clinical conditions were recorded by call-takers at the time of the initial telephone call to AV. Although this information is coded with guidance by Advanced Medical Priority Dispatch System ⁹⁷, the call-taker is dependent on information provided by the patient or third party calling on the patient's behalf. Coding of the clinical conditions and diagnoses recorded in the Department of Health hospital data sets (VEMD and VAED) is reliant on retrospective analysis of the medical record by clinical coders from the individual hospital health informatics departments. Issues with the VEMD's data quality and consistency, associated with recording information in the frenetic environment of an ED, are well

reported.^{55 98} However the clinical data recorded in the VAED has been assessed to be of better quality.⁹⁹ Possible explanations for this are that the clinical notes are made in the ward and theatre environment, and that funding of the public hospital episode of care is dependent upon this information. The audit process to ensure accuracy of the coding was described in Chapter 3.

This research is based on data from an Australian capital city with a population currently in excess of 4 million people. Therefore the findings may not be generalisable to non-urban areas. However the increase in ambulance utilisation and ED attendances identified in this thesis concur with the international literature as discussed in Chapter 2, alongside rising use by the elderly. The use of ambulance and ED services by older adults in residential care was described in the literature reviews in Chapter 2; however due to limitations of the data regarding place of residence, this was not a focus of this thesis. AV is Melbourne's sole ambulance service provider and almost 90% of patients are transported with no out-of-pocket expenses. The other studies were of data from government funded public hospitals. Therefore the overall findings may not be generalisable to jurisdictions with different funding and emergency health care arrangements.

9.4 RECOMMENDATIONS FOR FUTURE RESEARCH

This thesis has quantified the trends in the increasing utilisation of emergency patient services over a ten-year period, with a focus on the rise in demand for services by older age groups. In the context of an ageing population, it is proposed that the increase in emergency demand will continue to increase, which will require redesign of the current models of emergency healthcare. This thesis provides a baseline upon which further research can be built to guide the development of new responses by government and service providers.

Introduction of the Victorian Ambulance Clinical Information System (VACIS) in 2007 means that a comprehensive set of clinical and demographic data is now being collected

systematically on all patients. This will enable opportunities for future analysis of a more comprehensive range of factors associated with ambulance utilisation. Provision of unique identifiers together with the data available in VACIS will help profile the characteristics of repeat ambulance users in a further study.

Further investigation is recommended to examine the factors that influence lower acuity patients' decisions to seek care from EDs in preference to community-based services. Interviewing adults of all age groups in a future study; in conjunction with primary care and specialist doctor interviews or surveys would provide a wider more balance perspective of access issues to timely health care at time of acute needs. This would expand on the interview study findings in Chapter 7.

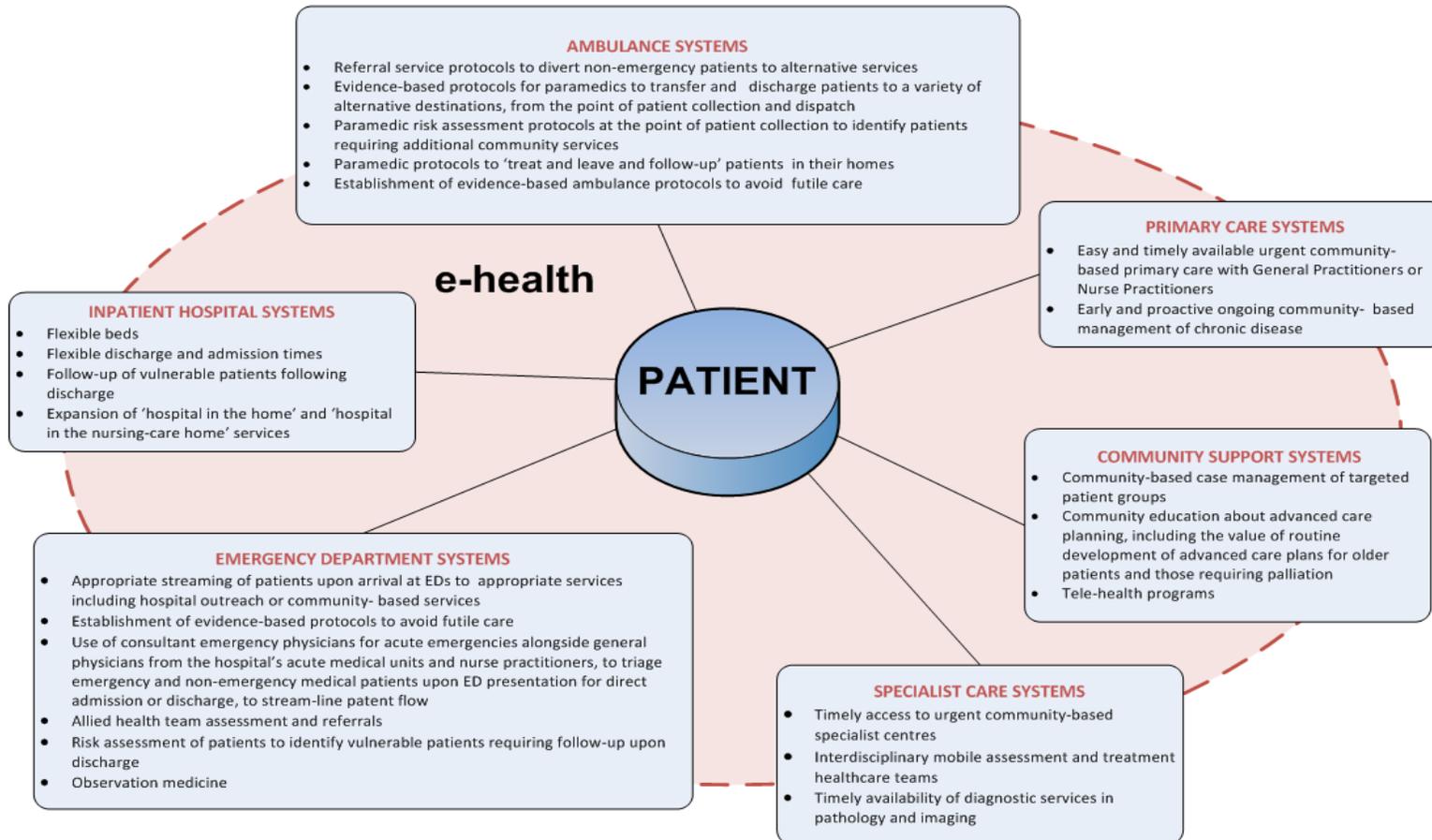
Examination of the clinical acuity and clinical reasons for older frequent ED attendees is recommended. Geographical mapping of the residence of repeat users of both ambulance and of ED services would allow testing of the impact of availability of and access to primary care and other community-based healthcare providers as an alternative source of health care to the ED. In addition, a prospective cohort study following up patients after discharge from ED would provide information about associated risk factors for re-presentation and re-admission.

Finally, the rapid rise in patients admitted to hospital for a single overnight stay identified in Chapter 8, warrants further investigation into whether this is associated with changes in the acute model of care or whether these patients actually warrant hospital admission.

9.5 POTENTIAL IMPLICATIONS FOR THE EMERGENCY CARE SYSTEM

Over the past decade, health departments and service providers have begun investing in intervention programs designed to manage emergency demand. These have included, but are not limited to, the ambulance referral service (outlined in Chapter 5), paramedic protocols to not transport patients or to transport them to alternative services,¹⁰⁰ 24 hour 'Nurse-on-Call' and telephone advice services,^{101 102 103} co-located general practice

Figure 1: Potential Solutions



clinics,¹⁰⁴ walk-in centres and urgent care clinics,¹⁰⁵ mobile outreach teams,¹⁰⁶ and fast track units within EDs.¹⁰⁷ These represent interventions targeting single elements of the emergency care system and have not stemmed the overall increase in demand.

It is unlikely that interventions at a single institution or by a single element of the system will be enough to manage the persisting increase in demand. Potential solutions will require more targeted system-wide interventions, rather than those limited to single components such as ambulances, EDs or hospital beds. Potential interventions, a range of which is outlined in Figure 11, will require formal evaluation. The findings of this thesis provide the baseline against which these interventions can be measured.

9.6 CONCLUSIONS

This chapter reflects on the program of research taken in the course of this thesis and discusses the results, their implications, and recommendations for future research. Understanding the trends and dynamics of emergency demand is essential for the development of effective alternative models of care for patients. This thesis has shown that there has been an acceleration in the numbers and rates of older people transported to EDs, and an increase in the numbers of older individuals repeatedly seeking acute care from the ED. With continued ageing of the population for the foreseeable future, it is highly likely these trends will persist. This creates the imperative for review and redesign of appropriate services for acute care in the community.

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APPENDICES

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APPENDIX 1: ETHICS APPROVALS

1.1 IDENTIFYING THE DRIVERS OF AMBULANCE DEMAND

Human Ethics Certificate of Approval

Date: 24 March 2009

Project Number: CF09/0802: 2009000354

Project Title: Identifying the drivers of emergency ambulance demand

Chief Investigator: Professor John McNeil

Approved: From: 24 March 2009 To: 24 March 2014

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained and a copy forwarded to SCERH before any data collection can occur at the specified organisation. **Failure to provide permission letters to SCERH before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research.**
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by SCERH.
4. You should notify SCERH immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to SCERH and must not begin without written approval from SCERH. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. SCERH should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by SCERH at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.



Professor Ben Canny
Chair, SCERH

cc: Ms Judy Lowthian, Professor Peter Cameron, Professor Just Stoelwinder, Mr Alex Currell

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Administration 03 9840 3500
Facsimile 03 9840 3534www.ambulance.vic.gov.au1st May 2009Ms Judy Lowthian
NHMRC PhD Scholar
Monash University
Level 3, Burnet Building
89 Commercial Road
Melbourne, 3004

File Ref: STR/08/17

Dear Judy

Re: Research Proposal: "R09-004 Increasing demand for emergency patient services: underlying drivers, implications and solutions" Version 2, dated 17 April 2009.

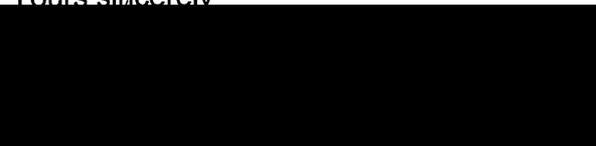
I am pleased to inform you that Ambulance Victoria (AV) has approved participation in the above study subject to ongoing ethics approval from the Monash University Standing Committee on Ethical Research in Humans. Note, that any changes to the original application will require submission of a protocol amendment to the AV Research Committee for consideration. Please ensure that AV is informed of any protocol changes as soon as possible.

You will need to sign a confidentiality agreement (attached) and return it to Marian Lodder prior to obtaining any AV data.

As a component of the ongoing communication processes, AV requires quarterly status reports and a final report on completion of the study. A report on the June 2009 quarter will be due in July 2009. You will be e-mailed a copy of the status report pro-forma with a reminder closer to the date. Status reports are required to be submitted by e-mail.

We look forward to working with you on this important project.

Yours sincerely

**ALEX CURRELL**
Executive General Manager Strategic Planning

1.2 IDENTIFYING THE DRIVERS OF DEMAND FOR EMERGENCY DEPARTMENT SERVICES



Human Ethics Certificate of Approval

Date: 10 March 2010

Project Number: CF10/0157 - 2010000050

Project Title: Identifying the drivers of demand for emergency department services

Chief Investigator: Prof John McNeil

Approved: From: 10 March 2010 to 10 March 2015

Terms of approval

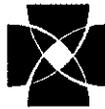
1. The Committee has granted a privacy exemption under the Statutory Guidelines on Research Issued for the purposes of HPP1.1(e)(iii) and 2.2 (g)(iii) – *Health Records Act 2001 (Vic.)*.
2. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research.**
3. Approval is only valid whilst you hold a position at Monash University.
4. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
5. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
6. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
7. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
8. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
9. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
10. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
11. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
12. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.



Professor Ben Canny
Chair, MUHREC

Cc: Judy Lowthian; Prof Peter Cameron; Prof Just Stoelwinder; Dr Vijaya Sundararajan

**1.3 IDENTIFYING THE DRIVERS OF EMERGENCY DEMAND – UNDERSTANDING WHY
PEOPLE COME TO EMERGENCY DEPARTMENTS**



TheAlfred

ETHICS COMMITTEE CERTIFICATE OF APPROVAL

This is to certify that

Project No: 112/11

Project Title: Identifying the drivers of emergency demand - understanding why people come to Emergency Departments

Principal Researcher: Professor Peter Cameron

Protocol No: 1 dated: 04-Mar-2011

Participant Information and Consent Form version 3 dated: 29-Apr-2011

was considered by the Ethics Committee on 28-Apr-2011 and APPROVED on 05-May-2011

It is the Principal Researcher's responsibility to ensure that all researchers associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Secretary of the Ethics Committee, via amendment or progress report, of

- Any significant change to the project and the reason for that change, including an indication of ethical implications (if any);
- Serious adverse effects on participants and the action taken to address those effects;
- Any other unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role, or any other change in research personnel involved in the project;
- Any expiry of the insurance coverage provided with respect to sponsored clinical trials and proof of re-insurance;
- A delay of more than 12 months in the commencement of the project; and,
- Termination or closure of the project.

Additionally, the Principal Researcher is required to submit

- A Progress Report on the anniversary of approval and on completion of the project (*forms to be provided*);

The Ethics Committee may conduct an audit at any time.

All research subject to the Alfred Hospital Ethics Committee review must be conducted in accordance with the National Statement on Ethical Conduct in Human Research (2007).

The Alfred Hospital Ethics Committee is a properly constituted Human Research Ethics Committee in accordance with the National Statement on Ethical Conduct in Human Research (2007).

SPECIAL CONDITIONS

None

SIGNED

Chair, Ethics Committee (or delegate)

**R. FREW
SECRETARY
ETHICS COMMITTEE**

Please quote Project No and Title in all correspondence



Human Ethics Certificate of Approval

Date: 12 May 2011

Project Number: CF11/1280 - 2011000702

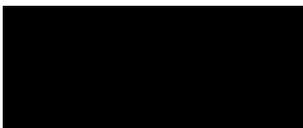
Project Title: Identifying the drivers of emergency demand – understanding why people come to Emergency Departments

Chief Investigator: Prof Peter Cameron

Approved: From: 12 May 2011 to 12 May 2016

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research.**
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. **Complaints:** The researchers are required to inform MUHREC promptly of any complaints made about the project, whether the complaint was made directly to a member of the research team or to the primary HREC.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.



Professor Ben Canny
Chair, MUHREC

cc: Ms Cathie Smith; Prof John McNeil; Prof Just Stoelwinder; Ms Judy Lowthian

1.4 DEPARTMENT OF HEALTH DEED

DEPARTMENT OF HEALTH

CONDITIONS OF RELEASE OF PATIENT LEVEL DATA SETS FROM THE VICTORIAN HEALTH INFORMATION REPORTING SYSTEM (VHIRS) TO EXTERNAL USERS (EXCEPT OTHER VICTORIAN GOVERNMENT DEPARTMENTS)

"Department" means the Department of Health, a Government Department of the State of Victoria.

These conditions relate to the release of patient level data sets from the Victorian Health Information Reporting System (VHIRS) by the Department to **Department of Epidemiology and Preventive Medicine, Monash University**, hereafter named "the recipient", for the purposes of research as specified in the request detailed in "**Identifying the drivers of demand for emergency department services**".

The data are released by the Department in reliance on the recipient agreeing to abide and ensuring that any other persons with access to the data agree to abide, and so abiding, by the following conditions and acknowledgements.

COPYRIGHT

The State of Victoria owns the copyright in the Department's datasets. The recipient(s) of these datasets agree not to reproduce, distribute or commercialise them, or any product or service derived from or incorporating them or part of them (whether or not amounting to copyright reproduction) other than as allowed by these Conditions of Release or with the prior written consent of the State of Victoria.

Where such consent is sought the State of Victoria reserves the right to set an appropriate charge or to require a revenue sharing arrangement.

The recipient(s) is permitted to quote an insubstantial part of the statistical data contained in the datasets (whether or not copyright subsists in the datasets), providing that:

an 'insubstantial part' means a fair dealing as defined in Sections 40, 41, 42 and 43 of the Copyright Act 1968;

the Department is cited as the source of the data used;

the terminology used is that used by the Department for describing data; and

any analysis or transformation of the data is not attributed to the Department.

Where a dataset consists of data in computer readable form, or software, the State of Victoria authorises the recipient(s) to use on a non-transferable and non-exclusive basis, this data or software personally or for internal purposes of its organisation (as the case may be).

The recipient is permitted to publish any analyses of the data but not the data itself, subject to the confidentiality conditions set out below. Any publication must be solely for the purpose specified in the recipient's request for data and the Department must be acknowledged as the data source. The recipient undertakes to consult the Department about the validity and interpretation of any such analyses prior to submitting the results of any such analyses for publication. A copy of any such analyses will be provided to the Department for approval prior to submission for publication.

In these Conditions, 'commercialise' in respect of a product or derivative of that product, means to manufacture, sell, distribute, hire or otherwise exploit a product or process, or to provide a service incorporating the product or any other product or service derived from that product, or to license a third party to do any of these things.

CONFIDENTIALITY

The data must not be used, published or disseminated in a way that might enable the identity of individual patients or the service profiles of individual doctors to be ascertained or published or disseminated in any way that might enable the identity of individual private hospitals to be ascertained. In particular, statistical tables with cells showing between one (1) and four (4) cases must not be published.

The data file is provided solely to the recipient and must not be communicated to other persons or organisations, or linked with files of personal information of other sources, without the prior agreement of the Department.

The data will only be used for the purpose(s) outlined by the recipient in requesting the data or for purposes approved by the Department.

Data files are to be maintained and stored in a secure manner in an environment where they cannot be linked (either electronically or by personal inspection) with other patient records or patient level data or personal information.

When no longer required, the data files are to be destroyed or returned to the Department of Health and the Department is to be notified of such destruction.

~~Not relevant for all agreements. Delete where not applicable.~~

~~Where a public health service or public hospital as defined in Schedules 1 and 5 of the *Health Services Act 1988* (the hospital) is provided with patient level data on patients of other campuses, such data may only be used for the purpose of service planning by the hospital's secretariat (including consultants engaged by the hospital secretariat) or for research projects approved by a Human Research Ethics Committee.~~

The recipient must ensure that all persons to whom data files are made available are aware of the conditions of release including the requirements in relation to the need for confidentiality and the need to comply with them.

LIMITATION OF LIABILITY

The State of Victoria gives no warranty, other than a warranty that may be implied by law, that the products are free from errors, are complete, have any particular quality, are suitable for any purpose or otherwise.

Subject to any warranty, which may be implied by law, the State of Victoria's liability to the recipient(s) for any loss, damage or injury howsoever caused by the State of Victoria, whether due to negligence or otherwise, in relation to a product shall be limited to providing a replacement copy of that product.

INDEMNITY

The recipient(s) of the data indemnifies and shall keep indemnified the State of Victoria and its servants, officers, agents and contractors against any action, claim, suit, demand, or damage, loss, expense or liability (including costs on a solicitor and client basis) caused by or flowing from:

- (a) a breach by the recipient(s) or any personnel employed or retained by the recipients of the data of the conditions on which this data is released;
- (b) any wilful, negligent or unlawful act or omission of the recipient(s) of this data in connection with this data.

It is not necessary for the State of Victoria to make or receive any payment before enforcing such an indemnity.

INSURANCE

The recipient(s) of this information shall ensure that the research activity proposed to be undertaken by the recipient is, on and from the date of receiving this data, insured with:

- (a) public liability insurance coverage with a limit of indemnity of at least \$5 million for any one occurrence; and
- (b) professional indemnity insurance coverage with a limit of indemnity of at least \$2 million for any one claim.

with an insurer(s) authorised under the Insurance Act 1973, and shall provide certificates of currency if the Department so requests.

The insurance policy may be in the recipient's own name or in the name of an organisation that the recipient is affiliated, provided that the policy adequately covers the proposed research activity.

The recipient(s) shall maintain the same level of professional indemnity insurance coverage for no less than 6 years after the date on which the recipient(s) has notified the Department that the data is no longer to be used.

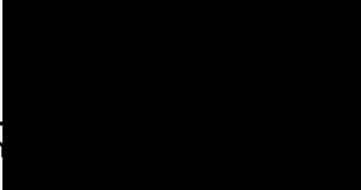
This Deed shall be construed in accordance with the law of the State of Victoria and I submit to the jurisdiction of the courts of Victoria (including the federal courts).

EXECUTED AS A DEED

Dated: 19/4/10

SIGNED SEALED AND DELIVERED by:

(Insert name and title of recipient here)



.....
Sign

Professor Ian Smith
Deputy Dean (Research)
Faculty of Medicine, Nursing & Health Sciences
Monash University

FURTHER INFORMATION

If the recipient wishes to commercialise the product, or reproduce the product other than as permitted by these Conditions, or has any further questions related to these Conditions, they should contact:

Manager, Health Information Provision
Metropolitan Health and Aged Care Services Division
Department of Health
GPO Box 4057
MELBOURNE 3001

Telephone: (03) 9096 0327
Fax: (03) 9096 7764

The recipient is reminded that additional Conditions of Sale or Release may apply to the Department's products.

INDIVIDUAL DE-IDENTIFIED UNIT RECORDS FROM VEMD

DATA FIELDS REQUESTED FOR METROPOLITAN EDs 1999-2009

All data is provided by the data custodian in a de-identified format, and as such will be reported in de-identified format. The researchers will not have access to identifiable personal information, such as names, dates of birth or addresses. All records will be de-identified by the data custodian, prior to release to the researchers. As mentioned, due to the large number of data points requested it is potentially re-identifiable; however as it is being analysed in an aggregated format, the risk of re-identification is very small. In addition, due to the large number of records (~ 10,000,000 patients over ten years) records are not likely to be potentially identifiable by disease and/or geographical areas. Even in cases where diseases are rare and in remote areas, the large volume of patients will make the individual identification of patients impossible.

Campus Code	to breakdown utilisation / trends per hospital / geographical region
Arrival date	to identify any trends by time periods /seasonal variation
Arrival time	to identify any trends by time of presentation
Arrival transport Mode	to compare characteristics of ambulance arrivals versus other means of transport
<u>Patient characteristics:</u>	
Age (in years)	to identify any trends by age group
Sex	to identify any trends by sex
Country of Birth	to identify any trends by country of origin / cultural group
Preferred Language	to examine the possibility of cultural influence, or English as a second language
2 DoH derived variables:	country of origin in an English speaking country & visible difference
SLA, LGA	to examine possible socio-demographic & economic factors & availability of primary care services that may be associated with the patients' residential area
Type of usual accommodation	to examine any association with social support or living alone
Compensation Status	to examine possible association with pricing signals
<u>Clinical characteristics</u>	
Triage category	to identify trends associated with acuity levels
Type of visit presentations	to separate emergency from planned return
Patient Description of injury/event	to ascertain trends in patient reasons for attendance
Diagnosis	to correlate acuity levels with the patients' perceptions of urgency
Additional diagnosis	to provide information about chronic comorbid conditions that may be associated with ED presentation
Human Intent	to identify any trends with self-harm, assault, or adverse events

Procedures	to identify any association with acuity levels or the 'convenience factor' of an ED
Departure Date /Time (LOS)	to identify trends of association of acuity levels with LOS in the ED
Departure Status	to identify trends in destination outcomes of ED visits – admission or discharge home

System issues

Referred by	to explore any association between self- or GP-referral, which may suggest issues with primary care access
Time from arrival to discharge from ED	to explore any association with wait time and leaving without being seen

The emergency admissions from the ED (in the VEMD) will be linked by the DoH to the VAED data set and provided to the researchers in a de-identified format.

The process of linking the data sets together has been separated from the actual process of extracting data for analysis. This means the personal demographic data used by DoH to link the data is generated separately from the process of extracting the healthcare data to be supplied to the researchers. Therefore personal demographic data is only available to the individuals performing the linkage. Once the encrypted linkage key file is created, the personal data is deleted from the demographic file. The linkage specialists may have access to personal information, but do not have access to the actual data files supplied to the researchers, therefore cannot connect a person to any clinical or health-related information. The researchers are the only people who see the clinical data from the linked dataset, which includes a coded project ID and the researchers do not see any personal identifiers.

The DoH performs such data linkages regularly for the purposes of research and regards the issues of privacy and confidentiality highly.

VAED Variables requested for patients admitted from ED (i.e. this is the linked data requested)

i.e. Admission type - type C patient data only (admission via ED)

Care type	to establish if it is related to the nature of the ED attendance
Carer availability	} to examine any association with social support or living
Marital status	} alone
Admission type	to cross check it is an emergency admission
Admission source	to ascertain where patient was residing prior to admission
Duration of stay in ICU	to ascertain if ICU care was needed from ED, to correlate with triage etc
Interpreter required	to correlate with ESL
Preferred language	to correlate with VEMD
LGA	to correlate with the Ambulance data I have (which is by LGA)

SLA	
LOS	to identify any trends with LOS and emergency admissions and specific patient characteristics
Principal diagnosis	}
Other diagnoses	}
Principal procedure	}
	}
DRG diagnostic group	} to provide additional information not identified in the VEMD, to identify trends in emergency admissions related to changes in population health
Separation mode	to ascertain disposition destination following emergency admission

APPENDIX 2: DATA DICTIONARIES

2.1 STUDY 1: EMERGENCY AMBULANCE TRANSPORTATIONS

2.1.1 *Local Government Areas across metropolitan Melbourne where emergency transportations for this study originated from*

Banyule	Bayside	Boroondara	Brimbank
Cardinia	Casey	Darebin	Frankston
Glen Eira	Greater Dandenong	Hobsons Bay	Hume
Kingston	Knox	Manningham	Maribyrnong
Maroondah	Melbourne	Melton	Monash
Moonee Valley	Moorabool	Moreland	Mornington Peninsula
Nillumbik	Port Phillip	Stonnington	Whitehorse
Whittlesea	Wyndham	Yarra	Yarra Ranges

2.2 STUDIES 2 AND 3: EMERGENCY DEPARTMENT ATTENDANCES

2.2.1 *Metropolitan Melbourne Public Hospital Emergency Departments included in this thesis*

Alfred	Angliss	Austin
Box Hill	Casey	Dandenong
Frankston	Maroondah	Mercy Werribee
Monash Medical Centre	Northern	Royal Children’s
Royal Melbourne	Sandringham	St. Vincent’s
Sunshine	Western	Williamstown

2.2.2 Description and Unification of coding of VEMD Variables for analysis

As outlined in Chapter 3, a number of variables from the Victorian Emergency Minimum Dataset (VEMD) were requested from the Department of Health for this study. Variation in categories and definitions over time meant that coding methods used in the analyses needed to be unified. The following pages represent all codes used in the VEMD across the study period. However not all codes were coded in the VEMD each year.

The final variables included in the trend analysis included: age, sex, referral source, arrival mode, triage category, length of stay in the ED, primary diagnostic reason for ED presentation, and discharge destination from the ED.

Variables not included were country of birth, compensation status, preferred language, requirement for an interpreter; as there were no significant changes in the numbers within each code per year over the study period. The geographical area that patients resided in was excluded, as a socioeconomic analysis was not within the scope of this study.

EMERGENCY PRESENTATIONS AND ADMISSIONS STUDIES 2, 3 & 5: CHAPTER 5, 6 & 8

VEMD DEMOGRAPHIC VARIABLES

VEMD DATA FIELD

Variable Name	Newid
Description	Unique patient identifier
Format	numeric
Categories	e.g. 3348584, 12657, etc

Codes derived for purposes of Analysis

Variable Name	Newid
Description	De-identified Dept Health unique patient identifier
Format	numeric
Categories	e.g. 3348584 12657 Etc.

VEMD DEMOGRAPHIC VARIABLES

VEMD DATA FIELD

Variable Name	age
Description	Age in years
Format	string
Categories	e.g. 1, 55,106

Codes derived for purposes of Analysis

Variable Name	age_gp_5yrs	
Description	Age in 5 year age groups	
Format	numeric	
Categories	0	0 - 4 yrs
	5	5 - 9 yrs
	10	10-14 yrs
	15	15-19 yrs
	20	20-24 yrs
	25	25-29 yrs
	30	30-34 yrs
	35	35-39 yrs
	40	40-44 yrs
	45	45-49 yrs
	50	50-54 yrs
	55	55-59 yrs
	60	60-64 yrs
	65	65-69 yrs
	70	70-74 yrs
	75	75-79 yrs
	80	80-84 yrs
	85	≥ 85 yrs

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	age
Description	Age in years
Format	string
Categories	e.g. 1, 55,106

Codes derived for purposes of Analysis

Variable Name	agegp_3	
Description	Age in groups for regression analysis	
Format	numeric	
Categories	0	0 - 4 yrs
	5	5 - 9 yrs
	10	10 - 14 yrs
	15	15 - 19 yrs
	20	20 - 34 yrs
	35	35 - 59 yrs
	60	60 - 69 yrs
	70	70 - 79 yrs
	80	80 - 84 yrs
	85	≥ 85 yrs

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	Sex	
Description	Sex of patient	
Format	string	
Categories	1	male
	2	female
	3	indeterminate (aged <90days)
	4	intersex

Codes derived for purposes of Analysis

Variable Name	sex	
Description	patient gender	
Format	numeric	
Categories	1	male
	2	female

(patients categorised as indeterminate / intersex were dropped for the analysis)

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	country
Description	Country of birth
Format	string
Categories	259 individual codes e.g. 1102/ 11* Victoria / Australia 2101 / 21 United Kingdom 3101/ 4201 Bahrain 4110 / 5105 Vietnam 6101 / 7201 Afghanistan etc.

**These codes change in 2006/2007, requiring further re-coding to unify all years*

Codes derived for purposes of Analysis

Variable Name	cob																												
Description	country of birth																												
Format	numeric																												
Categories	<table> <tr><td>0</td><td>Unknown</td></tr> <tr><td>10</td><td>Oceania</td></tr> <tr><td>11</td><td>Australia</td></tr> <tr><td>13</td><td>New Zealand</td></tr> <tr><td>14</td><td>Micro Polynesia</td></tr> <tr><td>20</td><td>Northern Europe</td></tr> <tr><td>21</td><td>United Kingdom</td></tr> <tr><td>22</td><td>Europe</td></tr> <tr><td>30</td><td>Middle East</td></tr> <tr><td>32</td><td>North Africa</td></tr> <tr><td>41</td><td>Asia</td></tr> <tr><td>71</td><td>USA / Canada</td></tr> <tr><td>80</td><td>South America</td></tr> <tr><td>90</td><td>Africa</td></tr> </table>	0	Unknown	10	Oceania	11	Australia	13	New Zealand	14	Micro Polynesia	20	Northern Europe	21	United Kingdom	22	Europe	30	Middle East	32	North Africa	41	Asia	71	USA / Canada	80	South America	90	Africa
0	Unknown																												
10	Oceania																												
11	Australia																												
13	New Zealand																												
14	Micro Polynesia																												
20	Northern Europe																												
21	United Kingdom																												
22	Europe																												
30	Middle East																												
32	North Africa																												
41	Asia																												
71	USA / Canada																												
80	South America																												
90	Africa																												

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	sla
Description	geographic division of Australia the patient resides in (Statistical Local Area of residence)
Format	string
Categories	1036 individual codes e.g. 20580 Casey 20565 South Melbourne 27071 Whittlesea

Codes derived for purposes of Analysis

Variable Name	SLA
Description	geographic region patient resides in
Format	numeric
Categories	1 Victoria 2 Interstate

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	Us_accom	
Description	Type of accommodation in which patient usually lives	
Format	string	
Categories	1	Private residence – living alone
	2	Private residence – living with others
	3	Residential aged care facility
	4	Boarding / rooming house
	5	Community-based supported residence
	6	Psychiatric hospital
	7	other hospital setting
	8	Homeless shelter
	9	shelter / refuge
	10	Public place (homeless)
	11	Prison / remand centre
	18	Unknown
	19	Other

This variable was introduced in 2003/2004

Codes derived for purposes of Analysis

Variable Name	us_accomm	
Description	Type of accommodation in which patient usually lives	
Format	numeric	
Categories	1	Private home
	2	Residential aged care facility
	3	Community-supported facility
	4	Hospital facility
	5	Homeless
	6	Unknown

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	compens	
Description	compensable status	
Format	string	
Categories	1	Transport Accident Commission
	2	Department of Veteran Affairs
	3	Other compensable status
	4	Workcover
	5	Non-compensable
	6	Medicare / overseas eligible / ineligible hospital exempt
	7	Unknown

Codes derived for purposes of Analysis

Variable Name	comp	
Description	source of compensation for patient presentation	
Format	numeric	
Categories	1	Transport Accident Commission
	2	Department of Veteran Affairs
	3	Other compensable status
	4	Workcover
	5	Non-compensable
	6	Medicare / overseas eligible / ineligible hospital exempt
	7	Unknown

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	referby																																		
Description	source from which patient referred to ED																																		
Format	string																																		
Categories	<table> <tr><td>0</td><td>Staff from this hospital</td></tr> <tr><td>1</td><td>Self / family / friends</td></tr> <tr><td>2</td><td>Local medical officer</td></tr> <tr><td>3</td><td>Outpatient Clinic at any hospital</td></tr> <tr><td>4</td><td>Private specialist</td></tr> <tr><td>5</td><td>ED review from this hospital</td></tr> <tr><td>6</td><td>Transfer from another hospital</td></tr> <tr><td>7</td><td>Nursing Home</td></tr> <tr><td>8</td><td>Prison / person in custodial care</td></tr> <tr><td>9</td><td>Crisis Assessment Team</td></tr> <tr><td>10</td><td>Other community service</td></tr> <tr><td>11</td><td>Hospital in the Home service</td></tr> <tr><td>12</td><td>Ward / Inpatient episode in this hospital</td></tr> <tr><td>13</td><td>Nurse (excluding categories 1 to 10)</td></tr> <tr><td>14</td><td>Nurse-on-call</td></tr> <tr><td>15</td><td>Other Nurse</td></tr> <tr><td>19</td><td>Other</td></tr> </table>	0	Staff from this hospital	1	Self / family / friends	2	Local medical officer	3	Outpatient Clinic at any hospital	4	Private specialist	5	ED review from this hospital	6	Transfer from another hospital	7	Nursing Home	8	Prison / person in custodial care	9	Crisis Assessment Team	10	Other community service	11	Hospital in the Home service	12	Ward / Inpatient episode in this hospital	13	Nurse (excluding categories 1 to 10)	14	Nurse-on-call	15	Other Nurse	19	Other
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14	Nurse-on-call																																		
15	Other Nurse																																		
19	Other																																		

**Codes were added and removed through the 10 years, requiring further recoding and unification of codes*

Derived Codes for Analysis overleaf

Codes derived for purposes of Analysis

Variable Name	ref_sce
Description	referral source for ED presentation
Format	numeric
Categories	1 Self / family / friends 2 Local medical officer 3 Private specialist 4 Community service including correctional service 5 Crisis Assessment Team 6 ED / Hospital 7 Other health service including nursing home, Hospital in the home, nurse-on-call 8 Other

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	preflang
Description	preferred language
Format	string
Categories	87 individual codes
	e.g.
	19 / 1201* English
	62 / 2505 Serbian
	36 / 2401 Italian
	60 / 3402 Russian
	98 / 0002 Not stated
	etc.

**These codes change in 2006/2007 requiring further re-coding for unification of codes*

Codes derived for purposes of Analysis

Variable Name	preflangn
Description	patient's preferred language for communication
Format	numeric
Categories	1 English
	2 Not stated
	3 Other

VEMD DEMOGRAPHIC VARIABLES**VEMD DATA FIELD**

Variable Name	Int_Req	
Description	patient's need for an interpreter as perceived by the person consenting for the patient	
Format	string	
Categories	1	Yes
	2	No
	9	Not stated / inadequately described

**This variable was introduced in 2003/2004*

Codes derived for purposes of Analysis

Variable Name	int_req	
Description	requirement for an interpreter for the patient	
Format	numeric	
Categories	1	Yes
	2	No
	3	Not stated / unknown

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES**VEMD DATA FIELD**

Variable Name	Campus Code
Description	the public hospital 24 hour ED where the patient presented
Format	string
Categories	29 individual codes
	e.g.
	1101 Ararat Hospital
	2440 Latrobe Regional Hospital
	1230 Royal Women’s Hospital etc.

Codes derived for purposes of Analysis

Variable Name	campus
Description	site of ED where presentation occurred
Format	numeric
Categories	1010 The Alfred
	1590 Angliss Hospital – Upper Ferntree Gully
	1031 The Austin Hospital
	1050 Box Hill Hospital
	3660 Casey Hospital
	2110 Dandenong Hospital
	2220 Frankston Hospital
	1210 Maroondah Hospital
	1320 Mercy Werribee Hospital
	1170 Monash Medical Centre
	1280 The Northern Hospital, Epping
	1191 Royal Children’s Hospital
	1334 Royal Melbourne Hospital
	1360 Sandringham & District Memorial Hospital
	1450 St Vincent’s Hospital
	1390 Western Hospital - Sunshine
	1180 Western Hospital - Footscray
	1460 Williamstown Hospital

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES

VEMD DATA FIELD

Variable Name	arr_dt
Description	Date of ED presentation
Format	numeric daily double [%dD_m_Y]
Categories	individual dates coded as follows: e.g. 14609.7

Codes derived for purposes of Analysis

Variable Name	arr_dt
Description	Date of ED presentation
Format	numeric daily double [%dD_m_Y]
Categories	individual dates coded as follows: e.g. 14609.7 – when decoded this represented 31 Dec 1999

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES**VEMD DATA FIELD**

Variable Name	arrtrans	
Description	Arrival transport mode	
Format	string	
Categories	1	Air ambulance
	2	Helicopter
	3	MICA Ambulance
	4	Road Ambulance
	6	Community / public hospital (includes council / philanthropic services)
	7/99	Other, includes private car, walked
	8	Police vehicle
	9	Undertaker
	10	Ambulance service – private ambulance car – contracted by Ambulance Service
	11	Ambulance service – private ambulance car – contracted by a hospital
	19	Other

**These codes changed over time, requiring unification of coding for the final analysis*

Codes derived for purposes of Analysis

Variable Name	arrmode	
Description	mode of transport to ED	
Format	numeric	
Categories	1	air ambulance incl helicopter
	2	emergency ambulance
	3	community services
	4	police
	5	walk-ins
	6	non-emergency ambulance contracted by AV/hospital
	7	undertaker

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES

VEMD DATA FIELD

Variable Name	tricat	
Description	triage category	
Format	string	
Definition	classification according to urgency of need for medical and nursing care, using National Triage Scale (ACEM)	
Categories	1	resuscitation
	2	emergency
	3	urgent
	4	semi-urgent
	5	non-urgent
	6	dead on arrival

Codes derived for purposes of Analysis

Variable Name	triage	
Description	triage category	
Format	numeric	
Definition	triage category of clinical urgency in accordance with Australasian Triage Scale	
Categories	1	resuscitation
	2	emergency
	3	urgent
	4	semi-urgent
	5	non-urgent
	6	dead on arrival

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES

VEMD DATA FIELD

Variable Name	ed_stay
Description	length of Stay in ED
Format	string
Definition	Length of Stay in Emergency Department (dep_dt – arr_dt)
Categories	calculated in minutes e.g. 43, 193 etc.

Please note: the 2002/2003 coding was indecipherable (9.2% of total ED presentations in the 10-year dataset) - so could not be included in any analyses

Codes derived for purposes of Analysis

Variable Name	ED_LOS																		
Description	length of stay in specific time groups																		
Format	numeric																		
Definition	Time spent in the ED, in 4 +hourly increments																		
Categories	<table> <tr> <td>4</td> <td>< 4 hours</td> </tr> <tr> <td>8</td> <td>4 to <8 hours</td> </tr> <tr> <td>12</td> <td>12 to < 24 hours</td> </tr> <tr> <td>24</td> <td>1 to <1.5 days</td> </tr> <tr> <td>36</td> <td>1.5 to <2 days</td> </tr> <tr> <td>48</td> <td>2 to <3 days</td> </tr> <tr> <td>72</td> <td>3 to <4 days</td> </tr> <tr> <td>96</td> <td>4 days</td> </tr> <tr> <td>97</td> <td>> 4 days</td> </tr> </table>	4	< 4 hours	8	4 to <8 hours	12	12 to < 24 hours	24	1 to <1.5 days	36	1.5 to <2 days	48	2 to <3 days	72	3 to <4 days	96	4 days	97	> 4 days
4	< 4 hours																		
8	4 to <8 hours																		
12	12 to < 24 hours																		
24	1 to <1.5 days																		
36	1.5 to <2 days																		
48	2 to <3 days																		
72	3 to <4 days																		
96	4 days																		
97	> 4 days																		

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES**VEMD DATA FIELD**

Variable Name	ed_stay
Description	length of Stay in ED
Format	string
Definition	Length of Stay in Emergency Department (dep_dt – arr_dt)
Categories	calculated in minutes e.g. 43, 193 etc.

Please note: the 2002/2003 coding was indecipherable (9.2% of total ED presentations in the 10-year dataset) - so could not be included in any analyses

Codes derived for purposes of Analysis

Variable Name	ED_los_hrs	
Categories	0	< 4 hours
	4	4 to <8 hours
	8	8 to <12 hours
	12	12 + hours

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES**VEMD DATA FIELD**

Variable Name	TYPEVIS	
Description	Type of Visit	
Format	string	
Definition	Reason patient presents to the ED	
Categories	1	Emergency presentation
	2	Return visit - planned
	3	Unplanned – continuing condition
	4	Outpatient request
	5	Private referral
	8	Pre-arranged admission – clerical, nursing, clinical
	9	Patient in Transit
	10	Dead on arrival

Codes derived for purposes of Analysis

Variable Name	Vis-typ	
Description	Type of ED visit	
Format	numeric	
Definition	reason for ED attendance	
Categories	1	Emergency presentation
	2	Planned return visit
	3	Unplanned return visit
	4	Outpatient request / Private referral /Pre-arranged admission – clerical, nursing, clinical
	5	Patient in Transit
	6	Dead on arrival

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES**VEMD DATA FIELD**

Variable Name	DIAG
Description	Diagnosis
Format	string
Definition	Diagnosis primarily responsible for presentation to the ED
Categories	963 codes e.g. I10 Hypertension, unspecified I104 abdominal colic S628 fracture of wrist I469 cardiac arrest M5499 backache, unspecified

Codes derived for purposes of Analysis

Variable Name	Diag_1
Description	Diagnostic group
Format	numeric
Definition	Diagnostic category of primary clinical reasons for ED attendance, according to ICD-10-AM classifications
Categories	1 Infectious and Parasitic Disease 2 Neoplasm 3 Endocrine, Nutritional & Metabolic Disease 4 Disease of the Blood / Blood Forming Organs 5 Mental / Behavioural Disorder 6 Disease of the Nervous System 7 Disease of the Eye / Adnexa 8 Disease of the Ear / Mastoid processes

Continued overleaf

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES**Codes derived for purposes of Analysis**

Variable Name	Diag_1	(continued)
Description	Diagnostic group	
	9	Disease of the Circulatory System
	10	Disease of the Respiratory System
	11	Disease of the Digestive System
	12	Disease of the Genitourinary System / Breast
	13	Male Genital Organs
	14	Breast
	15	Female genital organs
	16	Pregnancy, Childbirth and the Puerperium
	17	Disease of the skin / subcutaneous tissue
	18	Disease of the Musculoskeletal System / Connective Tissue
	19	Congenital Malformation, Deformation or Chromosomal Abnormality
	20	Condition originating in the perinatal period
	21	Symptoms, Signs, or Abnormal Clinical / Laboratory Findings
	22	Other or Unspecified Effects of External Causes
	23	Factors influencing health status & contact with health services
	24	Injury, poisoning or certain consequences of external causes

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES

VEMD DATA FIELD

Variable Name	DEPSTAT	*
Description	Departure Status	
Format	string	
Definition	Status of patient at departure from the ED	
Categories	0	Aged Care residential facility (includes nursing home, psycho geriatric nursing home, residential care respite bed)
	1	Home / Nursing home
	2	Hospital Admission (to ward, MAPU, HITH, excludes SSOU)
	3	SSOU
	4	Transfer to another hospital
	5	Left at Risk, after treatment started
	7	Died within ED
	8	Dead on arrival
	9	Mental health residential facility (excludes psycho geriatric nursing home)
	10	Left after clinical advice regarding treatment options
	11	Left at own risk, without being seen
	12	Correctional/Custodial Facility
	13	Emergency Medical Unit – excludes MAPU & SSOU
	14	To Ward – MAPU
	15	To Ward – ICU in this hospital
	16	To Ward – Mental health bed in this hospital
	17	Transfer to another hospital – Mental health bed
	18	To Ward – now elsewhere described
	19	Transfer another hospital – excluding MH/CCU/ICU
	20	Transfer another hospital - ICU
	21	Transfer another hospital – CCU
	22	To Ward – CCU in this hospital
	23	Mental health residential facility
	24	Residential care facility
	25	To Ward – mental Health Obs/Assessment Unit

**These codes changed every year in the VEMD*

Derived Codes overleaf

VEMD ED–SPECIFIC ATTENDANCE RELATED VARIABLES**VEMD DATA FIELD****Codes derived for purposes of Analysis**

Variable Name	EDdisp	
Description	Disposition destination	
Format	numeric	
Definition	Disposition / Discharge destination from ED	
Categories	0	Residential Aged Care Facility
	1	Home
	2	Hospital Admission (to ward, MAPU, HITH)
	3	Admission to EMU or SSOU
	4	Admission to ICU or CCU
	5	Hospital transfer
	6	Care facility
	7	Left at Risk
	8	Left without being seen
	9	Died in the ED
	10	Dead on arrival at ED

2.3 STUDY 5 EMERGENCY DEPARTMENT HOSPITAL ADMISSIONS**2.3.1 Metropolitan Melbourne Public Hospitals included in Study 5**

The hospitals used in this analysis were the same as those used in Studies 2 and 3.

Alfred	Angliss	Austin
Box Hill	Casey	Dandenong
Frankston	Maroondah	Mercy Werribee
Monash Medical Centre	Northern	Royal Children's
Royal Melbourne	Sandringham	St. Vincent's
Sunshine	Western	Williamstown

2.3.2 Description and Unification of coding of VEMD Variables for analysis

As outlined in Chapter 3, a number of variables from the Victorian Admitted Episodes Dataset (VAED) were requested from the Department of Health for this study. Variation in categories and definitions over time meant that coding methods used in the analyses needed to be unified. The following Table represents all codes used in the VAED across the study period. However not all codes were coded in the VAED each year.

The final variables included in the analysis included: age, sex, admission type, admission source, principal diagnosis, length of hospital stay, and hospital discharge destination.

Other variables not included were care type, and marital status due to missing data.

EMERGENCY ADMISSION STUDY 5 – CHAPTER 8

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	Newid
Description	Unique patient identifier
Format	numeric
Categories	e.g. 3348584, 12657, etc.

Codes derived for purposes of Analysis

Variable Name	Newid
Description	De-identified Dept Health unique patient identifier
Format	numeric
Categories	e.g.
	3348584
	12657
	etc.

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	age
Description	Age in years
Format	string
Categories	e.g. 1, 55,106

Codes derived for purposes of Analysis

Variable Name	age_gp_5yrs	
Description	Age in 5 year age groups	
Format	numeric	
Categories	0	0 - 4 yrs
	5	5 - 9 yrs
	10	10-14 yrs
	15	15-19 yrs
	20	20-24 yrs
	25	25-29 yrs
	30	30-34 yrs
	35	35-39 yrs
	40	40-44 yrs
	45	45-49 yrs
	50	50-54 yrs
	55	55-59 yrs
	60	60-64 yrs
	65	65-69 yrs
	70	70-74 yrs
	75	75-79 yrs
	80	80-84 yrs
	85	≥ 85 yrs

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	age
Description	Age in years
Format	string
Categories	e.g. 1, 55,106

Codes derived for purposes of Analysis

Variable Name	agegp_3	
Description	Age in groups for regression analysis	
Format	numeric	
Categories	0	0 - 4 yrs
	5	5 - 9 yrs
	10	10 - 14 yrs
	15	15 - 19 yrs
	20	20 - 34 yrs
	35	35 - 59 yrs
	60	60 - 69 yrs
	70	70 - 79 yrs
	80	80 - 84 yrs
	85	≥ 85 yrs

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	Sex	
Description	Sex of patient	
Format	string	
Categories	1	male
	2	female
	3	indeterminate (aged <90days)
	4	intersex

Codes derived for purposes of Analysis

Variable Name	sex	
Description	patient gender	
Format	numeric	
Categories	1	male
	2	female

(patients categorised as indeterminate / intersex were dropped for the analysis)

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	CARE
Description	Care Type
Format	string
Definition	the nature of clinical service provided to an admitted patient during an episode of care
Categories	<ul style="list-style-type: none"> 0 Alcohol and Drug Program 1 Nursing Home Type (NHT) / Non-Acute 2 Designated Rehab - Level 1 4 Other care (Acute) inc Qualified Newborn 5x Approved Mental Hlth/Psychogeriatric Program <ul style="list-style-type: none"> 5A Acute Adult Mental Health Service 5E Mental health secure extended care unit (SECU) 5G Acute Aged Persons Mental Health Service (APMH) 5K Child and Adolescent Mental Health Service (CAMHS) 5S Acute Specialist Mental Health Service 5T Mental health Nursing Home Type 6 Designated Rehab - Level 2 7 Designated Rehab - Level 3 8 Palliative Care Program 9 Geriatric Evaluation and Mgnt Program (GEM) E Interim Care (Introduced 1/7/02). Pub Hospitals only F Interim Care NHT (Introduced 1/7/02). Pub Hospitals only K Non-designated Rehab Program/Unit (= WIES funded) P Designated Paediatric Rehabilitation Unit/Program (07/08) U Unqualified Newborn

Derived Codes overleaf

Codes derived for purposes of Analysis

Variable Name	caretyp	
Description	Care Type	
Format	numeric	
Definition	type of clinical care provided during admitted episode	
Categories	0	Acute
	1	Other

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	MARITAL	
Description	Marital Status	
Format	string	
Definition	Current marital status of the patient at the time of admission	
Categories	1	Never married
	2	Widowed
	3	Divorced
	4	Separated
	5	Married
	6	De Facto
	9	Not stated/inadequately described

Codes derived for purposes of Analysis

Variable Name	mar_stat	
Description	Marital Status	
Format	numeric	
Definition	marital status of the patient at the time of admission	
Categories	1	Never married
	2	Widowed
	3	Divorced
	4	Separated
	5	Married
	6	unknown

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	ADMTYPE	
Description	Admission Type	
Format	string	
Definition	The type of admission relating to this episode of care	
Categories	C	Emergency admission through Emergency Department at this hospital
	L	Admission - from the Waiting List
	M	Maternity
	O	Other emergency admission
	S	Statistical admission (change in Care Type within this hospital)
	X	Other admission
	Y	Birth Episode

Codes derived for purposes of Analysis

Variable Name	admsce	
Description	admission source	
Format	numeric	
Definition	type of admission to hospital	
Categories	1	ED
	2	other

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	ADMSOURC
Description	Admission source
Format	string
Definition	Describes the circumstances of the commencement of an episode of care
Categories	<p>Statistical Admissions (Changes in Care Type at this hospital):</p> <p>0 Change from Alcohol and Drug Program</p> <p>1 Change from NHT/Non-Acute</p> <p>2 Change from Desig Rehab Program/Unit - L1</p> <p>3 Change from Family Choice: Awake Attendant Care</p> <p>4 Change from Other (Acute) Care</p> <p>5 Change from Mental Hlth/Psychogeriatric Program</p> <p>6 Change from Desig Rehab Program/Unit - L2</p> <p>7 Change from Desig Rehab Program/Unit - L3</p> <p>8 Change from Palliative Care Program</p> <p>9 Change from Geriatric Evaluation & Management Program</p> <p>Formal Admissions:</p> <p>A Transfer from mental health residential facility in this hospital</p> <p>C Emergency department of this hospital</p> <p>L Waiting list (public hospitals only)</p> <p>N Transfer from aged care residential facility</p> <p>TΦ Transfer from acute/extended care/rehabilitation/geriatric centre</p> <p>Y Birth episode in this hospital (newborns only)</p> <p>Z Other formal (including private booked patients)</p> <p>Φ Requires an admission transfer code</p>

Derived codes overleaf

Codes derived for purposes of Analysis

Variable Name	admsce	
Description	admission source	
Format	numeric	
Definition	type of admission to hospital	
Categories	1	ED
	2	other

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	TDIAG		
Description	ICD-10-AM Diagnosis		
Format	string		
Definition	Diagnoses code, as reported by the medical practitioner reflecting injuries, disease conditions, patient characteristics and circumstances impacting on this episode of care		
Categories	~7,500 codes		
e.g.	K529	Non-infective gastroenteritis and colitis, unspecified	
	J459	Asthma unspecified	
	T424	Benzodiazepines	
	T04	Crushing injuries involving multiple body regions	

Derived Codes overleaf

Codes derived for purposes of Analysis

Variable Name	Hsp_Diag_1	
Description	Primary diagnostic group	
Format	numeric	
Definition	Diagnostic category of primary clinical reasons for admission to hospital, according to ICD-10-AM classifications	
Categories	1	Infectious and Parasitic Disease
	2	Neoplasm
	3	Endocrine, Nutritional & Metabolic Disease
	4	Disease of the Blood / Blood Forming Organs
	5	Mental / Behavioural Disorder
	6	Disease of the Nervous System
	7	Disease of the Eye / Adnexa
	8	Disease of the Ear / Mastoid processes
	9	Disease of the Circulatory System
	10	Disease of the Respiratory System
	11	Disease of the Digestive System
	12	Disease of the Genitourinary System / Breast
	13	Male Genital Organs
	14	Breast
	15	Female genital organs
	16	Pregnancy, Childbirth and the Puerperium
	17	Disease of the skin / subcutaneous tissue
	18	Disease of the Musculoskeletal System / Connective Tissue
	19	Congenital Malformation, Deformation or Chromosomal Abnormality
	20	Condition originating in the perinatal period
	21	Symptoms, Signs, or Abnormal Clinical / Laboratory Findings
	22	Other or Unspecified Effects of External Causes
	23	Factors influencing health status & contact with health services
	24	Injury, poisoning or certain consequences of external causes

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	LOS
Description	Length of Stay
Format	string
Definition	Length of stay in days (census at midnight)
Categories	Total length of admitted episode in days

Codes derived for purposes of Analysis

Variable Name	LOS
Description	Length of Stay of admitted episode
Format	numeric
Definition	Length of Stay in days (census at midnight)
Categories	Total length of admitted hospital episode in days

VAED – ADMITTED EPISODE RELATED VARIABLES

VAED DATA FIELD

Variable Name	SEPMODE																
Description	Separation Mode																
Format	string																
Definition	Type of separation																
Categories	<table> <tr> <td>A</td> <td>Separation and transfer to mental health residential facility</td> </tr> <tr> <td>B</td> <td>Separation and transfer to Transition Care bed based program (from 1/7/05)</td> </tr> <tr> <td>D</td> <td>Death</td> </tr> <tr> <td>H</td> <td>Separation to private residence/accommodation</td> </tr> <tr> <td>S</td> <td>Statistical Separation (Change in Care Type within this Hospital)</td> </tr> <tr> <td>N</td> <td>Separation and transfer to aged care residential facility</td> </tr> <tr> <td>T<input type="checkbox"/></td> <td>Separation and transfer to other acute hospital/extended care/rehabilitation/geriatric centre <input type="checkbox"/>Requires separation transfer code</td> </tr> <tr> <td>Z</td> <td>Left against medical advice</td> </tr> </table>	A	Separation and transfer to mental health residential facility	B	Separation and transfer to Transition Care bed based program (from 1/7/05)	D	Death	H	Separation to private residence/accommodation	S	Statistical Separation (Change in Care Type within this Hospital)	N	Separation and transfer to aged care residential facility	T <input type="checkbox"/>	Separation and transfer to other acute hospital/extended care/rehabilitation/geriatric centre <input type="checkbox"/> Requires separation transfer code	Z	Left against medical advice
A	Separation and transfer to mental health residential facility																
B	Separation and transfer to Transition Care bed based program (from 1/7/05)																
D	Death																
H	Separation to private residence/accommodation																
S	Statistical Separation (Change in Care Type within this Hospital)																
N	Separation and transfer to aged care residential facility																
T <input type="checkbox"/>	Separation and transfer to other acute hospital/extended care/rehabilitation/geriatric centre <input type="checkbox"/> Requires separation transfer code																
Z	Left against medical advice																

Derived Codes overleaf

Codes derived for purposes of Analysis

Variable Name	dischgetype	
Description	discharge destination from admitted episode	
Format	numeric	
Definition	discharge destination from admitted episode	
Categories	1	funding reclassification
	2	mental health facility
	3	death
	4	home
	5	other
	6	nursing care home
	7	other hospital
	8	left against medical advice

APPENDIX 3: MEDIA INTEREST ASSOCIATED WITH THESIS

- 3.1 *The Age* newspaper, 23 May 2011
- 3.2 *ABC News* radio interview, 23 May 2011
- 3.3 *Australian Policy Online*, 7 June 2011

3.1 THE AGE NEWSPAPER, 23 MAY 2011

THE AGE



PUBLISHED IN MELBOURNE SINCE 1854

MONDAY, MAY 23, 2011

\$1.70

Ambulance trips for elderly soar by 75 per cent

By JULIA MIEDEW
HEALTH EDITOR

VICTORIA'S ambulance service is swamped, with an increasing number of elderly people and the trend is expected to get worse, researchers say.

A study published in the *Medical Journal of Australia* found that the number of ambulance trips involving people aged 85 and over increased 75 per cent between 1994-95 and 2007-08 — an increase beyond that expected with population growth and shifting demographics.

Modelling suggested demand

from the group would continue to accelerate, too, from 474 per 1000 people requiring an ambulance in 2007-08 to about 600 per cent in 2015, a further 69 per cent increase over seven years.

The Monash University researchers said there was no particular ailment responsible for the increase with the most common calls being for falls, chest pain, breathing problems and light-headedness. They said other factors may be driving the rise, though, including reduced capacity among younger people to care for older relatives, a growing proportion of older people

living alone and limited access to primary health-care services such as GPs.

The authors said although a referral service designed to direct non-urgent cases to other health services such as locum GPs had reduced ambulance trips to hospital, it had not slowed the increasing demand from the group over time.

"This shows that service providers and funding agencies across the continuum of emergency health care need to prioritise working together to develop a co-ordinated whole-of-system approach, including innovative

models of out-of-hospital patient-centred care," they wrote in the journal.

The researchers said that in a time of financial constraint, there was an urgent need for a co-ordinated response, including education of emergency health-care workers so they could respond appropriately.

"As numbers and rates of presentations of older patients with complex illnesses and medication regimens increase, the training of emergency healthcare workers must ensure that they are equipped to meet the special care needs of older patients. This

includes acknowledgement of limitations to care, especially with respect to aggressive treatment being inappropriate in very elderly and palliative-care patients," they wrote.

The study follows mounting concern about ambulance delays in Victoria because of soaring demand and insufficient resources. The Age reported last month that after years of worsening performance, ambulance delays for the most urgent "code one" patients had deteriorated this financial year, with some patients waiting close to an hour for paramedics.

6 THE AGE
MONDAY, MAY 23, 2011
NEWS

3.2 ABC NEWS RADIO INTERVIEW, 23 MAY 2011



Ambulance trips for elderly set to rise

Updated 9 hours 54 minutes ago

Researchers predict the number of ambulance trips for elderly Victorians will rise sharply over the next three to four years.

The study by Monash University predicts ambulance trips for people over 85 will double by 2015, compared to 2008 levels.

Judy Lowthian, of Monash University, says that increase will largely be driven by growing use among people over 70.

"More specifically by those aged 85 years and over and those older patients were in fact 8 times more likely to be transported," she said.

She says some factors behind the rise is the reduced capacity for family members to care for elderly relatives, and an increasing proportion of older people living alone.

The research forecasts the number of ambulance trips taken by all age groups will rise from 2008 to 2014 by up to 69 per cent.

Tags: [community-and-society](#), [aged-care](#), [disasters-and-accidents](#), [emergency-incidents](#), [vic](#), [melbourne-3000](#)

First posted 10 hours 2 minutes ago

[MORE stories from Victoria](#)



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3.3 AUSTRALIAN POLICY ONLINE, 7 JUNE 2011

Published on *Australian Policy Online* (<http://www.apo.org.au>)

[Home](#) > The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995–2015

The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995–2015

Creator: [Judy A. Lowthian](#) ^[1]

Creator (other): and others

Over the past 20 years, there has been a sustained rise in demand for emergency ambulance services across the developed world. Growth in emergency transportations is an important determinant of emergency department attendances. In particular, transport of older patients has a significant impact on acute hospital capacity because of high admission rates and long lengths of stay. Resultant pressure compromises access, quality of care and patient safety, with emergency department congestion and overcrowding reported regularly. The strains on ambulance services, however, are less well documented.

Demand on ambulance services encompasses telephone requests via Triple Zero (000) to ambulance call centres, dispatch of paramedics and ambulance vehicles (road and air, emergency and non-emergency), treatment of patients at the scene without transportation, and transport of patients to an emergency department, a non-acute care facility or the patient's place of residence.

To date, researchers and service providers have focused on describing the increasing rate of ambulance use and the effect on response times over short periods. ^[2] Some have examined the influence of demographic and health system dynamics on the use of emergency resources. Two recent reviews have suggested that changes in demographics, population health, health system practices, public expectations and accessibility of ambulance services contribute to rising demand, with population growth and ageing proposed as key drivers. ^[3]

Older people will make up an increasingly larger proportion of the population in the future. About 13% of the population in the United Kingdom, United States and Australia are currently aged over 65 years. It is projected that this will increase to 25% over the next 25 years, with the proportion aged over 85 years rising from 1.6% to around 5%. ^[4]

The authors aimed to measure the growth in emergency road ambulance transportations in metropolitan Melbourne since 1995, to measure the impact of population growth and ageing on these services, and to forecast demand for these services in 2015.

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The challenges of population ageing: accelerating demand for emergency ambulance services by older patients, 1995–2015 [5]

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