


Outcomes of paediatric patients who are not transported to hospital by Emergency Medical Services: a data linkage study

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ABSTRACT

Background Data on the safety of non-transport decisions for paediatric patients attended by Emergency Medical Services (EMS) are lacking. We describe the characteristics and outcomes of paediatric non-transported patients in Victoria, Australia.

Methods A retrospective data linkage study of consecutive paediatric (aged <18 years) non-transported patients between January 2015 and June 2019. Patients were linked to ED, hospital admission and death records. Multivariable logistic regression analyses were used to determine factors associated with EMS recontact, ED presentation, hospital admission and an adverse event (death/cardiac arrest, intensive care unit admission or highest ED triage category) within 48 hours of the initial emergency call.

Results In total, 62 975 non-transported patients were included. The mean age was 7.1 (SD 6.0) years and 48.9% were male. Overall, 2.2% recontacted the EMS within 48 hours, 13.7% self-presented to a public ED, 2.4% were admitted to hospital and 0.1% had an adverse event, including two deaths. Among patients with paramedic-initiated non-transport (excluding transport refusals and transport via other means), 5.6% presented to a public ED, 1.1% were admitted to hospital and 0.05% had an adverse event. In the overall population, an abnormal vital sign on initial assessment increased the odds of hospital admission and an adverse event. Among paramedic-initiated non-transport cases, cases occurring in the early hours of the morning (04:00–08:00 hours) were associated with increased odds of subsequent hospital admission, while the odds of ED presentation and hospital admission also increased with increasing prior exposure to non-transported cases.

Conclusion Adverse events were rare among paramedic-initiated non-transport cases. Vital sign derangements and attendance by paramedics with higher prior exposure to non-transported cases were associated with poorer outcomes and may be used to improve safety.

INTRODUCTION

Demand for Emergency Medical Services (EMS) has increased internationally and exceeds the growth rate of the population.¹ Existing studies report such increases to be driven by patients with non-urgent medical conditions and those not requiring medical intervention from paramedics.^{1–3} Such demand pressures have led to increased referral pathways, including referral to alternative health services at the point of telephone triage⁴ and by

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Paediatric patients present unique safety and assessment challenges to Emergency Medical Services, and transport rates to hospital vary internationally; however, the safety of non-transport decisions in this population has not been well explored.

WHAT THIS STUDY ADDS

⇒ This large data linkage study of paediatric patients who were attended but not transported to hospital by Emergency Medical Services indicates low rates of adverse outcomes.
 ⇒ Vital sign derangements and attendance by paramedics with higher exposure to non-transport cases were associated with poorer outcomes.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Understanding the clinical and paramedic factors associated with adverse outcomes in this patient cohort will inform EMS policies to improve patient safety.

EMS in the field.⁵ International data indicate that many patients are not transported to hospital after EMS attendance, although non-transport rates vary internationally from 4% to 94%.⁶

For paediatric patients, non-transport rates also vary, ranging from 13% to 46%.^{7–10} Up to 10% of all out-of-hospital emergencies involve paediatric patients.^{8–9} As such, EMS exposure to younger patients is infrequent. Paediatric patients present unique safety and assessment challenges,¹¹ and the safety of non-transport decisions in this population has not been well explored. Some studies report ED presentation rates of between 4% and 35% within 2 days of an EMS non-transport.^{7–9 12} However, these studies are limited by small sample size or have limited generalisability to international settings due to differing EMS skill sets and systems. As such, further exploration of the outcomes of non-transported paediatric patients is warranted.

Using a linked dataset from Victoria, Australia, we sought to assess patient outcomes within a large cohort of paediatric patients who were attended by EMS but not transported to hospital. We also describe patient, clinical and paramedic factors



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Table 1 Baseline characteristics according to documented non-transport reason

	Overall*	Transport not required	Transported by other means	Referred to GP/ Another provider	Transport refused
	N=62 975	N=30 789	N=9451	N=11 254	N=9171
Age category, n (%)					
0–11 months	8337 (13.2)	4177 (13.6)	1340 (14.2)	1410 (12.5)	1124 (12.3)
1–4 years	20476 (32.5)	9136 (29.7)	3931 (41.6)	3888 (34.5)	3007 (32.8)
5–11 years	15 111 (24.0)	7439 (24.2)	2196 (23.2)	2841 (25.2)	2103 (22.9)
12–17 years	19051 (30.3)	10037 (32.6)	1984 (21.0)	3115 (27.7)	2937 (32.0)
Male gender, n (%)					
	30 343 (48.9)	16 104 (52.3)	4454 (47.2)	5694 (50.6)	4689 (51.1)
Hour of day, n (%)					
00:00–04:00	7516 (11.9)	3364 (10.9)	1257 (13.3)	1418 (12.6)	1256 (13.7)
04:00–08:00	3988 (6.3)	1556 (5.1)	571 (6.0)	1126 (10.0)	613 (6.7)
08:00–12:00	8685 (13.8)	4357 (14.2)	1099 (11.6)	1824 (16.2)	1068 (11.7)
12:00–16:00	12 874 (20.4)	6633 (21.5)	1715 (18.2)	2274 (20.2)	1703 (18.6)
16:00–20:00	14 918 (23.7)	7674 (24.9)	2265 (24.0)	2290 (20.4)	2132 (23.3)
20:00–00:00	14 994 (23.8)	7205 (23.4)	2544 (26.9)	2322 (20.6)	2399 (26.2)
Weekend, n (%)					
	18 688 (29.7)	9346 (30.4)	2993 (31.7)	2868 (25.5)	2785 (30.4)
Remoteness Index, n (%)					
Major city	46 300 (77.8)	21 749 (72.7)	7427 (80.1)	9659 (86.9)	7306 (81.6)
Inner regional area	11 383 (19.1)	6837 (22.9)	1670 (18.0)	1341 (12.1)	1475 (16.5)
Outer regional area/Remote	1825 (3.1)	1340 (4.5)	175 (1.9)	110 (1.0)	174 (1.9)
Missing (%)	5.5	2.8	1.9	1.3	2.4
EMS dispatch code, n (%)					
Time critical (lights and sirens)	35 978 (57.2)	18 032 (58.6)	5269 (55.8)	6657 (59.2)	5546 (60.6)
Urgent	20 998 (33.4)	10 128 (32.9)	3401 (36.0)	3556 (31.6)	3021 (33.0)
Non-urgent	5924 (9.4)	2591 (8.4)	776 (8.2)	1026 (9.1)	590 (6.4)
Missing (%)	0.1	0.1	0.1	0.1	0.2
Case nature, n (%)					
Medical	34 283 (57.2)	14 160 (47.2)	6033 (64.8)	8082 (72.6)	5746 (63.4)
Trauma	16 170 (27.0)	9265 (30.9)	2585 (27.8)	1958 (17.6)	2277 (25.2)
Other	9526 (15.9)	6557 (21.9)	690 (7.4)	1092 (9.8)	1035 (11.4)
Missing (%)	4.8	2.6	1.5	1.1	1.3
Paramedic diagnosis, n (%)					
Mental health/Social/Behavioural issue or Alcohol/ Drug problem	6602 (10.8)	4203 (13.7)	526 (5.6)	967 (8.6)	823 (9.0)
Respiratory condition	6879 (11.2)	2324 (7.6)	1755 (18.6)	1639 (14.6)	1155 (12.6)
Neurological condition	4566 (7.5)	1897 (6.2)	513 (5.4)	818 (7.3)	1321 (14.4)
Infection	6881 (11.2)	2179 (7.1)	1521 (16.1)	2078 (18.5)	1094 (11.9)
Gastrointestinal/Genitourinary condition	2350 (3.8)	960 (3.1)	407 (4.3)	675 (6.0)	308 (3.4)
Other medical condition	5502 (9.0)	2653 (8.6)	827 (8.8)	1163 (10.3)	842 (9.2)
Musculoskeletal issue/Traumatic injury	7563 (12.4)	3790 (12.3)	1775 (18.8)	1043 (9.3)	940 (10.3)
Pain	4118 (6.7)	1745 (5.7)	751 (8.0)	891 (7.9)	726 (7.9)
No problem identified	13 339 (21.8)	9355 (30.4)	840 (8.9)	1575 (14.0)	1548 (16.9)
Unknown problem	3438 (5.6)	1683 (5.5)	536 (5.7)	405 (3.6)	414 (4.5)
Paramedic intervention, n (%)					
	5728 (9.4)	2493 (8.1)	1404 (14.9)	989 (8.8)	822 (9.0)
Abnormal vital sign, n (%)					
	15 454 (24.5)	7283 (23.7)	2610 (27.6)	2662 (23.7)	2664 (29.0)

*Includes 2108 patients for whom 'not transported reason' is unknown. Proportions exclude missing data.
EMS, emergency medical services; GP, general practitioner.

which are associated with patient outcomes following a non-transport decision.

METHODS

Study design

We performed a retrospective data linkage study of consecutive paediatric (<18 years) patients attended by EMS in Victoria, Australia between January 2015 and June 2019 who were not transported to hospital. Patients were linked to hospital ED and

admission datasets as well as state death records using deterministic linkage, allowing for fuzzy matching on patient names. The linkage process has been described in detail previously.¹³ We excluded patients who died at scene, were for palliative care only or who had missing identifiers precluding linkage.

Setting

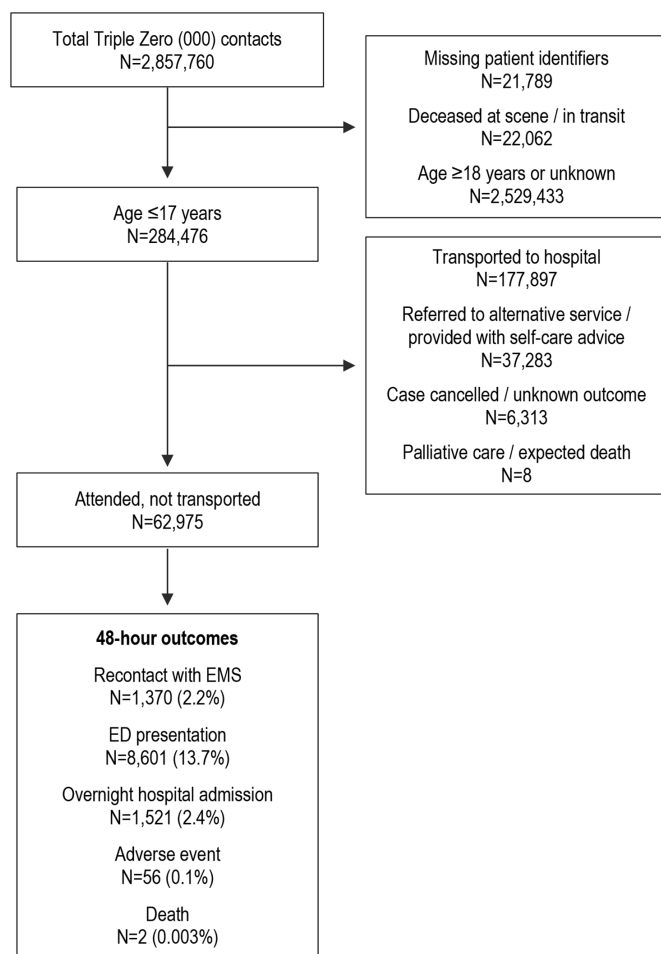
Ambulance Victoria is the single state-wide EMS in Victoria, Australia which has a population of >6.5 million people. More

Table 2 Paramedic crew characteristics according to non-transport reason

	Transport not required (n=30 789)	Transported by other means (n=9451)	Referred to GP/Another provider (n=11 254)	Transport refused (n=9171)
Age, mean (SD)	36.8 (8.3)	36.0 (8.0)	35.2 (7.6)	34.8 (7.6)
Highest experience level of attending paramedics, n (%)				
0–3 years	5660 (19.0)	1981 (21.7)	2567 (23.8)	2368 (26.8)
4–10 years	13 479 (45.2)	4303 (47.2)	5403 (50.1)	4366 (49.4)
≥11 years	10 689 (35.8)	2831 (31.1)	2812 (26.1)	2104 (23.8)
Number of cases attended in preceding 12 months, mean (SD)*	356.2 (153.0)	365.1 (151.2)	379.1 (140.7)	377.3 (137.6)
Number of paediatric cases attended in preceding 12 months, mean (SD)*	36.1 (16.5)	37.7 (16.4)	39.7 (15.8)	39.1 (15.2)
Number of non-transported cases attended in preceding 12 months, mean (SD)*	73.9 (39.2)	75.8 (38.1)	79.3 (36.5)	75.1 (34.3)
Missing crew data, (%)†	5.4	4.7	4.1	4.1

*Excludes 2015 calendar year due to unavailable 2014 exposure data. Proportions exclude missing data.
†Applies to all variables presented in this table.
GP, general practitioner.

than 5 million people reside in the capital city of Melbourne. Emergency phone calls are made to Triple Zero (000) and are triaged by non-medically trained call-takers using the Medical Priority Dispatch System.¹⁴ The EMS is two-tiered, with ALS and intensive care paramedics responding to medical emergencies. Non-transport decisions are made by paramedics on-scene

**Figure 1** Linkage flow chart. EMS, emergency medical services; ED, emergency department.

following patient assessment. Senior paramedic advice is available via radio or telephone if required. Reasons for no transport are documented in electronic patient care records. The EMS is funded through the Victorian state government and subscription fees. Ambulance treatment is free for subscribers and patients with private health insurance or concession entitlements. For other patients, the cost of treatment varies according to transport decision. EMS attendance without transport costs \$A550, while attendance with transport can cost between \$A1200 and \$A1800. During the study period, the EMS did not have a specific clinical guideline governing non-transport decisions and referral pathways for paediatric patients.

Data sources

EMS data sources

At the conclusion of each case, paramedics complete an electronic patient care record containing patient, case and clinical details. Data from these records are uploaded to a clinical data warehouse. For this study, data relating to paediatric non-transported patients were extracted for analysis. These data were linked to the Victorian Ambulance Cardiac Arrest Registry, which is maintained by the EMS and captures Utstein-style data for all out-of-hospital cardiac arrests attended by EMS in Victoria.¹⁵

Data linkage with hospital and death index data

The EMS dataset was provided to the Centre for Victorian Data Linkage for linkage with three state administrative datasets at the patient level, including:

1. Victorian Emergency Minimum Dataset, which contains administrative and clinical data related to ED presentations at 39 public hospitals in Victoria. These 39 hospitals receive >95% of all ambulance transports to public hospitals.
2. Victorian Admitted Episodes Dataset, which captures demographic, clinical and administrative data relating to each admitted episode of care occurring in public and private hospitals, as well as rehabilitation centres, extended care facilities and day procedure centres.
3. Victorian Death Index, which captures the date and cause of all deaths in Victoria.

Non-transported patients were linked to ED presentations occurring within 48 hours of the emergency call. If multiple ED presentations or EMS calls existed within the 48-hour period,

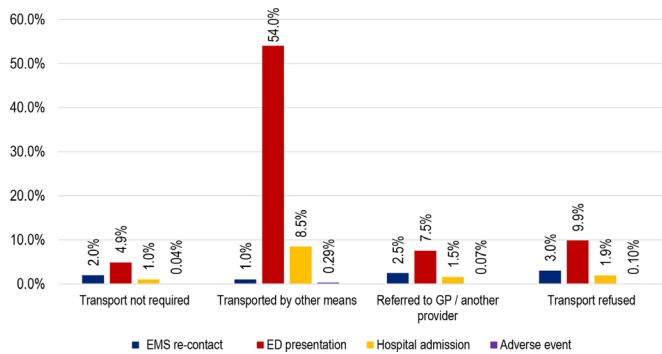


Figure 2 Patient outcomes within 48 hours of the emergency call. GP, general practitioner; EMS, emergency medical services; ED, emergency department.

the episodes occurring closest in time were linked. Hospital admissions occurring up to 48 hours after the emergency call were linked to EMS data. Where multiple admitted episodes or EMS calls were recorded within the 48-hour period, the episodes occurring closest in time were linked. Deaths occurring within 48 hours were linked to the final EMS record for the patient.

Definitions

The index non-transport event was defined as an ambulance attendance which did not result in transport to hospital. Paramedic-initiated non-transported cases documented as ‘transport not required’ or ‘referred to general practitioner (GP)’. ‘Transport not required’ is documented when the patient is determined not to require further assessment at an ED. ‘Transport by other means’ is documented when the planned course of action for the patient, as agreed between the paramedics and the child’s parent or guardian, is transport to an ED via private vehicle. ‘Transport refused’ is documented when the parent or guardian refuses transport. In some situations, mature minors (usually aged 16–17 years) may also have decision-making capacity. Consistent with state-wide health guidelines, paediatric patients were classified into four age categories (0–11 months; 1–4 years; 5–11 years; 12–17 years). Age-specific abnormal vital sign ranges were derived based on Clinical Practice Guidelines (online supplemental table 1). The weekend included Saturdays and Sundays. The Accessibility and Remoteness Index of Australia, a measure of relative access to services, was used to describe the geographical remoteness of a patient’s residential address.¹⁶ The highest experience level of the paramedics on-scene reflects the number of years of employment of the longest-serving paramedic. Recontact with the EMS was defined as a Triple Zero (000) call occurring within 48 hours of the index non-transport case. Patients who self-presented to hospital prior to recontacting EMS were not considered a recontact for this analysis. ED triage category classifies a patient’s clinical acuity using the Australasian Triage Scale.¹⁷ Hospital admission was defined as an overnight admission and therefore excluded admissions to ED Short Stay Units and day-only admissions. Hospital diagnosis was defined using the International Classification of Disease Chapters. The primary diagnosis on admission was used for admitted patients, while the primary ED diagnosis was used for patients discharged from the ED. An adverse event was defined as either death, cardiac arrest, triage category 1 (resuscitation) on presentation at an ED, or intensive care unit admission within 48 hours of the non-transport episode.

Statistical analyses

Categorical data are presented as frequencies and proportions. Continuous data are presented as mean and SD or median and first and third quartiles, as appropriate. The average number of cases attended by the paramedic crew in the preceding 12 months was calculated as the total number of cases attended by all paramedics at the case during the 12-month period, divided by the total number of paramedics at the case. The number of these cases that involved paediatric patients and non-transport was also calculated.

The primary outcome was an adverse event occurring within 48 hours of the index non-transport episode. Secondary outcomes included: recontact with the EMS, ED presentation or a hospital admission, each occurring within 48 hours of the index episode. We used a 48-hour follow-up period as existing evidence suggests that longer periods are more likely to be influenced by factors unrelated to the index episode.¹⁸ Patient outcomes are presented as proportions according to non-transport reason. Multivariable logistic regression analyses were performed to understand factors associated with the primary and secondary outcomes. Models were adjusted for all patient and paramedic characteristics presented in tables 1 and 2, except for paramedic case exposure in the preceding 12 months due to unavailable 2014 data. For all models, Remoteness Index (major city vs other), case dispatch code (time critical vs other) and case nature (medical vs other) were dichotomised. Missing data were assumed to be missing at random and were excluded.

We conducted two preplanned supplementary analyses. For both, the primary outcome was not modelled due to the small number of adverse events. In the first analysis, we investigated factors associated with each secondary outcome among the subgroup of paramedic-initiated non-transported cases (ie, excluding patients transported via other means or refusing EMS transport). In the second analysis, we investigated the influence of paramedic exposure within the paramedic-initiated non-transport cohort using a 3.5-year period (January 2016 to June 2019). These models included paramedic exposure to: (1) all cases; (2) paediatric cases and (3) non-transported cases in the preceding 12 months. Results are presented as adjusted ORs and 95% CIs.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

A total of 2857760 Triple Zero (000) calls were received during the 4.5-year study period, of which 62975 non-transported paediatric patients were included in the analysis (figure 1).

Patient characteristics

The mean age was 7.1 (SD 6.0) years, 48.9% were male and 77.8% of cases occurred in major cities (table 1). The majority (57.2%) of cases were medical in nature and 24.5% had at least one abnormal vital sign on initial assessment. The most common paramedic diagnosis was ‘no problem identified’ (21.8%), followed by musculoskeletal/traumatic injuries (12.4%), respiratory conditions (11.2%) and infections (11.2%). Transport was refused in 14.6% of cases. Patients documented as not requiring transport were less likely to have a respiratory condition or infection and were more likely to have ‘no problem identified’ listed as their paramedic diagnosis. Patients attended in major cities were more likely to be referred to their GP, while regional

Table 3 Multivariable analyses of factors associated with patient outcomes within 48 hours of the emergency call

	Recontact	ED presentation	Hospital admission	Adverse event
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Male gender	1.04 (0.93 to 1.17)	1.05 (0.99 to 1.11)	1.07 (0.96 to 1.20)	0.91 (0.53 to 1.56)
Patient age				
0–11 months	Ref	Ref	Ref	Ref
1–4 years	0.94 (0.75 to 1.16)	0.92 (0.84 to 1.00)	0.58 (0.50 to 0.68)	0.47 (0.23 to 0.98)
5–11 years	1.05 (0.84 to 1.32)	0.71 (0.64 to 0.78)	0.45 (0.38 to 0.54)	0.24 (0.09 to 0.64)
12–17 years	1.53 (1.21 to 1.92)	0.68 (0.61 to 0.76)	0.48 (0.40 to 0.59)	0.61 (0.24 to 1.56)
Hour of day				
00:00–04:00	1.29 (1.03 to 1.60)	1.13 (1.01 to 1.26)	0.71 (0.57 to 0.88)	0.76 (0.28 to 2.05)
04:00–08:00	1.39 (1.08 to 1.79)	1.11 (0.97 to 1.26)	1.24 (0.99 to 1.56)	1.09 (0.37 to 3.24)
08:00–12:00	1.25 (1.01 to 1.55)	1.13 (1.02 to 1.26)	1.34 (1.11 to 1.62)	1.07 (0.43 to 2.68)
12:00–16:00	Ref	Ref	Ref	Ref
16:00–20:00	1.23 (1.02 to 1.49)	1.10 (1.01 to 1.20)	0.98 (0.82 to 1.16)	0.42 (0.15 to 1.15)
20:00–00:00	1.19 (0.98 to 1.43)	1.19 (1.09 to 1.30)	0.83 (0.69 to 0.98)	0.94 (0.42 to 2.07)
Weekend	0.97 (0.85 to 1.10)	1.04 (0.98 to 1.10)	1.00 (0.89 to 1.13)	0.67 (0.35 to 1.28)
Major city residential address	0.85 (0.74 to 0.98)	0.96 (0.90 to 1.03)	0.95 (0.83 to 1.09)	1.10 (0.54 to 2.22)
Time-critical dispatch code	0.75 (0.66 to 0.85)	0.91 (0.85 to 0.97)	0.91 (0.81 to 1.03)	1.36 (0.73 to 2.54)
Medical case nature	1.75 (1.47 to 2.07)	1.23 (1.12 to 1.34)	2.22 (1.85 to 2.66)	0.83 (0.37 to 1.85)
Paramedic diagnosis				
No problem identified	Ref	Ref	Ref	Ref
Mental health/Social/Behavioural issue or Alcohol/Drug related	2.07 (1.65 to 2.60)	0.96 (0.83 to 1.13)	1.63 (1.20 to 2.20)	1.85 (0.51 to 6.70)
Respiratory condition	1.15 (0.90 to 1.48)	1.96 (1.74 to 2.20)	1.31 (1.05 to 1.65)	1.68 (0.56 to 5.07)
Neurological condition	1.87 (1.48 to 2.37)	1.10 (0.95 to 1.28)	0.98 (0.73 to 1.32)	1.56 (0.39 to 6.19)
Infection	1.41 (1.12 to 1.78)	1.85 (1.64 to 2.07)	1.58 (1.27 to 1.96)	1.65 (0.54 to 5.02)
Gastrointestinal/Genitourinary condition	1.21 (0.88 to 1.66)	1.98 (1.70 to 2.31)	2.00 (1.53 to 2.61)	1.20 (0.23 to 6.16)
Other medical condition	0.82 (0.62 to 1.08)	1.52 (1.34 to 1.73)	1.19 (0.92 to 1.53)	1.66 (0.53 to 5.25)
Musculoskeletal issue/Traumatic injury	0.70 (0.51 to 0.95)	2.62 (2.33 to 2.95)	1.98 (1.53 to 2.56)	0.17 (0.02 to 1.57)
Pain	0.61 (0.43 to 0.85)	2.17 (1.89 to 2.48)	1.70 (1.28 to 2.25)	1.63 (0.41 to 6.45)
Unknown problem	1.23 (0.87 to 1.74)	1.82 (1.55 to 2.13)	1.55 (1.15 to 2.10)	2.43 (0.68 to 8.67)
Paramedic treatment provided	1.14 (0.91 to 1.42)	1.25 (1.14 to 1.37)	1.26 (1.04 to 1.52)	1.91 (0.76 to 4.79)
Abnormal vital sign	1.00 (0.87 to 1.15)	1.05 (0.99 to 1.12)	1.23 (1.09 to 1.39)	2.22 (1.25 to 3.95)
Documented non-transport reason				
Transport not required	Ref	Ref	Ref	Ref
Transported by other means	0.49 (0.39 to 0.62)	19.06 (17.75 to 20.46)	7.59 (6.56 to 8.78)	7.33 (3.46 to 15.52)
Referred to GP/Another provider	1.19 (1.02 to 1.39)	1.36 (1.24 to 1.49)	1.24 (1.02 to 1.51)	1.82 (0.71 to 4.65)
Transport refused by patient/Carer	1.42 (1.22 to 1.66)	1.97 (1.80 to 2.16)	1.79 (1.47 to 2.18)	2.16 (0.85 to 5.50)
Highest experience level of crew (per year)	1.00 (0.99 to 1.01)	1.00 (1.00 to 1.00)	1.00 (0.99, 1.01)	1.00 (0.97, 1.04)

ED, emergency department; GP, general practitioner; Ref, reference.

patients were more likely to be documented as not requiring transport.

Paramedic crew characteristics

Crews with up to 3 years of experience were more likely to refer the patient to their GP or to document a refusal of transport (table 2). Crews in which the longest-serving paramedic had been employed for 11 years or more were more likely to record transport as not being required or transport via other means.

Patient outcomes

Patient outcomes are presented in figure 1 and figure 2 according to non-transport reason. Overall, 2.2% of patients recontacted the EMS within 48 hours, 13.7% self-presented to an ED, 2.4% were admitted to hospital and 0.1% had an adverse event. Two deaths were identified, one which was documented as being transported to hospital via other means, and one which was referred to a GP. In total, 54.0% of patients who planned to go to hospital via other means were linked to a public ED attendance and 8.5% were admitted within 48 hours. Among paramedic-initiated non-transports, 5.6% presented to an ED, 1.1% were admitted to hospital and 0.05% had an adverse

event. For reference, among paediatric patients who were documented as being transported to a public ED, 82.4% were linked to a public ED record.

For patients who were admitted to hospital or self-presented to the ED after their index non-transport episode, hospital outcomes are presented in online supplemental table 2. The most common diagnoses were injuries, respiratory disorders and symptoms not otherwise classified. ED length of stay was longest for patients who were referred by paramedics to their GP. Among the patients who recontacted EMS within 48 hours of the index non-transport episode, 62.3% (n=853) were transported to hospital on re-attendance. ED outcomes were available for 759 (89.0%) of these patients (online supplemental table 3). Most patients were discharged home from the ED with symptoms not otherwise classified, respiratory disorders or injuries.

Multivariable analyses

In comparison to cases where transport was not required, transport to hospital via other means was associated with reduced odds of EMS recontact (OR 0.49, 95% CI 0.39 to 0.62), and increased odds of ED presentation (OR 19.06, 95% CI 17.75 to 20.46), hospital admission (OR 7.59, 95% CI 6.56 to 8.78)

Table 4 Multivariable analyses of factors associated with patient outcomes within 48 hours of the emergency call among paramedic-initiated non-transport, including paramedic exposure

	Recontact	ED presentation	Hospital admission
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Male gender	1.14 (0.97 to 1.34)	1.06 (0.96 to 1.18)	1.20 (0.96 to 1.50)
Patient age			
0–11 months	Ref	Ref	Ref
1–4 years	0.99 (0.73 to 1.33)	0.77 (0.66 to 0.90)	0.54 (0.40 to 0.73)
5–11 years	1.09 (0.80 to 1.48)	0.54 (0.45 to 0.65)	0.32 (0.22 to 0.46)
12–17 years	1.62 (1.19 to 2.21)	0.71 (0.59 to 0.86)	0.31 (0.21 to 0.47)
Hour of day			
00:00–04:00	1.34 (1.00 to 1.80)	1.00 (0.82 to 1.21)	0.89 (0.58 to 1.34)
04:00–08:00	1.13 (0.78 to 1.62)	1.15 (0.93 to 1.43)	1.61 (1.07 to 2.42)
08:00–12:00	1.28 (0.97 to 1.70)	1.13 (0.95 to 1.34)	1.30 (0.90 to 1.89)
12:00–16:00	Ref	Ref	Ref
16:00–20:00	1.31 (1.02 to 1.68)	1.03 (0.88 to 1.20)	1.02 (0.72 to 1.44)
20:00–00:00	1.18 (0.92 to 1.53)	0.92 (0.78 to 1.09)	0.56 (0.38 to 0.83)
Weekend	0.96 (0.80 to 1.14)	1.01 (0.91 to 1.14)	0.99 (0.77 to 1.27)
Major city residential address	0.71 (0.59 to 0.87)	0.79 (0.70 to 0.91)	0.75 (0.56 to 1.00)
Time-critical dispatch code	0.77 (0.65 to 0.91)	0.93 (0.84 to 1.04)	0.95 (0.74 to 1.21)
Medical case nature	1.50 (1.20 to 1.87)	1.41 (1.21 to 1.64)	2.38 (1.68 to 3.36)
Paramedic diagnosis			
No problem identified	Ref	Ref	Ref
Mental health/Social/Behavioural issue or Alcohol/Drug related	1.92 (1.44 to 2.56)	0.85 (0.66 to 1.10)	1.82 (1.06 to 3.13)
Respiratory condition	1.19 (0.85 to 1.66)	1.45 (1.18 to 1.79)	1.57 (1.03 to 2.38)
Neurological condition	1.96 (1.43 to 2.69)	0.87 (0.65 to 1.15)	0.81 (0.43 to 1.54)
Infection	1.56 (1.15 to 2.12)	1.93 (1.59 to 2.34)	1.84 (1.24 to 2.74)
Gastrointestinal/Genitourinary condition	1.21 (0.79 to 1.84)	1.75 (1.35 to 2.26)	2.01 (1.22 to 3.30)
Other medical condition	0.85 (0.59 to 1.23)	1.28 (1.03 to 1.59)	1.14 (0.71 to 1.85)
Musculoskeletal issue/Traumatic injury	0.58 (0.38 to 0.89)	2.54 (2.08 to 3.10)	2.23 (1.36 to 3.66)
Pain	0.48 (0.28 to 0.80)	2.22 (1.77 to 2.79)	1.71 (0.94 to 3.10)
Unknown problem	1.11 (0.68 to 1.82)	1.46 (1.08 to 1.98)	1.55 (0.82 to 2.91)
Paramedic treatment provided	1.16 (0.87 to 1.56)	1.38 (1.17 to 1.63)	1.85 (1.28 to 2.67)
Abnormal vital sign	0.92 (0.76 to 1.12)	1.07 (0.94 to 1.21)	1.16 (0.91 to 1.50)
Documented non-transport reason			
Transport not required	Ref	Ref	Ref
Referred to GP/Another provider	1.19 (0.99 to 1.42)	1.46 (1.31 to 1.64)	1.22 (0.96 to 1.56)
Highest experience level of crew (per year)	1.01 (1.00 to 1.02)	1.01 (1.00 to 1.01)	1.00 (0.99 to 1.02)
Crew exposure			
Mean exposure in preceding 12 months (per 10 cases)	1.01 (1.00 to 1.01)	1.00 (1.00 to 1.01)	1.00 (1.00 to 1.01)
Proportion that were paediatric (per 10 percent)	0.97 (0.69 to 1.36)	0.84 (0.67 to 1.04)	0.78 (0.49 to 1.26)
Proportion that were not transported (per 10 percent)	1.11 (0.95 to 1.29)	1.12 (1.02 to 1.23)	1.29 (1.07 to 1.58)

ED, emergency department; GP, general practitioner; Ref, reference.

and an adverse event (OR 7.33, 95% CI 3.46 to 15.52, [table 3](#)). In comparison, refusal of transport was independently associated with increased odds of recontact (OR 1.42, 95% CI 1.22 to 1.66), ED presentation (OR 1.97, 95% CI 1.80 to 2.16) and hospital admission (OR 1.79, 95% CI 1.47 to 2.18). Patients with at least one abnormal vital sign on initial paramedic assessment had increased odds of hospital admission (OR 1.23, 95% CI 1.09 to 1.39) and adverse event (OR 2.22, 95% CI 1.25 to 3.95). Compared with patients without an obvious problem/diagnosis, patients with a paramedic-diagnosed respiratory condition, infection, gastrointestinal/genitourinary condition, musculoskeletal issue/traumatic injury or pain had increased odds of ED presentation and hospital admission.

In the supplementary analysis of paramedic-initiated non-transport, minor changes to effect sizes and CIs were observed ([online supplemental table 4](#)). EMS attendance during the early hours of the morning (04:00–08:00 hours) was associated with increased odds of hospital admission (OR 1.56, 95% CI 1.11 to 2.21). An abnormal vital sign on initial assessment was no longer associated with hospital admission (OR 1.13, 95% CI 0.91 to

1.39). In the supplementary analysis assessing paramedic crew case exposure ([table 4](#)), increasing exposure to non-transported cases in the preceding 12 months was associated with increased odds of ED presentation (OR 1.12, 95% CI 1.02 to 1.23) and hospital admission (OR 1.29, 95% CI 1.07 to 1.58). Paramedic exposure to paediatric patients was not associated with any outcome.

DISCUSSION

In this large study of paediatric patients who were attended but not transported to hospital by EMS, 2.2% recontacted EMS within 48 hours of the initial call, 13.7% self-presented to an ED, 2.4% were admitted to hospital and 0.1% had an adverse event. Among paramedic-initiated non-transport, 5.6% presented to an ED, 1.1% were admitted to hospital and 0.05% had an adverse event. In the overall non-transported population, at least one abnormal vital sign on initial assessment was associated with increased odds of adverse event. However, this association did not exist in the subgroup of paramedic-initiated non-transport.

Furthermore, among patients with paramedic-initiated non-transport, attendance during the early hours of the morning (04:00–08:00 hours) was associated with increased odds of subsequent hospital admission. The odds of ED presentation and hospital admission increased with attendance by crews who had an increasing proportion of non-transported cases.

Our results compare favourably to a recent meta-analysis of adult and paediatric studies which reported pooled ED presentation and hospital admission rates of 21% and 8%, respectively up to 30 days after the emergency call.⁵ Coupled with our low mortality rate, our results support paramedic non-transport decision-making. EMS internationally have implemented guidelines aimed at assisting paramedics in their decision-making processes. For example, in the UK, a national policy around non-transportation of paediatric patients exists to optimise patient safety. A recent study reported that only 1% of paediatric patients were subsequently admitted to hospital after non-transport in that setting.¹⁹ Some ambulance services in Australia strongly recommend transport of all paediatric patients aged 12 years or less.²⁰ In our setting, such a recommendation would increase transports to hospital by 9750 patients annually. This would ultimately increase total ambulance case durations, reduce resource availability and contribute to increased ED crowding.

Instead, our service adopted a 'red flag' clinical practice guideline in early 2020 which outlines criteria under which hospital transport is strongly advised. These criteria include an abnormal vital sign as well as several specified health conditions. Our results suggest that vital sign derangements were not useful in determining subsequent hospital admission when the paramedics had deemed transport not to be required. A future evaluation of the effectiveness of the 'red flag' criteria in reducing the rate of adverse outcomes is planned.

We observed differing patient outcomes according to the non-transport reason documented by paramedics. Relative to patients documented as not requiring transport, patients with a documented refusal, referral to a GP or transport via other means experienced higher recontact, ED presentation and hospital admission rates in the 48 hours following EMS attendance. In the hospital setting, discharge against medical advice has been associated with an increased risk of mortality and readmission.^{21 22} Our results suggest that this may also apply to the prehospital setting. It is not clear from our study why parents or guardians refuse transport after being assessed by EMS. It is possible that guardians are reassured by the paramedics' assessment and opt out of further assessment in the ED, against the recommendation of paramedics. Furthermore, guardians of children with complex physical, social or behavioural needs, or whose underlying condition require frequent hospital visits (eg, epilepsy), may be more likely to refuse ED care. Other factors, such as health literacy, social determinants of health and level of education were not explored in our study. Importantly, the cohort that carried the greatest risk in our study were those who required transport to hospital but planned to go via other means. The cost of EMS transport in our region may be a significant factor influencing this decision. Interestingly, only 54% of these patients were linked to a public ED record, suggesting that many patients did not subsequently self-present.

Within the cohort of paramedic-initiated non-transport, attendance by crews with higher exposure to non-transport cases was associated with increased odds of ED presentation and hospital admission. To our knowledge, ours is the first study to report such a finding. One possible explanation is that paramedics with high non-transport rates are less conservative in their decision-making, and therefore carry a higher level of risk.

This finding warrants further exploration both locally and internationally. Furthermore, the early hours of the morning (04:00–08:00 hours) were associated with increased odds of hospital admission. This time of day coincides with the conclusion of paramedics' 14-hour night shift at 07:00 hours, and may indicate that fatigue, sleep loss and circadian misalignment impairs paramedic alertness and performance.²³ Alternatively, a desire to complete their shift on time may increase a paramedic's likelihood of a non-transport decision. A previous report from our region demonstrated deteriorating response time performance in the early hours of the morning despite less road congestion.²⁴ These findings support the theory that work performance may decline with extended working hours.

Our study has several limitations. It is retrospective and carries the associated limitations, including a small amount of missing data. The linkage rate for paediatric patients who were transported to a public hospital was 82.4%, indicating an underestimation rate of >15%. As such, it is possible that the true rates of ED presentation and hospital admission are under-reported in our study. The highest level of paramedic experience was derived using employment start date. Paramedics who worked internationally or interstate prior to their employment in Victoria may have a higher experience level than we were able to calculate. We had to rely on the non-transport reason documented within patient care records, however documentation errors may be present. Finally, we did not investigate outcomes occurring >48 hours after the index non-transport case. However, previous research suggests that longer follow-up periods are more likely to be influenced by factors unrelated to the index case.¹⁸

CONCLUSION

This large data linkage study of paediatric patients who were attended but not transported to hospital by EMS indicates low rates of adverse outcomes. For patients with paramedic-initiated non-transport, rates of ED presentation, hospital admission and adverse event within 48 hours of the initial emergency call were low. Vital sign derangements and attendance by paramedics with increasing prior exposure to non-transport were associated with poorer outcomes and may be used to improve safety.

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Outcomes of paediatric patients who are not transported to hospital by Emergency Medical Services: a data linkage study

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Supplementary appendix

Supplementary Table 1: Age-specific vital sign derangement criteria

Age	Heart Rate (beats/min)	Respiratory Rate (breath/min)	Systolic Blood Pressure (mmHg)	Glasgow Coma Scale	Oxygen Saturation (%)
Newborn (<24 hours)	<110 or >170	<25 or >60	<60	<15	<96
Small infant (<3 months)	<110 or >170	<25 or >60	<60	<15	<96
Large infant (3-12 months)	<105 or >165	<25 or >55	<65	<15	<96
Small child (1-4 years)	<85 or >150	<20 or >40	<70	<15	<96
Medium child (5-11 years)	<70 or >135	<16 or >34	<80	<15	<96
12-17 years	>120	>30	<90	<13 (<15 if age <16)	<90

Supplementary Table 2: Hospital outcomes for admitted patients or those who presented to the ED

	Transport not required	Transport via other means	Referred to GP	Transport refused
ED Outcomes	n=1,503	n=5,107	n=846	n=905
ED length of stay (minutes), median (Q1, Q3)	151 (96, 228)	150 (94, 223)	174 (107, 241)	154 (95, 228)
ED Discharge status, n (%)				
Home	1,050 (69.9)	3,660 (71.7)	573 (67.7)	607 (67.1)
Ward	185 (12.3)	503 (9.8)	111 (13.1)	102 (11.3)
Short Stay Unit	140 (9.3)	454 (8.9)	112 (13.2)	113 (12.5)
Other	128 (8.5)	490 (9.6)	50 (5.9)	83 (9.2)
Primary hospital diagnosis, n (%)	n=1,437	n=4,742	n=830	n=855
Infectious disease	156 (10.8)	475 (10.0)	127 (15.3)	84 (9.8)
Neoplastic disease	0	1 (0.02)	0	0
Blood disease	3 (0.2)	12 (0.3)	4 (0.5)	0
Endocrine disease	5 (0.4)	28 (0.6)	3 (0.4)	10 (1.2)
Mental / behavioural disorder	52 (3.6)	68 (1.4)	20 (2.4)	17 (2.0)
Neurological disorder	16 (1.1)	53 (1.1)	12 (1.5)	13 (1.5)
Eye and ear disorders	14 (1.0)	38 (0.8)	9 (1.1)	8 (0.9)
Cardiovascular disorder	13 (0.9)	22 (0.5)	7 (0.8)	5 (0.6)
Respiratory disorder	273 (19.0)	1,256 (26.5)	183 (22.0)	225 (26.3)
Gastrointestinal disorder	23 (1.6)	78 (1.6)	18 (2.2)	17 (2.0)
Dermatological disorder	15 (1.0)	64 (1.4)	8 (1.0)	21 (2.4)
Musculoskeletal problem	23 (1.6)	50 (1.1)	14 (1.7)	10 (1.2)
Genitourinary disorder	20 (1.4)	45 (1.0)	15 (1.8)	7 (0.8)
Pregnancy / childbirth-related	0	2 (0.04)	1 (0.1)	0
Perinatal condition	16 (1.1)	21 (0.4)	3 (0.4)	6 (0.7)
Symptoms not otherwise classified	269 (18.7)	816 (17.2)	173 (20.8)	168 (19.7)
Injury	491 (34.2)	1,639 (34.6)	218 (26.3)	247 (28.9)
Factors influencing health status	48 (3.3)	74 (1.6)	15 (1.8)	17 (2.0)

Supplementary Table 3: ED outcomes for patients transported by EMS on re-attendance

n=759	
ED length of stay (minutes), median (Q1, Q3)	203 (132, 295)
ED discharge status, n (%)	
Home	382 (50.3)
To ward	183 (24.1)
Short Stay Unit	151 (19.9)
Other	43 (5.7)
Primary diagnosis, n (%)	
Symptoms not otherwise classified	197 (26.8)
Respiratory disorder	158 (21.5)
Injury	111 (15.1)
Mental / behavioural disorder	76 (10.3)
Neurological disorder	64 (8.7)
Infectious disease	53 (7.2)
Other	77 (10.5)
Missing (%)	3.0

Supplementary Table 4: Multivariable analyses of factors associated with patient outcomes within 48 hours of the emergency call among paramedic-initiated non-transport

		Recontact	ED presentation	Hospital admission
		OR (95% CI)	OR (95% CI)	OR (95% CI)
Male gender		1.10 (0.95, 1.26)	1.06 (0.97, 1.16)	1.05 (0.87, 1.27)
Patient age	0-11 months	Ref	Ref	Ref
	1-4 years	0.97 (0.75, 1.27)	0.80 (0.70, 0.92)	0.54 (0.42, 0.69)
	5-11 years	1.12 (0.86, 1.47)	0.57 (0.49, 0.67)	0.31 (0.23, 0.43)
Hour of day	12-17 years	1.53 (1.17, 2.02)	0.68 (0.58, 0.79)	0.31 (0.22, 0.44)
	Midnight-4am	1.31 (1.02, 1.70)	0.93 (0.79, 1.11)	0.77 (0.54, 1.11)
	4am-8am	1.16 (0.85, 1.59)	1.17 (0.97, 1.40)	1.56 (1.11, 2.21)
	8am-12pm	1.21 (0.95, 1.55)	1.12 (0.96, 1.29)	1.32 (0.97, 1.79)
	12pm-4pm	Ref	Ref	Ref
	4pm-8pm	1.26 (1.01, 1.57)	1.01 (0.89, 1.16)	0.99 (0.74, 1.33)
	8pm-Midnight	1.19 (0.95, 1.49)	0.94 (0.82, 1.08)	0.62 (0.45, 0.85)
Weekend		1.03 (0.89, 1.20)	1.01 (0.92, 1.11)	0.93 (0.75, 1.15)
Remoteness Index	Major city	0.78 (0.66, 0.91)	0.87 (0.78, 0.96)	0.85 (0.68, 1.06)
Case dispatch code	Time-critical	0.76 (0.65, 0.88)	0.90 (0.82, 0.99)	0.92 (0.75, 1.12)
Case nature	Medical	1.71 (1.41, 2.09)	1.42 (1.25, 1.61)	2.27 (1.70, 3.04)
Paramedic diagnosis	No problem identified	Ref	Ref	Ref
	Mental health/social/behavioural issue or alcohol/drug related	2.05 (1.58, 2.65)	0.91 (0.73, 1.14)	2.01 (1.27, 3.20)
	Respiratory condition	1.19 (0.88, 1.60)	1.55 (1.29, 1.87)	1.81 (1.26, 2.60)
	Neurological condition	2.01 (1.52, 2.66)	0.91 (0.71, 1.17)	0.99 (0.58, 1.69)
	Infection	1.52 (1.16, 1.99)	2.12 (1.79, 2.50)	2.28 (1.63, 3.19)
	Gastrointestinal / genitourinary condition	1.28 (0.89, 1.84)	1.93 (1.54, 2.40)	2.43 (1.60, 3.69)
	Other medical condition	0.88 (0.64, 1.21)	1.29 (1.07, 1.56)	1.31 (0.87, 1.97)
	Musculoskeletal issue / traumatic injury	0.66 (0.46, 0.95)	2.90 (2.45, 3.42)	2.10 (1.38, 3.20)
	Pain	0.57 (0.37, 0.87)	2.64 (2.18, 3.19)	2.50 (1.58, 3.97)
Unknown problem	1.16 (0.75, 1.79)	1.60 (1.23, 2.07)	1.96 (1.16, 3.31)	
Paramedic treatment provided		1.19 (0.91, 1.55)	1.40 (1.21, 1.61)	1.77 (1.29, 2.44)
Abnormal vital sign		0.95 (0.80, 1.13)	1.05 (0.95, 1.17)	1.13 (0.91, 1.39)
Documented no-transport reason	Transport not required	Ref	Ref	Ref
	Referred to GP / another provider	1.21 (1.03, 1.42)	1.34 (1.21, 1.47)	1.13 (0.92, 1.39)
Highest experience level of crew (per year)		1.00 (0.99, 1.01)	1.00 (1.00, 1.01)	1.00 (0.99, 1.01)