Research

Characteristics associated with emergency department suitability in low-acuity ambulance cases

Kathryn Eastwood PhD, MEmergHealth(MICA), RN, BSc, CHIA is an intensive care paramedic^{1,2}; Ameer Morgans BSc(Hons), PhD, is Executive Director Operations Support³; Karen Smith BSc(Hons), PhD, is Manager of Research and Evaluation^{1,2}

Affiliations:

¹Department of Epidemiology and Preventive Medicine, The Alfred Centre, Monash University, Melbourne, Victoria

²Ambulance Victoria, Melbourne, Victoria

³Emergency Services Telecommunications Authority, Victoria

<https://doi.org/10.33151/ajp.17.782>

Abstract

Objective

To identify the patient and case characteristics associated with emergency department (ED) suitability of cases referred for emergency ambulance dispatch following ambulance-based secondary telephone triage.

Methods

A retrospective cohort analysis was conducted of secondary telephone triage cases transported to an ED by emergency ambulance between September 2009 and June 2012 in Melbourne, Australia. Patients were considered ED suitable if they were triaged as a category 1, 2 or 3 according to the Australian Triage Scale, were admitted to hospital or referred to another hospital for admission, or died in the ED.

Descriptive statistics and multivariable binary logistic regression analysis were used to identify the variables associated with ED suitability.

Results

There were 2694 (21.2%) cases classified as 'not ED suitable'. The mean age of this group was 51.7 years (SD 23.7 years) and 56.5% were female. Those that were ED suitable were older, with a mean age of 59.1 years (SD 22.6 years) and 53.6% were female. After adjusting for confounders the age ($p<0.001$), pain ($p<0.001$) and triage guideline groups ($p<0.001$) variables had statistically significant relationships with ED suitability. Gender ($p=0.108$), time of day ($p=0.118$), secondary triage call-taker qualification ($p=0.237$) and comorbidities ($p=0.182$) showed no association with ED suitability, and income status was approaching significance (95% CI 0.85–1.02, $p=0.055$).

Conclusion

There are patient and case characteristics associated with ED suitability that could be used to improve patient triage to better match patients with care pathways appropriate to their needs.

Keywords:

health services research; models of care; paramedic; emergency medical services

Corresponding Author: Kathryn Eastwood, Kathryn.Eastwood@monash.edu

Introduction

Increasing demand from cases more suitable for community-based management is a problem for emergency departments (ED) over the world (1-8). Previous attempts to identify ED patients suitable for community-based care have predominantly used the primary diagnosis recorded in medical and insurance claims records (9-12). However, this approach is unreliable in consistently identifying patients (9,13,14), and doesn't include patient characteristics known to be associated with ED use such as age, income, gender, comorbidities, access to general practitioners and presenting problem (5,9,15).

Cases arriving by emergency ambulance are generally accepted as being appropriate for the ED (16), however almost a third are not triaged as an emergency or urgent (17,18). Although there is some contention about the impact of low-acuity patients on the ED (19), the fact remains that many low-acuity ambulance patients do not receive the most appropriate or timely care by presenting at the ED (9), nor are they building relationships with community-based healthcare providers to support their ongoing wellbeing (9).

To better align patients with more appropriate care pathways and avoid medically unnecessary ambulance transport and ED presentations, many ambulance services globally have implemented clinician-led secondary telephone triage services that delve deeper into the patient's presenting problem and current medical and logistical needs (20,21). These services can refer patients to visit community-based healthcare, to home visiting doctors, nurses or allied health professionals, or arrange either emergency (via emergency ambulance) or non-emergency transport (via non-emergency ambulances, taxis or private means) to the ED (21). This has been an effective demand management strategy in the United States, United Kingdom and Australia (20-22). A cost saving of US\$29 million resulted in the UK when 90,000 emergency ambulance calls were diverted away from the ED using a secondary triage response, and 134,935 ambulance unit hours were saved (23). Similarly, a cost saving for an Australian ambulance service alone was US\$28.9 million as a result of secondary telephone triage (24). Studies in the US have found that these systems also produce high levels of patient satisfaction (22). Despite the success of these systems, a study of ED presentations found 22.2% of cases triaged for emergency ambulance dispatch following secondary telephone triage were potentially more suitable for community-based care (19).

Understanding the role of patient and case characteristics identifiable during secondary telephone triage can elucidate the needs of particular patient cohorts facilitating effective matching of the right patient to the right care and contributing to demand management for ambulance services and EDs. It will also highlight gaps in the suite of available alternative care pathways allowing for improvements to be made to encourage patients to source appropriate care in the community and build ongoing

care relationships that avoid deteriorations in patient conditions leading to ED presentations.

This study aimed to identify the patient and case characteristics associated with ED suitability of cases referred for emergency ambulance dispatch following secondary telephone triage.

Methods

Study design

A retrospective cohort analysis was conducted of cases transported to the ED by an emergency ambulance after undergoing secondary telephone triage between September 2009 and June 2012.

Study setting

This study was conducted in Melbourne, Australia's second largest city comprising 4.25 million people in 2012 (25,26). Ambulance Victoria, the sole emergency medical service provider in Victoria, uses the Advanced Medical Priority Dispatch System and an Ambulance Victoria formulated service allocation matrix to triage triple zero calls and respond Advanced Life Support (ALS) paramedics or Intensive Care Paramedics (ICP), depending on patient need. In addition to responding emergency ambulances, Ambulance Victoria operates the 'Referral Service' 24 hours a day, 7 days a week. This service provides a paramedic or nurse-led secondary telephone triage for cases deemed to be low-acuity following primary triage using a computer-based triage algorithm to determine a disposition (21). Low-acuity cases have historically low paramedic treatment and transportation rates and rarely re-present within 24 hours (19,27,28). The final dispositions include self-care advice, a recommendation to present at a community-based health service or hospital, dispatch of alternative service providers such as home-visiting doctors, nurses or hospital outreach programs, or dispatch of a non-emergency or emergency ambulance. The Referral Service has been described elsewhere in detail (21).

Definitions

The ED suitability outcome measure has been utilised in previous research (19). A patient was considered ED suitable if they:

- were triaged as a category 1, 2 or 3 according to the Australian Triage Scale (29)
- were admitted to hospital or referred to another hospital for admission, or
- died in the ED.

ED treatment does not feature in the ED suitability measure as much of the treatment that occurs can be conducted in community-based settings.

'All Victorian ED presentations' included all the Victorian ED presentations in the study timeframe irrespective of their mode of arrival.

Data sources

Referral Service records were linked to corresponding electronic patient care records for cases that were referred for emergency ambulance dispatch. Hospital data was extracted from the Victorian Emergency Minimum Dataset (ED records) and Victorian Admitted Episodes Dataset (admission records). The ambulance data (Referral Service records and electronic patient care records) were linked to the hospital data using deterministic data-linkage methods using ambulance case number, date of birth, Medicare suffix (ie. first three letters of the patient's first given name, address, postal code or locality) and record date within 48 hours of ED arrival. The linkage was validated using gender which identified a mismatch for 2% of the linkages which were discarded (n=856). There were 2300 linkages where the hospital record occurred before the Referral Service triage; these were also discarded.

Procedure

Cases with a Referral Service record and a corresponding ED record were included. The explanatory variables were age, gender, income status, comorbidities, pain score, triage guideline group, time of call and call-taker qualification (Table 1). The 343 Referral Service triage guidelines available to triage patients were consolidated into 44 triage guideline groups to improve model parameter approximations and maintain the predictive power of the logistic regression analysis (30,31). To ensure adequate group populations to reliably identify relationships with the greatest impact, the 20 triage guideline groups with the largest populations were included and comprised 80.4% of the total eligible population.

Table 1. Explanatory variables used in the prediction modelling

Variable name	Reference category
Age	55–59 years of age (contained the mean age for the cases included in this study)
Gender	Male
Income status	The 'above' category
Qualification	ALS paramedics (triaged the largest volume of cases)
Pain level	Mild
Time of day	Day shift
Triage guideline groups	The outcome variable was either ED suitable or not ED suitable. The triage guideline group with the ED suitability rate most similar to all Victorian ED presentations (61.0%) was the back-pain group (66.8%)

Median wage was dichotomised to above and below the metropolitan Melbourne median wage for 2011–2012 (AU\$54,100). Time of day was dichotomised into the two dominant shifts worked by paramedics at the time of the study: day shift (0700–1700 hours) and night shift (1700–0700 hours).

The call-taker qualification level consisted of nurses, ALS paramedics and ICPs. Finally, the 1 to 10 pain scale variable was divided into three categories: mild <3, moderate 3–6, and severe pain 7–10. Local protocols dictated that any patients with pain in the moderate or severe categories should have routinely received analgesia unless the patient declined. The reference categories are listed in Table 1.

Analysis of specific combinations of predictive variable categories was then conducted to determine if these combinations improved the ability to predict ED suitability.

Systematic bias evaluation

A systematic bias evaluation compared cases that had a corresponding ED record to those that did not for cases transported via emergency ambulance. Age, gender and triage guideline group were compared across these groups. The gender distribution did not differ between the ED record and no ED record groups (54.2% and 55.1% respectively; chi-square = 0.773, df=1, p=0.379). However, these groups differed in mean age (57.6 years vs. 64.62 years; t(4475.011) 15.525, p<0.001) and triage guideline groups (chi-square = 94.653, df=19, p<0.001). The most common triage guideline groups for the cases with a corresponding ED record were abdominal pain (17.0%), dizziness and vertigo (11.7%) and back pain (10.4%). For the cases without an ED record, the most common triage guideline groups were abdominal pain (21.5%), back pain (14.1%) and dizziness and vertigo (8.7%). The large sample sizes for these calculations could produce high statistical sensitivity to small distribution differences, which is apparent in the statistical difference in the triage guideline groups.

Statistical analysis

Descriptive statistics and multivariable binary logistic regression analysis were used to identify the variables associated with ED suitability. Explanatory variable assessment for multiple collinearity found no correlations likely to affect the multivariable analysis (32). Pearson's chi-square test of independence compared the ED suitability and admission rates between the age-triage guideline group combination and the age group including all the triage guideline groups. Binomial tests of equality were used to compare ED suitability and admission for the explanatory variable categories to the population mean data (all Victorian ED presentations). All data analysis was performed using SPSS Version 20 (33).

Results

Ambulance Victoria received just over 1 million calls for assistance in metropolitan Melbourne during the study timeframe, and 103,768 (10.0%) of these cases underwent a secondary telephone triage by the Referral Service. A final disposition of emergency ambulance dispatch resulted for 28.5% (n=29,579) of the cases and of these 19,487 (65.9%)

had records indicating the patient was transported to hospital. ED records were linked to 15,825 (81.2%) of these cases. The case selection process resulted in 12,720 cases with ED records being eligible for inclusion (Figure 1). These cases had a mean age of 56.9 years (SD 23.7 years) and 54.3% were female.

Overall, there were 2694 (21.2%) cases classified as 'not ED suitable'. The mean age of this group was 51.7 years (SD 23.7 years) and 56.5% were female. Those that were ED suitable were older, with a mean age of 59.1 years (SD 22.6 years) and 53.6% were female. After adjusting for confounders gender, time of day, Referral Service call-taker qualification and comorbidities showed no association with ED suitability (Table 2), while income status was approaching significance (95% CI 0.85–1.02, $p=0.055$). Only the age, pain and triage guideline group variables had statistically significant relationships with ED suitability (Table 2). Further analysis of these variables identified which of the categories within these variables had a significant relationship with ED suitability (Table 2).

Cases less than 10 years of age and those aged 20–24 years were less likely to be ED suitable than those aged 55–59 years (Table 2). Conversely, cases more than 60 years of age were more likely to be ED suitable than the 55–59 years of age cases (Table 2).

The back-pain triage guideline group had the ED suitability rate closest to all Victorian ED presentations (66.8% vs. 61.0%) and was therefore used as the reference category. A strong positive relationship between triage guideline group categories and ED suitability was expected given the average ED suitability rate for all Referral Service cases referred to the ED was 77.8%. When compared to the back pain reference category, the strongest relationship occurred in the fever category, which was six times more likely to be ED suitable, followed by the confusion/disorientation/agitation triage guideline which was over four times more likely to be ED suitable (Table 2). The chest pain, neurological symptoms/transient ischemic attack (TIA), nausea and vomiting and diabetes-related problems categories were also more likely to be ED suitable, with odds more than three times that of back pain cases (Table 2).

Finally, worsening pain was associated with increasing ED suitability. Overall, this model only explained 7.6% of the variation in ED suitability, but it had good fit (χ^2 6.628, df 8, $p=0.577$), and had 78.7% accuracy in predicting the outcome. The model demonstrated good sensitivity for identifying cases that were ED suitable (99.6%), but poor specificity (1.2%).

The variables and categories with the strongest relationships with ED suitability were patients less than 10 years of age and more than 60 years of age (elderly cases), the pain variable,

Figure 1. Case inclusion flow chart

Table 2. Multivariable analysis of the associations between explanatory variables and ED suitability (continued)

Explanatory variable	Categories	Sample size	% ED suitable	Multivariate logistic regression results			Admission %
				OR (95% CI)	Category p-value	Variable p-value	
Gender	Male	5829	79.9	1	-	0.108	56.1
	Female	6891	77.9	0.93 (0.85-1.02)	0.108		56.4
Age	0–4 years	167	70.1	0.62 (0.41-0.92)	0.019	<0.001	26.3
	5–9 years	115	58.3	0.47 (0.31-0.72)	0.001		35.7
	10–14 years	143	70.6	0.83 (0.55-1.25)	0.362		35.7
	15–19 years	291	70.4	0.77 (0.56-1.05)	0.099		37.8
	20–24 years	444	67.6	0.69 (0.53-0.91)	0.009		40.3
	25–29 years	611	70.2	0.79 (0.61-1.02)	0.065		38.5
	30–34 years	712	73.9	0.97 (0.75-1.24)	0.787		40.0
	35–39 years	753	75.7	1.06 (0.83-1.36)	0.644		48.6
	40–44 years	871	73.8	0.96 (0.76-1.22)	0.753		46.7
	45–49 years	688	78.3	1.20 (0.93-1.56)	0.160		56.5
	50–54 years	633	76.5	1.09 (0.84-1.41)	0.516		56.6
	55–59 years	679	75.1	1	-		55.4
	60–64 years	801	79.9	1.29 (1.01-1.66)	0.045		59.7
	65–69 years	886	84.8	1.75 (1.35-2.26)	<0.001		63.1
	70–74 years	1024	85.0	1.84 (1.43-2.36)	<0.001		65.7
	75–79 years	1453	83.3	1.61 (1.27-2.03)	<0.001		64.6
	80–84 years	1023	85.3	1.98 (1.56-2.52)	<0.001		67.2
	85+ years	1426	83.5	1.74 (1.38-2.20)	<0.001		68.2
Time of day	0700–1859 hours	7796	79.3	1	-	0.118	57.3
	1900–0659 hours	4924	78.0	0.93 (0.85-1.02)	0.118		54.7
Income status	Above median income \$54K	1426	81.3	1	-	0.055	60.2
	Below median income \$54K	11294	78.5	0.87 (0.75-1.003)	0.055		55.8
Pain level	Mild	5258	79.9	1	-	<0.001	57.2
	Moderate	1902	75.1	1.18 (1.02-1.35)	0.023		55.7
	Severe	4221	79.3	1.76 (1.55-2.003)	<0.001		55.1
Triage guideline groups	Abdominal pain	3126	77.8	1.97 (1.71-2.26)	<0.001	<0.001	53.7
	Back pain	1589	66.8	1	-		51.2
	Dizziness/vertigo	937	81.3	2.47 (1.989-3.06)	<0.001		62.6
	Nausea/vomiting	873	82.8	3.09 (2.48-3.85)	<0.001		61.5
	Psychiatric conditions	745	73.8	2.36 (1.89-2.94)	<0.001		40.1
	Fever	728	90.4	6.32 (4.72-8.44)	<0.001		63.7
	Headache	565	80.4	2.50 (1.97-3.18)	<0.001		55.6
	Weakness	555	84.3	2.85 (2.18-3.73)	<0.001		67.4
	Flank pain	528	84.8	2.72 (2.09-3.54)	<0.001		58.7
	Confusion/disorientation/agitation	493	88.4	4.30 (3.15-5.86)	<0.001		68.4
	Hip non-injury	346	72.8	1.10 (0.84-1.43)	0.496		63.3
	Chest Pain/discomfort	325	86.2	3.45 (2.46-4.85)	<0.001		58.5
	Trauma	294	71.8	1.45 (1.09-1.93)	0.011		50.7
	Neurological symptoms/TIA	286	87.4	3.98 (2.73-5.81)	<0.001		66.4
	Urinary problems	275	81.8	2.18 (1.56-3.04)	<0.001		46.2
	Hip Injury	229	82.1	1.90 (1.33-2.73)	<0.001		70.7
	Fainting	211	74.4	2.53 (1.79-3.58)	<0.001		43.6
	Diabetes-related problems	209	85.6	3.42 (2.27-5.17)	<0.001		58.9
	Musculoskeletal other	209	68.9	1.26 (0.91-1.74)	0.162		48.8
	Hypertension	197	74.1	1.49 (1.05-2.11)	0.025		45.7

Table 2. Multivariable analysis of the associations between explanatory variables and ED suitability (continued)

Explanatory variable	Categories	Sample size	% ED suitable	Multivariate logistic regression results			
				OR (95% CI)	Category p-value	Variable p-value	
Referral Service call-taker qualification	Nurse	1754	79.3	1.07 (0.94-1.21)	0.314	0.237	58.4
	Ambulance paramedic	10,595	78.8	1	-		53.1
	ICP	371	76.0	0.86 (0.67-1.11)	0.242		56.0
Continuous variables	Not ED suitable (mean)		ED suitable (mean)				
Comorbidities	2.8	12,720	3.24	1.02 (0.99-1.04)	0.182	0.182	

Table 3. ED suitability and admission rates for the top three triage guideline groups for cases more than 60 years of age and comparisons of these groups to all the cases more than 60 years of age

	Cases more than 60 years of age and:					
	Abdominal pain	All other guidelines	Dizziness and vertigo	All other guidelines	Back pain	All other guidelines
	% (n)	% χ^2 -test p-value	% (n)	% χ^2 -test p-value	% (n)	% χ^2 -test p-value
ED suitability	85.4 (1150)	85.1 χ^2 (1)=0.088 p=0.766	84.4 (688)	85.2 χ^2 (1)=0.348 p=0.555	78.1 (586)	85.9 χ^2 (1)=31.915 p<0.001
Admission	67.2 (903)	68.9 χ^2 (1)=1.400 p=0.237	68.7 (559)	68.6 χ^2 (1)=0.002 p=0.962	68.0 (510)	68.7 χ^2 (1)=1.139 p=0.709

and the fever, chest pain, neurological symptoms/TIA, confusion/disorientation/agitation, diabetes-related problems and nausea and vomiting triage guideline group categories. These relationships underwent further analysis.

The mean age of the 0–4 years cases was 1.6 years, and although 70.1% were ED suitable, this was below the average ED suitability rate for cases transported to hospital after the Referral Service referred them for emergency ambulance dispatch (p=0.001). However, this rate was higher than the ED suitability rate for all Victorian ED presentations in 2011–2012 (p=0.024). The most common triage guideline groups for the ED suitable cases (fever 49.6%, n=58 and nausea and vomiting 23.1%, n=27) were the same as for the 0–4 years age group as a whole (fever 44.9%, n=75 and nausea and vomiting 23.4%, n=39). The rate of ED suitability in the 0–4 years fever triage guideline cases was 77.3% (n=58), and they were more likely to be ED suitable than members of the 0–4 years age group who weren't triaged using this guideline (62.2%; χ^2 (1)=4.338; p=0.037). There was no difference between the 0–4 years nausea and vomiting group and the remaining 0–4 years category with respect to ED suitability (66.7%; χ^2 (1)=0.417; p=0.518).

The mean age for the 5–9 years category was 7.1 years. The ED suitability and admission rates were almost the same as for all Victorian ED presentations (ED suitability: p=0.372; admission: p=0.541). The two most common guidelines used in the 5–9 years category were abdominal pain (53.9%, n=62) and fever (13.0%, n=15). Of the 5–9 years age group, abdominal

pain cases 58.1% (n=36) were considered ED suitable, which was just below the rate for cases in this age category without abdominal pain (61.4%; χ^2 (1)=0.279; p=0.597). The admission rate was slightly higher than average for this age category, at 38.8% (31.6%; χ^2 (1)=0.703; p=0.402). Given the small sample size for the 5–9 years fever guideline group, no further analysis was conducted.

The aggregate ED suitability (85.1%) and admission rates (68.6%) for the cases more than 60 years of age were higher than for all Victoria ED presentation population rates (p<0.001 and p<0.001 respectively). The hospital admission rates increased with age and were nearly double that of all Victorian ED presentations in some categories (Table 2).

The most common triage guideline groups for the cases more than 60 years of age were abdominal pain (18.4%; n=1339), dizziness and vertigo (10.6%; n=771) and back pain (10.0%; n=727). Cases more than 60 years of age triaged under the back-pain triage guideline had a significantly different rate of ED suitability to the remainder of cases more than 60 years of age (Table 3).

The fever, chest pain, neurological symptoms/TIA, confusion/disorientation/agitation, diabetes-related problems and nausea and vomiting triage guideline groups demonstrated ED suitability (p<0.001 for all groups) and hospital admission rates significantly higher than all Victorian ED presentations (p<0.001 for all groups).

The pain variable demonstrated ED suitability rates higher than all Victorian ED presentations in all three pain categories ($p < 0.001$ for ED suitability and hospital admission). Primary pain complaints made up the three most common triage guideline groups in the moderate and severe pain categories (Table 4).

Table 4. Most common triage guideline groups and their outcomes for the three pain categories

Pain category	Most common triage guidelines	ED suitability %	Admission %
Mild pain (pain <3/10)	Dizziness and vertigo (12.9%; n=848)	80.5	62.1
	Psychiatric conditions (10.8%; n=712)	74.4	40.7
	Abdominal pain (10.7%; n=704)	71.7	48.6
Moderate pain (pain 3–6/10)	Abdominal pain (34.1%; n=648)	74.4	54.9
	Back pain (18.2%; n=346)	63.3	48.6
	Flank pain (5.4%; n=102)	80.4	62.7
Severe pain (pain >6/10)	Abdominal pain (42.0%; n=1774)	81.5	55.2
	Back pain (23.0%; n=972)	69.0	52.0
	Flank pain (8.8%; n=373)	89.3	58.7

Discussion

This was the first study to investigate patient or case characteristics associated with ED suitability in cases presenting at the ED by emergency ambulance following ambulance-based secondary telephone triage. Age, pain and triage guideline group were related to ED suitability.

Compared to 55–59 years of age, cases less than 10 years of age were at least 38% less likely to be ED suitable, and cases more than 60 years of age were at least 29% more likely to be ED suitable. Both paediatric and geriatric patients have a propensity for high ED presentations rates (34,35), and a consistent inverse relationship between age and inappropriate health service usage has been detected in many studies (15). Our results are consistent with these findings and suggest that higher ED presentations rates among the elderly are appropriate, however care pathways that avoid the ED could provide more appropriate care to young patients and their parents.

In metropolitan Melbourne hospitals, the ED presentation rates of older adults increased by 72% compared to 59% for younger adults between 1999 and 2009, despite similar population growth rates (36). Drivers of geriatric ED presentation include

comorbidities, access to primary care and social circumstances such as marital status and living alone (15). Although comorbidities were not a significant predictor in this model, prior research indicates it influences decision-making during triage (37,38). On ED presentation, these patients are often more acutely unwell (39,40), undergo more diagnostic testing (41), have longer ED stays (36,40) and higher admission rates than younger populations (36,39,40,42). Despite there being many different measures of ED suitability (15) most older adults have consistently been found to be appropriate for the ED (15,38,42), as was the case in this study. The analysis of the age-triage guideline group sub-cohorts detected no sub-cohort with an ED suitability rate below that of all Victorian ED presentations. Further analysis of patient pathways would establish whether community-based diagnostic testing could support GPs to arrange direct hospital admission, bypassing the ED.

The fever, confusion/disorientation/agitation, chest pain, neurological symptoms, diabetes and nausea and vomiting triage guideline groups showed particularly strong positive associations with ED suitability, and had ED suitability and hospital admission rates well above that of all Victorian ED presentations. Cases triaged with musculoskeletal guideline groups (back pain, hip non-injury, trauma and musculoskeletal other) had lower ED suitability rates than those triaged using medical guidelines, which may reflect the chronic nature of many musculoskeletal problems (43). ED care for back pain is largely limited to diagnostic imaging and pharmacological therapy (44), whereas community-based management can include a range of non-pharmacological care options such as physiotherapy, massage and alternative medicines such as acupuncture (44).

Pain is among the most common reasons for ED presentations (45–47), being responsible for half of all ED presentations in patients with a history of chronic pain (46,48). Nonetheless, it is well established that the ED is not the most appropriate setting for these patients (45,47–49), which can result in inconsistent care, adverse events (43) and the dissuasion of relationships with community-based providers (15). The true ED suitability of pain cases in this study was concealed by the fact that the Australian Triage Scale triages patients presenting with moderate or severe pain to the second and third highest triage categories respectively to facilitate prompt analgesia (29). Patients triaged to these categories were automatically categorised as ED suitable in this study. Further investigation of the ED management of pain cases could inform the identification of suitable alternative care pathways that provide timely pain relief and facilitate more appropriate ongoing management in the community.

The retrospective analysis using predefined variables is a limitation for this study as the variables were not specifically devised to identify relationships. The systematic bias evaluation identified a potential for bias from the cases where corresponding ED records could not be linked (19.9%). The formulation of the ED suitability outcome measure had strengths and limitations. The strength of this measure was

that it was constructed using multiple patient outcomes that occurred during the episode of care, therefore avoiding the problems such as retrospective expert opinion failing to achieve consensus (50). The ED triage categories were based on Australian guidelines, which may differ to those in other countries. Finally, the major strength of this methodological approach is that it, and the ED suitability measure can be applied to any ambulance service irrespective of differences in operational structures.

Conclusion

There are patient and case characteristics associated with ED suitability that could be used to improve patient triage to better match patients with care pathways appropriate to their needs. Identifying cases that are not ED suitable is also useful in identifying gaps in alternative care pathways that could allow for some patients to avoid an unnecessary ED presentation.

Funding

This research did not receive any specific funding.

Competing interests

Dr Eastwood has previously worked for the Ambulance Victoria Referral Service (secondary telephone triage service). Professor Smith is the Manager of Research and Evaluation at Ambulance Victoria. Each author of this paper has completed the ICMJE conflict of interest statement.

Author contributions

KE, AM and KS devised the study. KE conducted the statistical analysis and conducted the data analysis. KE, AM and KS were subject matter experts. KE, AM and KS wrote and edited the paper.

References

1. Redstone P, Vancura JL, Barry D, Kutner JS. Nonurgent use of the emergency department. *J Ambul Care Manage* 2008;31:370-6.
2. Lowthian JA, Curtis AJ, Jolley DJ, et al. Demand at the emergency department front door: 10-year trends in presentations. *MJA* 2012;196:128-32.
3. Yarmohammadian MH, Rezaei F, Haghshenas A, Tavakoli N. Overcrowding in emergency departments: a review of strategies to decrease future challenges. *J Res Med Sci* 2017;22:23.
4. Tenbensel T, Chalmers L, Jones P, et al. New Zealand's emergency department target – did it reduce ED length of stay, and if so, how and when? *BMC Health Serv Res* 2017;17:678.
5. Uscher-Pines L, Pines J, Kellermann A, Gillen E, Mehrotra A. Deciding to Visit the emergency department for non-urgent conditions: a systematic review of the literature. *Am J Manag Care* 2013;19:47-59.
6. Ismail SA, Gibbons DC, Gnani S. Reducing inappropriate accident and emergency department attendances. a systematic review of primary care service interventions. *Br J Gen Pract* 2013;63:e813-20.
7. Schoenfeld EM, McKay MP. Weekend emergency department visits in Nebraska: higher utilization, lower acuity. *J Emerg Med* 2010;38:542-5.
8. Farion KJ, Wright M, Zemek R, et al. Understanding low-acuity visits to the pediatric emergency department. *PLoS ONE* 2015;10:e0128927.
9. Jeffery MM, Bellolio MF, Wolfson J, et al. Validation of an algorithm to determine the primary care treatability of emergency department visits. *BMJ Open* 2016;6:e011739.
10. Ballard DW, Price M, Fung V, et al. Validation of an algorithm for categorizing the severity of hospital emergency department visits. *Med Care* 2010;48:58-63.
11. Wagner N. NYU ED Algorithm: Background/Introduction: NYU Wagner. Available at: <http://wagner.nyu.edu/faculty/billings/nyued-background.php> [Accessed 26 March 2013].
12. Billings J, Parikh N, Mijanovich T. Emergency department use in New York City: a substitute for primary care? Issue brief (Commonwealth Fund) 2000;(433):1-5.
13. Raven MC, Lowe RA, Maselli J, Hsia RY. Comparison of presenting complaint vs discharge diagnosis for identifying “nonemergency” emergency department visits. *JAMA* 2013;309:1145-53.
14. Lowe RA. Updating the emergency department algorithm: one patch is not enough. *Health Serv Res* 2017;52:1257-63.
15. Carret ML, Fassa AC, Domingues MR. Inappropriate use of emergency services: a systematic review of prevalence and associated factors. *Cad Saude Publica* 2009;25:7-28.
16. Nagree Y, Camarda VJ, Fatovich DM, et al. Quantifying the proportion of general practice and low-acuity patients in the emergency department. *MJA* 2013;198:612-5.
17. Lin C-H, Kao C-Y, Huang C-Y. Managing emergency department overcrowding via ambulance diversion: a discrete event simulation model. *J Formos Med Assoc* 2015;114:64-71.
18. Australian Institute of Health and Welfare. Australian hospital statistics 2011-2012 emergency department care. Canberra: AIHW; 2013.
19. Eastwood K, Smith K, Morgans A, Stoelwinder J. Appropriateness of cases presenting in the emergency department following ambulance service secondary telephone triage: a retrospective cohort study. *BMJ Open* 2017;7(10).
20. Eastwood K, Morgans A, Smith K, Stoelwinder J. Secondary triage in prehospital emergency ambulance services: a systematic review. *Emerg Med J* 2014;32:486-92.
21. Eastwood K, Morgans A, Smith K, et al. A novel approach for managing the growing demand for ambulance services by low-acuity patients. *Aust Health Rev* 2016;40:378-84.
22. Gardett I, Scott G, Clawson J, et al. 911 emergency communication nurse triage reduces EMS patient costs and directs patients to high-satisfaction alternative point of care. *Ann Emerg Dispatch Response* 2015;3:8-13.

References (continued)

23. Barron T, Fivaz M, Overton J. Using EMS telephone triage data to assess the amount of ambulance resources saved through telephone triage. 8th European Congress on Emergency Medicine; 28 Sept -1 Oct 2014; Amsterdam 2014.
24. Eastwood K, Smith K, Morgans A, Stoelwinder J, editors. A novel solution for managing the growing demand for ambulance services by low-acuity patients. European Health Management Association: what healthcare can we afford? 2013; Bocconi University Milan, Italy. Belgium: European Health Management Association; 2013.
25. Australian Bureau of Statistics. 3218.0 Regional population growth Australia 2012-2013 Canberra: Australian Government; 2015 [Updated 2015]. Available at: www.abs.gov.au/ausstats/abs@.nsf/Products/3218.0~2012-13~Main+Features~Victoria?OpenDocument#PARALINK3 [Accessed 3 February 2016].
26. Australian Bureau of Statistics. Greater Melbourne (GCCSA) Canberra: Australian Government; 2015 [updated 29 June 2015]. Available at: http://stat.abs.gov.au/itt/r.jsp?RegionSummary®ion=2GMEL&dataset=ABS_REGIONAL_ASGS&geoconcept=REGION&measure=MEASURE&datasetASGS=ABS_REGIONAL_ASGS&datasetLGA=ABS_REGIONAL_LGA®ionLGA=REGION®ionASGS=REGION [Accessed 22 March 2016].
27. Eastwood K, Morgans A, Stoelwinder J, Smith K. Patient and case characteristics associated with 'no paramedic treatment' for low-acuity cases referred for emergency ambulance dispatch following a secondary telephone triage: a retrospective cohort study. *Scand J Trauma Resusc Emerg Med* 2018;26:8.
28. Ambulance Victoria. Delivering our patients the right care, at the right time, at the right place: revised clinical response model evaluation report. Doncaster: 2017. Available at: www.ambulance.vic.gov.au/wp-content/uploads/2017/06/av-revised-clinical-response-model-evaluation-report.pdf
29. Australasian College for Emergency Medicine. Guidelines on the implementation of the Australasian triage scale in emergency department. West Melbourne: 2013 Contract No.: G24. Available at: file:///C:/Users/eastwood/Downloads/G24_04_Guidelines_on_Implementation_of_ATS_Jul-16.pdf [Accessed 3 February 2016].
30. Murad H, Fleischman A, Sadetzki S, Geyer O, Freedman LS. Small samples and ordered logistic regression: does it help to collapse categories of outcome? *Am Stat* 2003;57:155-60.
31. Lund B, Raimi S, editors. Collapsing levels of predictor variables for logistic regression and weight of evidence coding. Midwest SAS Users Group 2012; Minneapolis, MN. Minneapolis, MN 2012.
32. Tabachnick B, Fidell L. Using multivariate statistics. Boston: Pearson; 2001.
33. IBM Corp. IBM SPSS Statistics for Windows. 23.0 edn. Armonk, NY: IBM Corp.; 2015.
34. Berchet C. Emergency care services: Trends, drivers and interventions to manage the demand. In: Division H, editor. Paris: Organisation for Economic Co-operation and Development (OECD); 2015.
35. Anderson A, Roland M. Potential for advice from doctors to reduce the number of patients referred to emergency departments by NHS 111 call handlers: observational study. *BMJ Open* 2015;5:e009444-e.
36. Lowthian J, Curtis A, Stoelwinder J, McNeil J, Cameron P. Emergency demand and repeat attendances by older patients. *Intern Med J* 2013;43:554-60.
37. Townsend CH, Maxwell W, Sears LT. Nurse practitioner patient centered telephone calls in a VA primary care geriatric clinic. *J Am Assoc Nurse Pract* 2001;13:269-75.
38. Latham LP, Ackroyd-Stolarz S. Emergency department utilization by older adults: a descriptive study. *Can Geriatr J* 2014;17:118-25.
39. Baum SA, Rubenstein LZ. Old people in the emergency room: age-related differences in emergency department use and care. *J Am Geriatr Soc* 1987;35:398-404.
40. Biber R, Bail HJ, Sieber C, et al. Correlation between age, emergency department length of stay and hospital admission rate in emergency department patients aged ≥ 70 years. *Gerontology* 2013;59:17-22.
41. Pines JM, Mullins PM, Cooper JK, Feng LB, Roth KE. National trends in emergency department use, care patterns, and quality of care of older adults in the United States. *J Am Geriatr Soc* 2013;61:12-7.
42. Eastwood K, Morgans A, Stoelwinder J, Smith K. The appropriateness of low-acuity cases referred for emergency ambulance dispatch following ambulance service secondary telephone triage: a retrospective cohort study. *PLoS ONE* 2019;14: e0221158. <https://doi.org/10.1371/journal.pone.0221158>.
43. Poulin PA, Nelli J, Tremblay S, et al. Chronic pain in the emergency department: a pilot mixed-methods cross-sectional study examining patient characteristics and reasons for presentations. *Pain Res Manag* 2016;2016:3092391.
44. Nunn ML, Hayden JA, Magee K. Current management practices for patients presenting with low back pain to a large emergency department in Canada. *BMC Musculoskelet Disord* 2017;18:92.
45. Baker K. Chronic pain syndromes in the emergency department: identifying guidelines for management. *Emerg Med Australas* 2005;17:57-64.
46. Cordell WH, Keene KK, Giles BK, et al. The high prevalence of pain in emergency medical care. *Am J Emerg Med* 2002;20:165-9.
47. McLeod D, Nelson K. The role of the emergency department in the acute management of chronic or recurrent pain. *Australas Emerg Nurs J* 2016(1):30-6.
48. Todd KH, Cowan P, Kelly N, Homel P. Chronic or recurrent pain in the emergency department: national telephone survey of patient experience. *West J Emerg Med* 2010;11:408-15.
49. Wilsey BL, Fishman SM, Crandall M, Casamalhuapa C, Bertakis KD. A qualitative study of the barriers to chronic pain management in the ED. *Am J Emerg Med* 2008;26:255-63.
50. Lowe RA, Abbuhl SB. Appropriate standards for 'appropriateness' research. *Ann Emerg Med* 2001;37:629-32.