



## Demand for Emergency Services Trends in New South Wales Years 2010–2014 (DESTINY): Age and Clinical Factors Associated with Ambulance Transportation to Emergency Departments

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# DEMAND FOR EMERGENCY SERVICES TRENDS IN NEW SOUTH WALES YEARS 2010–2014 (DESTINY): AGE AND CLINICAL FACTORS ASSOCIATED WITH AMBULANCE TRANSPORTATION TO EMERGENCY DEPARTMENTS

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## ABSTRACT

**Objectives:** The study aimed to analyze ambulance transportations to Emergency Departments (EDs) in New South Wales (NSW) and to identify temporal changes in demographics, acuity, and clinical diagnoses. **Methods:** This was a retrospective analysis of a population based registry of ED presentations in New South Wales. The NSW Emergency Department data collection (EDCC) collects patient level data on presentations to designated EDs across NSW. Patients that presented to EDs by ambulance between January 2010 and December 2014 were included. Patients dead on arrival, transferred from another hospital, or planned ED presentations were excluded. **Results:** A total of 10.8 million ED attendances were identified of which 2.6 million (23%) were transported to ED by ambulance. The crude rate of ambulance transportations to EDs across all ages increased by 3.0% per annum over the five years with the highest rate observed in those 85 years and over (620.5 presentations per 1,000 population). There was an increase in the proportion of cate-

gory 1 and 2 (life-threatening or potentially life-threatening) cases from 18.1% to 24.0%. **Conclusion:** Demand for ambulance services appears to be driven by older patients presenting with higher acuity problems. Alternative models of acute care for elderly patients need to be planned and implemented to address these changes. **Keywords:** ambulance; emergency; acuity; transport

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## INTRODUCTION

Ambulance and emergency medical services are a critical part of any modern health system and an important pathway for patients who may need emergency care.<sup>1</sup> Demand for ambulance services has in general paralleled the rapid rise in demand for Emergency Department (ED) care over the past decade.<sup>2</sup> Various factors are thought to be associated with these trends, including the ageing population, out-of-pocket medical expenses for community based care, and accessibility of primary health care services.<sup>3</sup>

The increasing demand for ambulance transfers to ED can result in delays in paramedics' response times to myocardial infarction, cardiac arrest, major trauma, and severe sepsis that can lead to poorer outcomes.<sup>4–8</sup> These delays have raised concerns around the sustainability of current models of acute care. Despite these issues, the drivers of the demand for ambulance transportation to EDs remain poorly understood. Lowthian et al.<sup>9</sup> described the increase in ambulance transportations to EDs across all age groups over a 14-year period, and postulated that the increases in demand, at least in the elderly, were associated with more complex problems such as falls, reduced access to health care during certain hours and lack of social supports.<sup>9</sup> These and other studies have generally used ambulance service databases to describe trends and factors in patient transportations to EDs.<sup>10,11</sup> Investigating cases arriving by ambulance from ED datasets, however, permits an examination of important clinical factors such as ED triage based measures of urgency, and diagnostic categories. Understanding these further allows analysis of the proportions of cases that arrived at an ED by an ambulance within each triage and diagnostic category. This may assist in the identification of the characteristics of patients who may benefit from al-

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ternative models of care, such as paramedic referrals to community-based health care providers, extended care paramedics (ECPs), or transportation to more appropriate healthcare facilities.<sup>12</sup> ECP models and physician led walk in centers have reduced ED attendances in some settings and ultimately allow a more efficient use of ambulance resources.<sup>13–15</sup>

The aim of the present study was to analyze a cohort of patients transported by ambulance to EDs in New South Wales (NSW), Australia, and to identify temporal changes in the demographics, acuity, and clinical diagnoses of these presentations.

## METHODS

The study was approved by the NSW Population Health Services Research Ethics Review Committee.

### Setting and Design

This was a retrospective analysis of a population based registry of ED presentations in NSW, conducted as part of the Demand for Emergency Services in Years 2010–2014 (DESTINY) project.

NSW is the most populous state in Australia with a population of around 7.5 million people and a land area of 850,000 square kilometres.<sup>16</sup> The state is served by a single government-funded ambulance service: NSW Ambulance. In NSW, paramedics may have received a university education or vocational training through three year programs. The service is staffed by over 3,500 paramedics, extended care paramedics, intensive care paramedics, special operations paramedics, counter disaster paramedics, flight nurses, and aero medical physicians. Each year, NSW Ambulance clinicians respond to more than 1.2 million emergency and non-emergency cases.<sup>17</sup> Until 2013, NSW Ambulance paramedics were obliged to transport a patient to an ED if requested to do so by a patient or their relative.

### Database

The NSW Emergency Department Data Collection (EDCC) routinely collects patient level data on 150 of the 186 designated EDs in NSW. The EDDC is managed by the Health System Information and Performance Reporting Branch of the NSW Ministry of Health.<sup>18</sup> The reporting unit of the EDDC is the ED presentation not the individual person, so probabilistic data linkage was used to obtain individual level presentation information. This record linkage was performed by the Centre for Health Record Linkage (CHeReL).<sup>19</sup>

Due to incomplete EDDC data at the beginning of the study period (2010–2011), 35 small rural EDs (level 1 and 2) were excluded from analyses. Data

collection from the remaining 115 EDs includes, referral source (self-referred, General Practice, Specialist, Nursing Home), mode of arrival (self-referral, ambulance), hospital facility, presenting problem, and mode of separation (admitted to hospital, discharged or died). Hospital facilities were classified as per the Ministry of Health definitions for designation of EDs based on case-mix, staffing, and specialist facilities within each hospital.<sup>20</sup> In summary, these range from: Level six centers comprising tertiary level teaching hospitals that are Major Trauma Centers (including two specialist pediatric centers); Level five tertiary non-trauma centers; Level four centers which are mainly Metropolitan District level hospitals; Level three centers which are smaller district and general hospitals; and, level two and one centers which comprise smaller rural multi-purpose and urgent care centers that typically serve many remote regions and accept ambulance transports. ED allocated triage categories allocated by the triage nurse as a measure of urgency were defined by the Australasian Triage Scale (ATS) (1 = immediately life-threatening, 2 = imminently life threatening, 3 = potentially life-threatening, 4 = potentially serious and 5 = less urgent).<sup>21–23</sup> Presenting problems allocated by triage nurses and ED diagnoses entered by clinicians were categorized into broad clinical groups (see Table 1). Full data definitions for the EDDC are located at, <http://www.cherel.org.au/data-dictionaries#section2>

### Study Population

Cases were included in this analysis if the patient presented to an ED by ambulance between January 2010 and December 2014. Cases where patients were dead on arrival, transferred from another hospital, or were planned presentations to ED were excluded. As one patient could have more than one ED presentation during the study period, results are presented as 'cases' or episodes of care. Presentations to EDs with incomplete or missing data during 2010–2014 were also excluded. Patients who did not wait or left before treatment commenced were included.

### Outcome

The outcome of interest was cases where a patient was transported to a NSW ED by ambulance: by age group, triage category and ED diagnostic category. These were expressed as a rate per 1,000 population in NSW. We also examined inpatient admission rates for patients transported to ED by ambulance.

TABLE 1. Classification Of Triage Presenting Problems and Emergency Department (ED) Diagnoses Examples Contained in Dataset

Presenting problem/diagnostic category	ED Diagnosis examples
Abdominal/gastrointestinal	Abdominal pain, gastroenteritis, constipation, vomiting, rectal bleeding
Cardiovascular	Chest pain, atypical chest pain, syncope, atrial fibrillation, palpitations
Respiratory	Upper respiratory tract infection, shortness of breath, asthma, pneumonia, croup, chronic obstructive pulmonary disease
Infection	Viral illness, fever, sepsis, abscess, pyrexia, febrile illness
Injury/musculoskeletal	Head injury, soft tissue injury, laceration, falls, motor vehicle accident
Unwell (general)	Dehydration, generally unwell, lethargy, pain, hyponatremia
Neurology	Headache, seizure, cerebral vascular accident, dizziness, transient ischaemic attack, migraine
Mental health	Schizophrenia, psychosis, suicidal, self-harm, behavioral problems
Toxicology/Drug and alcohol	Alcohol intoxication, drug overdose, opioid dependence,
Ear Nose and Throat, Eye, Oral	Tonsillitis, toothache, epistaxis, dental abscess, Foreign body eye
Administrative procedures and nonurgent reviews	Informal referral signposted to other agency, attends outpatients, wound observation, medication administration,
Urinary, Renal	Urinary tract infection, renal colic, urine retention, hematuria
Social	Social problem, emotional crisis, parental concern of a child,
Endocrine	Hyperglycemia, hypoglycemia, diabetic ketoacidosis, diabetes mellitus
Obstetrics/ gynecology	Threatened miscarriage, miscarriage, bleeding in early pregnancy,
Allergy/Skin	Cellulitis, allergic reaction, skin rash, viral rash
Hematology/Oncology	Anemia, febrile neutropenia, metastatic cancer, lymphadenopathy
Did not wait	Did not wait for treatment, did not attend, left against medical advice
Neonatal	Newborn
Dead	Dead on arrival at hospital, dead, dead-sudden death
Well	Well baby, well adult, no abnormalities, physically well but worried
Uncodeable	Chief compliant, foreign body, other, seen by nurse

### Statistical Analyses

Descriptive statistics were used to compare rates and proportions of cases transported to an ED by an ambulance by age group and triage category respectively. Generalized negative binomial regression was used to estimate the incidence rate ratio (IRR) of ambulance presentations by age groups over the five year period adjusting for yearly increases and changes in broad population age groups (0–9, 10–19 yrs, 20–39 yrs, 40–59 yrs, 60–79 yrs, and 80 years and over), with the reference age category being 40–59 years to represent the “middle-aged” category. Analyses were conducted on SAS Enterprise Guide (SAS Institute, Cary, NC) version 6.1. Annualized rates of change were calculated using the compound change formula  $[(p1/p0)^{1/n}-1]$  and estimated residential population for NSW by age and sex were obtained from the Australian Bureau of Statistics, the national statistical agency, providing official Australian statistics on economic, social, population, and environmental matters.<sup>16</sup>

### RESULTS

Over the study period a total of 10.8 million ED attendances were identified of which 2.6 million (23%) were cases where a patient had been transported to an ED by ambulance. This proportion did not change over the five year period. Of those cases that presented to ED by ambulance, the mean patient age was 57.3 (SD 26.1)

years and 48% of cases were male. Overall 35.9% of cases that arrived at an ED by ambulance were triaged as category 4 or 5; 43.0% as category 3; and 21.0% as the most urgent category 1 or 2 cases. Level 5 or 6 EDs accounted for the largest proportion (61.6%) of ambulance arrival cases followed by Level 3 or 4 EDs (36.0%) and Level 1 or 2 centers (2.3%).

Even though the proportion of ED presentations arriving by ambulance did not change, the crude rate of cases arriving to ED by ambulance across all ages increased from 63.1 to 73.0 per 1000 population between 2010 and 2014, respectively. This represented a 3.0% increase per annum over the five years. Figure 1 demonstrates the age specific rates of cases where a patient arrived at an ED by ambulance per 1,000 pop-

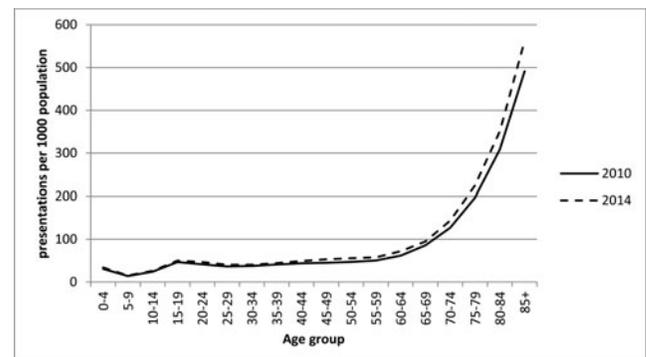


FIGURE 1. Cases transported to NSW EDs by NSW Ambulance, by age groups during 2010 and 2014.

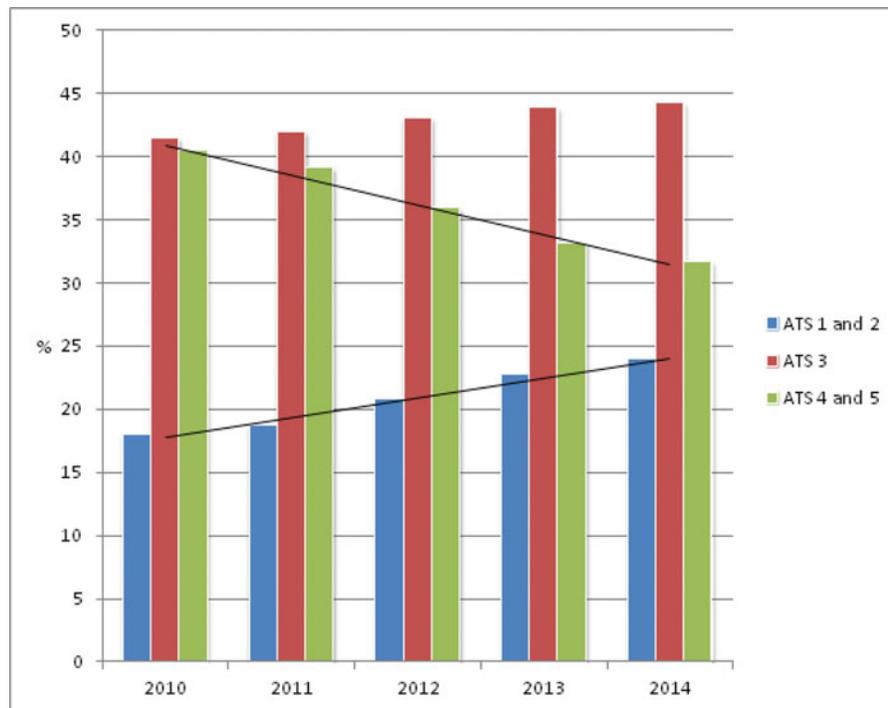


FIGURE 2. Proportion of New South Wales Ambulance arrivals to Emergency Departments with Australasian Triage Scale (ATS) category by year of arrival.

ulation in 2010 and 2014. Overall, the highest rate was observed in those 85 years and over (620.5 presentations per 1,000 population) compared with the lowest rate observed in those between 5 – 9 years of age (15.4 presentations per 1,000 population). Annual rates of increase between 2010 and 2014 for selected age groups were 2.1% (0 – 4 years), 1.4% (30 – 34 years) and 2.7% (85 years and over). After controlling for year and population changes, those cases where patients were over 80 years of age were 10 times more likely to have been transported to hospital by ambulance (IRR 10.3 95% CI 10.0, 10.7  $p < 0.001$ ) compared to those between 40 and 59 years of age.

The overall inpatient admission rate for patients brought to ED by ambulance was 54.6%. This was higher across all triage categories when compared to non-ambulance transported patients: triage category 1 (91.1% vs. 68.9%,  $p < 0.001$ ), triage category 2 (73.5% vs. 52.5%,  $p < 0.001$ ), triage category 3 (57.2% vs. 32.0%,  $p < 0.001$ ), triage category 4 (40.7% vs. 11.4%,  $p < 0.001$ ), triage category 5 (23.5% vs. 3.8%,  $p < 0.001$ ). There was no apparent trend in admission rates by triage category during the study period.

Figure 2 displays the cases arriving in an ED by ambulance across the study period with respect to ATS triage categories. There was an increase in the proportion of category 1 and 2 (life-threatening or potentially life-threatening) cases from 18.1% to 24.0% with a corresponding decrease in the proportion of triage

category 4 or 5 (semi or non-urgent) cases from 40.5% to 31.8% ( $p < 0.001$ ). Triage category 3 cases increased from 41.5% to 44.3% in 2014. Across 2010–2014 there was a 10.4% per annum increase in the rate per 1000 population of cases transported to an ED by ambulance for triage category 1 and 2 cases in the 80 year and over age group (see Figure 3).

Figure 4 shows the relative proportions of each ATS triage category accounted for by major ED diagnostic categories. Injury and musculoskeletal related diagnoses accounted for the highest proportion of those allocated an ATS triage category 4 and 5 whilst cardiovascular and respiratory diagnoses accounted for the highest proportion of those in the more urgent ATS categories of 1, 2, and 3. There was an increase in the proportion of ear nose and throat (including eye and oral diagnoses), skin or allergy, and administrative (including non-urgent procedures) cases with decreasing urgency according to ATS category.

## DISCUSSION

This was a large population based study of cases where a patient was transported to ED by NSW Ambulance over a five year period. Major findings included a significant increase in rates of cases arriving in ED by ambulance that exceeded population increases, particularly for those patients over 80 years of age. There was an increase in the proportion of all ED presentations where the patient had arrived by ambulance

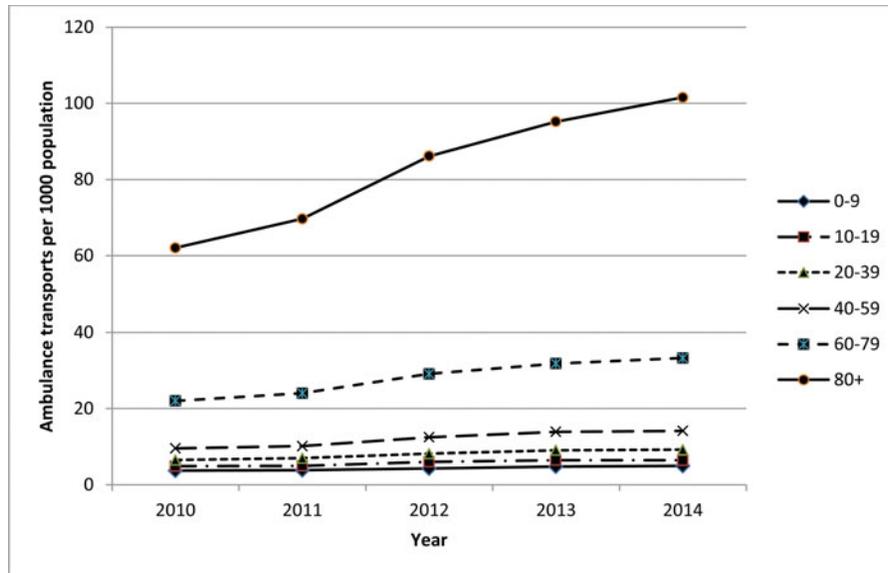


FIGURE 3. ATS 1 and 2 (immediately or imminently life-threatening) cases transported to NSW EDs as a proportion of the NSW population over time: 2010–14.

with high urgency (ATS category 1 and 2) with a corresponding decrease in the proportion of low urgency cases (triage category 4 and 5). Around a third of all cases transported to an ED by ambulance were for low urgency presentations. The rate of increase in overall crude rates of arrivals by ambulance in the present study (3.0%) was lower than the 4.8% per annum in-

crease reported by Lowthian et al. in a study of ambulance presentations to metropolitan EDs in Victoria, Australia between 1994 and 2008.<sup>9</sup>

The findings of this study have important implications regarding how EDs and ambulance services respond to increasing demand and the changing needs of patients as the population ages.

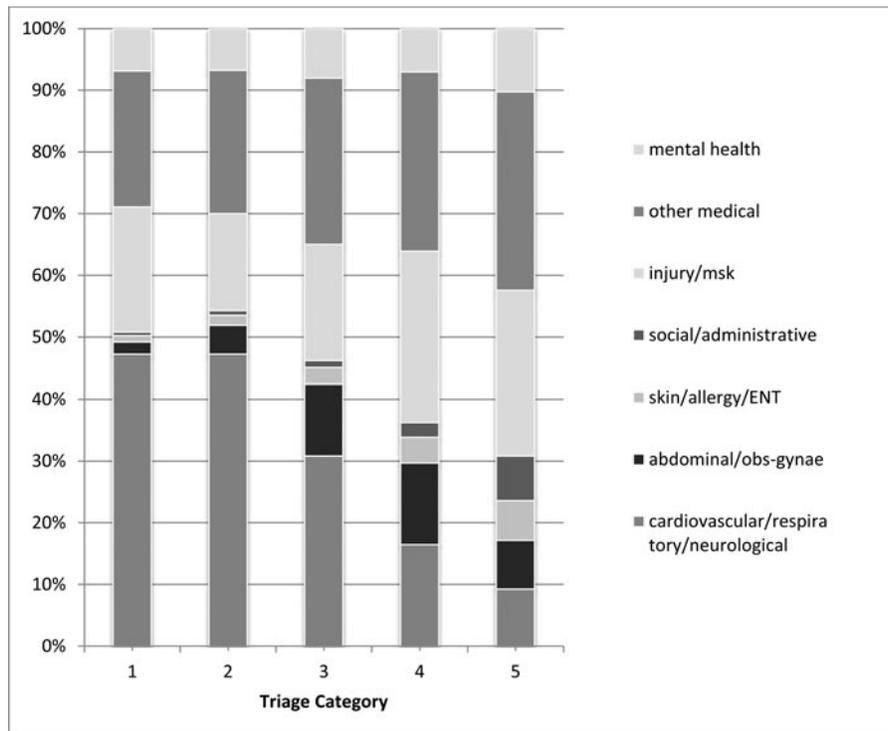


FIGURE 4. Presenting problem types by triage category in Emergency Department patients who arrive by ambulance. Msk = musculoskeletal, ENT = ear nose and throat, obs-gynae = obstetrics and gynaecology.

Increased ambulance transportations to an ED by the elderly, presenting with more acute problems, may be compounded by a lack of social supports and difficulties accessing community-based health care early.<sup>9,24</sup> This is noteworthy as this patient group already has longer lengths of stay and higher in-patient admission rates.<sup>9</sup> The results suggest that the most common diagnostic categories in the elderly who were transported by ambulance were cardiovascular and respiratory (around 30%), with much higher in-patient admission rates for those transported by ambulance. These findings together with a much higher rate of in-patient admissions in the elderly suggest that ambulance presentations in general may have little to do with lack of social supports or access to primary care for the elderly as reported in previous studies.<sup>9,24</sup> An alternative approach to addressing the increased demand in the elderly may be to invest in streamlining care such as geriatric assessment units that focus on medical stabilization rather than more aggressive interventions. Additionally utilizing transitional care beds or residential aged care in-reach services and improving advance care planning is required.<sup>25,26</sup> Further studies are required to investigate the clinical reasons and outcomes of the elderly presenting to EDs with respect to length of stay, disposition and representation rates. This may facilitate different models of acute care that better meet the needs of this patient population.<sup>27,28</sup>

While difficulty accessing primary care may explain higher acuity and unplanned hospital presentations, improving access or considering alternative models of acute care may also prevent worsening clinical states that results in higher acuity transportations to EDs.

The corollary of this is that around a third of all ambulance cases transported to EDs during the study period were triaged as category four and five. The findings indicate that most of these patients were transported with minor injuries, skin, ear, nose, and throat complaints or for minor procedures and social related problems. This supports the findings in an ambulance study where over half of all patients transported did not require any medical assistance or monitoring *en route* to hospital<sup>10</sup>. There is debate in the literature about what constitutes “appropriate” use of ambulances in relation to the perceived “urgency” of the clinical condition, with variable definitions of each described<sup>1</sup>. “Appropriateness” can be evaluated from social or clinical perspectives and although many cases in our study were deemed low acuity, the patient may have required health services that were not available elsewhere, particularly if the incident occurred after-hours or in rural or remote areas. The issue is not whether such “low acuity” patients should be in ED, given the small impact they have on overall ED function<sup>27</sup> but rather whether there are appropriate models of care available to meet these needs. In order to provide the right care in the best place for each

patient and avoid unnecessary transportations to EDs, NSW Ambulance, like many other ambulance services, have implemented a number of models of care that aim to facilitate patient focused care in the best location, including paramedic community referral pathways, and, in appropriate cases, the dispatch of paramedics with extended skills (such as suturing, catheterization, and advanced falls assessment) to assess and treat patients in their home or at a scene.<sup>28,29</sup>

## LIMITATIONS

Trends reported in the present study were limited by the relatively small number (5) of years of analyzed data and incomplete data from the 35 excluded small rural EDs. These centers accounted for 2.3% of all ambulance transportations to an ED and were therefore unlikely to bias or change the estimates of age specific rates reported here. Changes in triage categorization for conditions like chest pain over the study period may have influenced the observed trends. As we did not perform data linkage with ambulance service databases, we were unable to estimate the proportion of ambulance call outs that were treated at the scene and did not require transport to ED. These data would give a more accurate reflection of ambulance service workloads. This study specifically examined ambulance arrivals to EDs and its potential impact on ED workload and case mix. Also, our review did not consider the treatment delivered in the ED, (such as blood tests, radiology) particularly for low acuity cases, and evaluate whether it could have reasonably been provided in an alternative health care setting.

## CONCLUSION

The proportion of cases transported to EDs by an ambulance continued to increase disproportionately to population changes, with the most dramatic increases observed in those presenting with life threatening clinical problems, and those aged 80 years and over. Around a third of all ambulance presentations to ED were classified as low acuity.

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