International Journal of Paramedicine

Published by the National EMS Management Association (USA)

RESEARCH REPORTS

AN EXAMINATION OF THE DIFFERENCES IN ACCURACY BETWEEN PARAMEDICS AND EMERGENCY MEDICAL TECHNICIANS (EMTS) IN IDENTIFYING LOW-ACUITY PEDIATRIC PATIENTS

Jerry M. Yang, BS*[1]; Kathleen M. Brown, MD[1,2]; Joelle N. Simpson, MD, MPH[1,2]; James M. Chamberlain, MD[1,2]; Caleb E. Ward, MB, BChir, MPH[1,2]

Author Affiliations: 1. Division of Emergency Medicine, Children's National Hospital; Washington, DC, USA; 2. The George Washington University School of Medicine and Health Sciences, Washington, DC, USA.

**Corresponding Author*: jmyang23@umd.edu

Recommended Citation: Yang, J.M., Brown, K.M., Simpson, J.N., Chamberlain, J.M, & Ward, C.E. (2024). An examination of the differences in accuracy between paramedics and emergency medical technicians (EMTs) in identifying low-acuity pediatric patients. *International Journal of Paramedicine.* (8), 110-124. https://doi.org/10.56068/VDDB2309. Retrieved from https://internationaljournalofparamedicine.com/index.php/ijop/article/view/3064

Keywords: pediatrics, triage, patient acuity, emergency medical services, EMS, paramedicine

Received: February 19, 2024
Revised: May 20, 2024
Accepted: July 17, 2024
Published: October 8, 2024

Funding: This work was supported by the NIH National Center for Advancing Translation Sciences under Award Number UL1TR001876.

Disclosures: None.

Disclaimer: The contents of this paper are solely the responsibility of the authors and do not necessarily represent the official views of the National Center for Advancing Translational Sciences or the National Institutes of Health.

Presentation: This work was presented as an oral platform presentation at the Pediatric Academic Societies Meeting in Washington, DC on April 30th, 2023.

Acknowledgements: The authors wish to acknowledge Michael Taylor who assisted with data collection, and Gia Badolato who provided advice on study design and preliminary analysis for the parent study.

ABSTRACT

Background: Alternative emergency medical services (EMS) disposition programs have been developed for adults with low-acuity complaints. One barrier to including children in such programs is a lack of evidence regarding whether paramedics and emergency medical technicians (EMTs) can accurately identify children with low-acuity complaints. Our primary objective was to compare the accuracy of EMTs to that of paramedics in identifying low-acuity pediatric encounters. Our secondary objective was to determine whether support for alternative EMS dispositions differed between paramedics and EMTs.

Methods: This was a planned secondary analysis of a cross-sectional study of children transported by EMS to an emergency department (ED). Acuity was defined using a composite measure that included physiological patient assessments, resources used (including laboratory tests and radiographs), and patient disposition. EMS clinicians rated on a Likert scale their level of agreement that a patient had a low-acuity problem and could have been transported by private vehicle, seen in clinic, or not transported. The sensitivity, specificity, and positive and negative predictive values (PPV and NPV) for paramedic and EMT acuity assessments were calculated.

Results: EMS surveys were completed for 84.0% of 996 participants (76.4% by EMTs, 22.6% by paramedics). 35.1% of participants were classified as having a low-acuity complaint. The sensitivity for identifying a child as low-acuity was 24% (95% CI 20%, 38%) for paramedics and 50% (46%, 54%) for EMTs. The PPV for identifying a child as low-acuity was 0.44 (0.28, 0.60) for paramedics and 0.62 (0.55, 0.68) for EMTs. Only 20.5% of paramedics and 22.5% of EMTs supported non-transport for children with low-acuity complaints.

Conclusions: Relying on EMS assessments of pediatric patient acuity may lead to under-triage, regardless of whether a paramedic or EMT makes this determination. Additional training and triage tools may be required before children can be safely included in alternative EMS disposition programs.

BACKGROUND

Of the 1.6 million children who seek help from emergency medical services (EMS) in the US each year (Duong et al., 2018), up to 50% have low-acuity complaints that do not require emergent medical interventions (Patterson et al., 2006; Ward, Badolato, et al., 2022). EMS activations for children with low-acuity complaints can result in unnecessary transports (Ward, Badolato, et al., 2022), increased healthcare costs (Alpert et al., 2013), and longer wait times for more critical patients(Mell et al., 2017) and can contribute to Emergency Department (ED) crowding (Derlet & Richards, 2000).

Alternative EMS disposition programs have been developed over the last 20 years for patients with low-acuity complaints (Millin et al., 2011). These programs include substituting taxis for ambulances, transporting patients to primary or urgent care clinics rather than the ED, and treating patients in place without transport (Jensen et al., 2015; Kamper et al., 2001; Millin et al., 2011). The novel coronavirus (COVID-19) pandemic increased the need for such programs. Many EMS agencies suffered critical workforce shortages (Satty et al., 2021), and patients were concerned about exposure to COVID-19 in healthcare settings (Ward et al., 2023). The federal government has also encouraged innovation in this area with the recent Emergency Triage, Treat, and Transport (ET3) program (Goldman et al., 2020).

Most alternative EMS disposition programs have not included children. In order to safely include children in these programs, it is essential that EMS clinicians accurately identify children with low-acuity complaints without missing patients with emergent illness or injuries, or at risk of rapid deterioration. Diagnostic accuracy in children can be particularly challenging as many are non-verbal and may not have a caregiver present. Furthermore, many EMS clinicians have limited pediatric training and exposure. (Hansen et al., 2015; Jeruzal et al., 2019; Rahman et al., 2015; Zaritsky, 1994) Little is known about whether EMS clinicians can accurately determine medical necessity for pediatric patients (Millin et al., 2011). Previous studies analyzing the accuracy of pediatric acuity assessments by EMS clinicians have excluded emergency medical technicians (EMTs). (Kahalé et al., 2006; Seltzer et al., 2001) In our previous study, we compared the accuracy of EMS clinicians (grouping paramedics and EMTs), caregivers and ED staff in determining patient acuity. For EMS clinicians we found a sensitivity of 0.46, specificity of 0.74, positive predictive value (PPV) of 0.60, and negative predictive value (NPV) of 0.62. (Ward, Badolato, et al., 2022) EMS clinicians had similar accuracy to ED nurses and providers. However, EMTs were grouped with paramedics in analysis, which may have obscured differences between paramedics and EMTs. This is important because many jurisdictions rely heavily on EMTs (National Registry of Emergency Medical Technicians, 2023) and 27% of pediatric calls managed by EMTs result in non-transport (Ward et al., 2022). Our aim, therefore, was to determine whether there are significant differences in accuracy between paramedics and EMTs when assessing pediatric patient acuity.

OBJECTIVES

Our primary objective was to compare the accuracy of paramedics and EMTs in identifying pediatric patients with low-acuity complaints. Our hypothesis was that EMTs would be less accurate than paramedics in identifying low acuity conditions due to limited pediatric training and patient exposure. Our secondary objective was to determine wheth-

er paramedics and EMTs differed in their support for use of alternative EMS dispositions for children with low-acuity complaints. Our hypothesis was that EMTs would be less supportive of alternative dispositions.

METHODS

Study Design and Setting

This was a planned secondary analysis of a prospective observational study of children transported by EMS to a pediatric ED. (Ward, Badolato, et al., 2022) Most EMS transports came from two EMS agencies with two-tier infrastructure, including paramedics and EMTs (collectively described as 'EMS clinicians' in this analysis). Based on information provided from the 9-1-1 caller, paramedics, EMTs, or both may be dispatched to a call and make decisions about transport disposition. Both agencies are large, fire-based public access EMS systems serving predominantly urban and suburban areas. One agency is staffed entirely by career EMS clinicians; the other includes career and volunteer clinicians. Both agencies require demonstration of pediatric skills in simulated events or skills stations at least once a year. The study site ED receives the majority of pediatric transports and serves as the local pediatric trauma center for both agencies. The local Institutional Review Board approved this study (Pro00013740).

Participants

Inclusion criteria for enrollment were patients under 18 years old transported by EMS to the ED. Exclusion criteria were interfacility transports, patients with an Emergency Severity Index (ESI) score of 1 (requiring immediate life-saving interventions), (Gilboy et al., 2011) and caregivers with a preferred language other than English or Spanish. Caregivers, EMS, and ED clinicians for eligible participants were approached by research staff and asked to complete a brief survey. This secondary analysis focuses solely on the EMS clinician surveys. Participants were enrolled from August 2020 to September 2021 during enrollment windows (8 am - 11 pm on weekdays and 2 pm – 10 pm on weekends).

Data Collection

The data for this study were collected from participant surveys and the electronic health care records of enrolled children. Participants (including caregivers, EMS clinicians and ED staff) were asked to complete a survey on an electronic tablet device as soon as possible after ED arrival. Participants were provided with a survey preamble that described potential EMS alternative dispositions that have been developed for low acuity patients. They were then asked four questions about whether their child could be considered to have a low acuity condition and if it would have been acceptable for their child to be included in these alternative dispositions (Figure 3 and Figure 4). Participants rated on a 5-point Likert scale their level of agreement with each statement. These survey questions closely match survey items developed in a previously validated survey (Power et al., 2019), and were pilot tested to ensure face validity. EMS clinicians were asked to base responses on their clinical impression and not with reference to a specific protocol.

Research staff extracted additional data from the ED and EMS electronic health care records to determine ED resource use and disposition and any return visits within five days of the index EMS encounter.

Outcome Measures

In the absence of established criteria for classifying EMS patient acuity (Schmidt, 2004), we derived a novel outcome measure based on consensus findings from the Neely Conference: Developing Research Criteria to Define Medical Necessity in EMS (Cone, 2004a, 2004b; Mann, 2004). Our study definition of low-acuity, which was used as the reference standard, incorporated physiologic assessments, resources used, and patient disposition. We have previously published full details of how acuity was defined and the prevalence and characteristics of patients with low-acuity complaints (Ward et al., 2023). To be classified as low-acuity, patients needed stable vital signs; did not require any procedures or medications from EMS; did not require any radiographs, blood tests, IV medications, or procedures in the ED; and were discharged home with no return visits leading to admission within five days. EMS procedures included airway intervention, IV placement, and splint or cervical collar application. ED procedures included laceration repair, fracture reduction, and procedural sedation.

Data Analysis

EMS clinician surveys and data abstracted from patient medical charts were used as the data sources for our analyses. Descriptive statistics were generated to describe the cohorts of patients transported by paramedics and EMTs. EMS clinician survey responses were dichotomized by grouping "agree" and "strongly agree" as agreement and all other responses as disagreement. We then calculated and compared the sensitivity, specificity, positive and negative predictive values (PPV and NPV) for paramedic and EMT acuity assessments when compared against the study reference standard for low-acuity. We defined sensitivity and positive predictive value as the correct detection of low-acuity because of our objective of identifying the accuracy of EMS clinicians in identifying children with low-acuity complaints. Thus, in these analyses, specificity and negative predictive value are measures of the correct identification of patients with emergent, or high acuity, illness. When calculating the level of support from paramedics and EMTs for specific alternative EMS dispositions, analysis was restricted to participants with low-acuity complaints using the study definition. We considered differences in accuracy to be statistically significant when the 95% confidence interval around the point estimate of one group did not overlap with the point estimate of the other group. Differences in the proportion of EMTs and paramedics supporting alternative dispositions were based on chi square tests. We decided a priori to enroll 1,000 patients for the parent study to ensure we had sufficient power for the primary study objective, analyzing the prevalence and characteristics of low-acuity pediatric patient transports. Analyses were performed using SAS (SAS Institute, Inc, Cary, NC) (SAS/STAT 15.3 User's Guide, 2023).

RESULTS

We enrolled 996 children in the parent study. EMS clinicians completed surveys for 837 participants (84.0%). Most EMS surveys were completed by EMTs (640/837, 76.4%), and the remainder were completed by paramedics (189/837, 22.6%). EMS clinician type was missing on 8 surveys. The mean age of the entire patient cohort was 6.9 years (SD 5.5). 401/837 (47.9%) patients were female. The most common race and ethnicity responses were non-Hispanic Black (532/837, 63.6%) and non-Hispanic White (87/837, 10.4%). 65/837 (7.8%) of the patients required interpreters in the ED. The patients transported by

paramedics and EMTs differed in several respects (Table 1). The cohort transported by EMTs was younger and more likely to be non-Hispanic Black and publicly insured. As expected for two-tiered EMS agencies, EMTs were more likely to transport patients with low-acuity complaints both as measured by ESI triage level and by our study reference standard. For participants transported by EMTs, 40.3% were triaged as ESI levels 4 or 5, and 39.5% were low-acuity using the study definition. For participants transported by paramedics, 29.1% were triaged as ESI levels 4 or 5, and 20.6% were low-acuity using the study definition.

For the enrolled participants defined as having a low-acuity condition, paramedics agreed that 19/39 (48.7%) were low-acuity, and EMTs agreed that 158/253 were low-acuity (62.4%). The sensitivity for identifying children with a low-acuity complaint was significantly lower for paramedics than EMTs (24% [95% CI 20%,38%] vs. 50% [46%, 54%] respectively) (Table 2 and Figure 1). The specificity for identifying children with emergent medical needs (not low-acuity) was significantly higher for paramedics than EMTs (83% [78%, 87%] vs. 70% [66%, 74%], respectively). The PPV for identifying a child as low acuity was 0.44 (0.28, 0.60) for paramedics and 0.62 (0.55, 0.68) for EMTs. The NPV for identifying children with emergent medical needs (not low-acuity) was 0.71 (0.63, 0.78) for paramedics and 0.59 (0.54, 0.64) for EMTs (Figure 2).

We observed limited agreement from both paramedics and EMTs in supporting that alternative dispositions would have been appropriate for patients they were caring for, who met the study definition for a low-acuity condition (Table 3). For patients defined as having a low-acuity complaint, 35.9% of paramedics and 54.5% of EMTs agreed that substituting a taxi for an ambulance would have been appropriate. For these low-acuity patients, 56.4% of paramedics and 53.4% of EMTs agreed it would have been appropriate for the child to be seen in a primary care or urgent care clinic rather than the ED. Both paramedics and EMTs demonstrated little support for treatment in place and non-transport for children with low-acuity complaints (20.5% and 22.5% agreement, respectively).

DISCUSSION

In this prospective observational study, both paramedics and EMTs had limited accuracy when identifying low-acuity pediatric patients as defined by our composite measure. EMTs had a higher sensitivity than paramedics when identifying low-acuity pediatric patients and a lower specificity. We did not observe a statistically significant difference between the PPV and NPV of paramedics and EMTs. The differences observed in sensitivity and specificity between paramedics and EMTs may stem from differences in the patient cohorts transported by each group, or could be attributable to the different training requirements and pediatric exposure for paramedics and EMTs. (Hansen et al., 2015; Jeruzal et al., 2019; Rahman et al., 2015; Zaritsky, 1994) We were surprised to find EMTs had a higher sensitivity in identifying low-acuity patients. This may reflect the larger proportion of low-acuity patients they see, with paramedics erring on the side of transport if they were dispatched to the scene. Greater exposure to high-acuity pediatric patients may also explain why paramedics demonstrated a higher specificity, i.e. ability to detect sick children. The overall limited accuracy observed from both EMTs and paramedics may reflect limited exposure to pediatric calls. We were not able to measure pediatric exposure in this study.

	EMT cohort, n (%)	Paramedic cohort, n (%)	Total, n (%)
VARIABLE	N=640 (%)	N=189 (%)	N=837[a]
Age (years)			
< 1	88 (13.8)	13 (6.9)	102 (12.2)
1 - 3	188 (29.4)	66 (34.9)	257 (30.7)
4 - 6	93 (14.5)	18 (9.5)	111 (13.3)
7 - 12	136 (21.3)	55 (29.1)	192 (22.9)
13 - 18	135 (21.1)	37 (19.6)	175 (20.9)
Mean age (std)	6.8 (5.5)	7.2 (5.4)	6.9 (5.5)
Sex			
Male	334 (52.2)	98 (51.9)	436 (52.1)
Race			
Non-Hispanic Black	426 (66.6)	101 (53.4)	532 (63.6)
Non-Hispanic White	57 (8.9)	30 (15.9)	87 (10.4)
Hispanic	104 (16.3)	35 (18.5)	141 (16.8)
Other	43 (6.7)	22 (11.6)	66 (7.9)
Not Documented	10 (1.6)	1 (0.5)	11 (1.3)
Interpreter			
Yes	46 (7.2)	19 (10.1)	65 (7.8)
Insurance status			
Private insurance	109 (17.0)	49 (25.9)	158 (18.9)
Public	466 (72.8)	114 (60.3)	587 (70.1)
No insurance	35 (5.5)	12 (6.4)	48 (5.7)
Unknown	30 (4.7)	14 (7.4)	44 (5.3)
Date/time arrival			
Office Hours (Mon-Fri, 8 am – 5 pm)	460 (71.9)	130 (68.8)	533 (63.7)
Chief Complaint			
Behavioral/psychiatric	40 (6.3)	3 (1.6)	43 (5.1)
Neurologic	65 (10.2)	56 (29.6)	125 (14.9)
Gastrointestinal	48 (7.5)	9 (4.8)	57 (6.8)
Global/general	119 (18.6)	24 (12.7)	143 (17.1)
Musculoskeletal/skin	250 (39.1)	44 (23.3)	297 (35.5)
Pulmonary	88 (13.8)	36 (19.1)	125 (14.9)
Other	30 (4.7)	17 (9.0)	47 (5.6)
Injury			
Yes	260 (40.6)	49 (25.9)	311 (37.2)
Motor vehicle crash victim			
Yes	52 (8.1)	8 (4.2)	60 (7.2)
ESI triage level			
1/2	76 (11.9)	36 (19.1)	113 (13.5)
3	306 (47.8)	117 (61.9)	428 (51.1)
4	237 (37.0)	34 (18.0)	273 (32.6)
5	21 (3.3)	2 (1.1)	23 (2.7)
Low Acuity[b]			
Yes	253 (39.5)	39 (20.6)	294 (35.1)

[a] There were 8 EMS surveys with no clinician type, so the total of EMT and Paramedic cohorts is 829 instead of 837.

[b] As defined using the novel composite definition developed for this study.

Table 1. Characteristics of enrolled children transported to the emergency department (ED) by Emergency Medical Services (EMS), grouped by EMS clinician type.

	Sensitivity (95% CI)	Specificity (95% CI)	Positive Predictive Value (95% CI)	Negative Predictive Value (95% CI)
EMT (N=640)	50% (46%, 54%)	70% (66%, 74%)	0.62 (0.55, 0.68)	0.59 (0.54, 0.64)
Paramedic (N=189)	24% (20%, 38%)	83% (78%, 87%)	0.44 (0.28, 0.60)	0.71 (0.63, 0.78)
All EMS Clinicians (N=837)[a]	46% (43%, 50%)	74% (71%, 77%)	0.60 (0.54, 0.65)	0.62 (0.58, 0.67)
[a] There were 8 EMS surveys with no clinician type, so the total of EMT and Paramedic cohorts is 829 instead of 837.				

Table 2. Ability of Emergency Medical Services (EMS) clinicians to predict low-acuity pediatric patients.

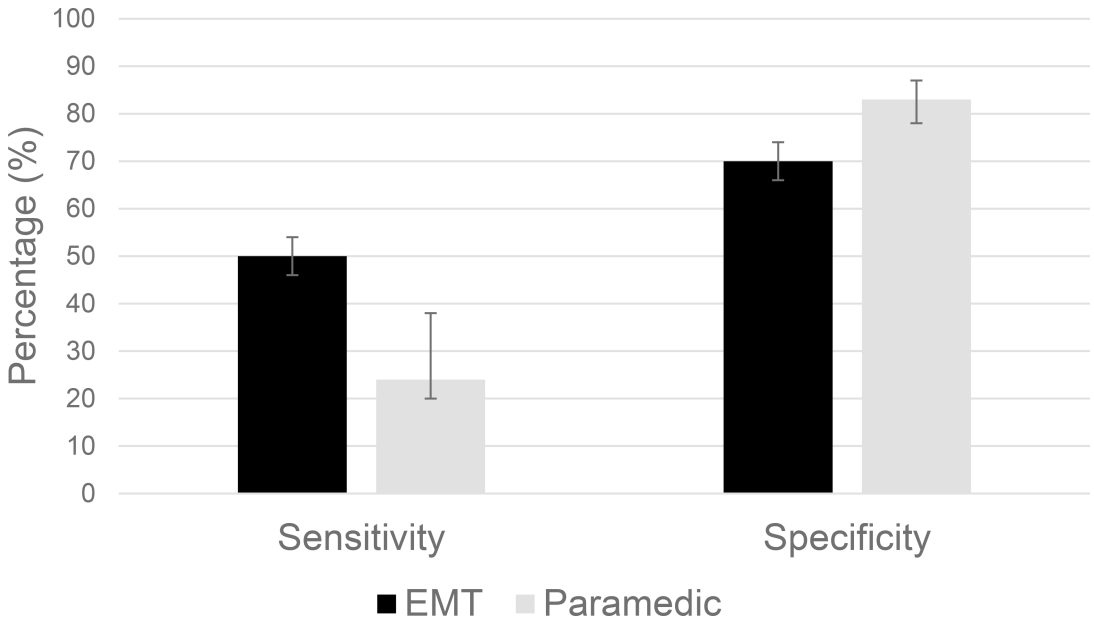


Figure 1. Sensitivity and specificity of EMTs and Paramedics for identifying children with a low-acuity condition. Error bars depict the 95% confidence intervals.

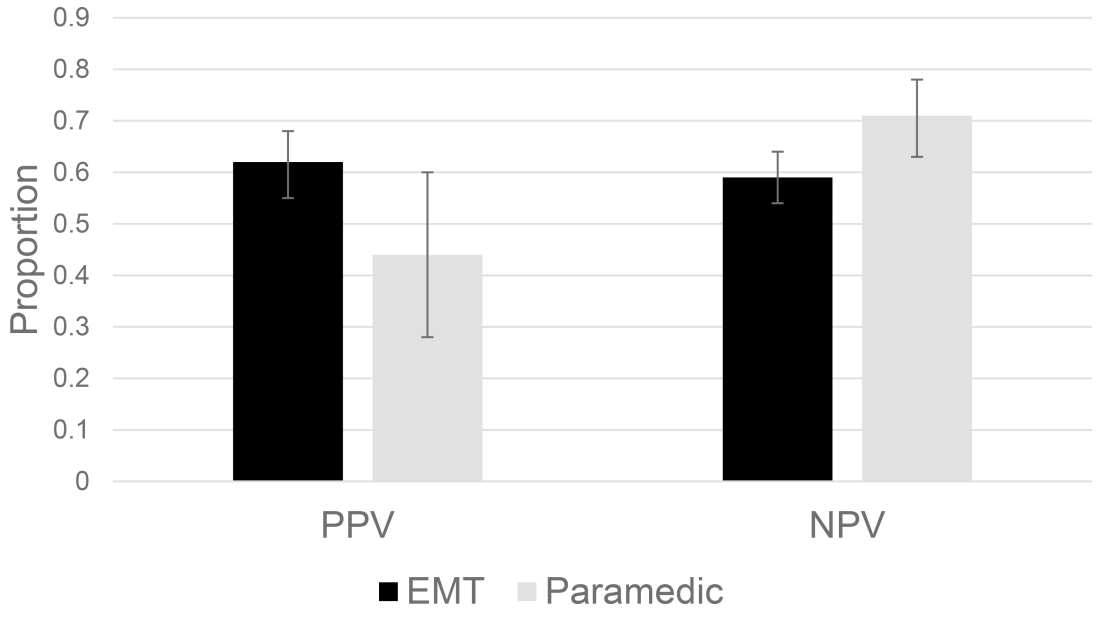


Figure 2. Positive and negative predictive values for EMTs and Paramedics when identifying a child as having a low-acuity condition. Error bars depict the 95% confidence intervals.

	EMT (N=253[a]) % Agreement	Paramedic (N=39[a]) % Agreement	Chi-Square Statistic	P-value
This child's complaint could be considered "low acuity."	62.4	48.7	2.7	0.102
It would have been acceptable for this child to be transported in a commercial ride-sharing service rather than an ambulance today.	54.5	35.9	4.7	0.030
It would have been acceptable for this child to be seen in a primary care clinic or urgent care clinic today rather than an ED.	53.4	56.4	0.13	0.722
It would have been acceptable for EMS to have assessed and treated this child today and left them at home.	22.5	20.5	0.1	0.778
[a] Number of participants transported by EMS who were classified as low-acuity using study composite definition				

Table 3. Agreement of Emergency Medical Services (EMS) clinicians for children with low-acuity complaints being managed by alternative EMS dispositions.

The PPVs observed in our study when EMS clinicians classified a child as low-acuity are lower than in previous studies. A previous meta-analysis found a predictive value of 0.91 (0.71, 0.98) for paramedic determination of patients not requiring transport and 0.68 (0.48, 0.83) for patients not needing ED evaluation. (Brown et al., 2009) There are several reasons we may have observed a lower PPV. First, most previous studies analyzing EMS acuity determinations have excluded children. EMS clinicians have limited pediatric training and less comfort managing children (Hansen et al., 2015; Jeruzal et al., 2019; Rahman et al., 2015; Zaritsky, 1994) and, therefore, may have lower accuracy when assessing acuity in children compared to adults. The only pediatric study in the meta-analysis reported a predictive value of 0.98 when identifying children with low-acuity complaints. (Haines et al., 2006) However, the reference standard was a physician assessment based solely on an EMS verbal report. Second, the reference standard used in our study for low-acuity may have excluded patients that other studies classified as low-acuity. For example, if a patient received a radiograph, we classified the encounter as not low-acuity regardless of whether any abnormalities were identified on the radiograph. Less conservative reference standards have been used in previous studies, including physician opinion (Haines et al., 2006; Pointer et al., 2001) and hospital admission status. (Levine et al., 2006; Price et al., 2005; Richards & Ferrall, 1999; Zachariah et al., 1992) Third, our study was restricted to children transported to the ED. Not including children managed on scene without transport may have resulted in spectrum bias and worse performance in identifying low-acuity children. Finally, our study included both paramedics and EMTs. While we observed some differences between these two groups, the PPV when identifying low-acuity encounters was not significantly different. This suggests that including EMTs in our study does not explain the lower PPV.

We observed limited support among both paramedics and EMTs for alternative EMS dispositions for children with low-acuity complaints. A narrow majority of EMTs agreed that transport to a clinic site (53.4%) or transport by taxi (54.5%) would have been acceptable for children who met the study criteria for low acuity. Paramedics showed a similar level of support for transport to clinic sites (56.4%) but a lower level of support for transport by taxi (35.9%). Both paramedics and EMTs demonstrated very little support for non-transport (20.5% and 22.5% respectively). These low levels of support are not surprising given that only 48.7% of paramedics and 62.4% of EMTs agreed that children defined by the study as low-acuity could be considered low-acuity. Previous studies have

found that EMS clinicians believe many of their patients do not require emergency ambulance transport to the ED. (Crowe et al., 2018, 2020; Ward, Singletary, et al., 2022) Most previous studies, however, have not assessed support for specific alternatives, and one recent study noted a lack of agreement among EMS clinicians about whether children should be included in such programs (Power et al., 2019). It is also important to note that decisions around the transport for children are not based solely on medical acuity, but also caregiver preferences and various social needs may need to be considered. EMS clinicians may be reluctant to recommend alternative dispositions if they believe caregivers will be opposed. (Ward, Singletary, et al., 2022)

To summarize, paramedics demonstrated significantly higher sensitivity when detecting high-acuity children, but lower specificity than EMTs. Both paramedics and EMTs collectively demonstrated low support for use of alternative dispositions, however paramedics demonstrated lower support for use of alternative means of transport.

There are several implications of our findings. First, relying on clinical impressions of acuity for non-transport decisions or alternative dispositions may be unsafe regardless of whether a paramedic or EMT makes this assessment. The lower limit of the 95% confidence interval for the NPV when identifying children as having emergent needs (not low-acuity) was 0.63 for paramedics and 0.54 for EMTs. This suggests that the under-triage for children could be as high as 37% and 46%, respectively. There is, however, no consensus on how under-triage should be defined, nor what an acceptable rate of under-triage would be. (Mann, 2004) The safety of EMS clinician acuity assessments is paramount, as one-third of all pediatric patients assessed by EMS are not transported from the scene. (Ward et al., 2022) There is a lack of validated pediatric non-transport protocols, so most of these non-transport decisions likely rely on the clinical gestalt of EMS clinicians and caregivers. Despite the high rate of non-transport for children, safety outcomes after pediatric non-transport in the US are poorly described. Most studies examining outcomes after pediatric non-transport have involved single EMS agencies enrolled in small total patient numbers and have low follow-up capture rates. (Haines et al., 2006; Seltzer et al., 2001) Our study suggests an urgent need to better understand patient outcomes after non-transport by EMS.

Second, our study suggests that the clinical gestalt of EMS clinicians (both paramedics and EMTs) may need to be enhanced with dedicated pediatric protocols and triage tools to identify children who can be safely managed through alternative dispositions. Existing EMS triage measures focus on identifying severely ill and injured patients, have low sensitivities, and perform poorly in children (Totten et al., 2018). EMS clinicians have noted there is a need for pediatric non-transport protocols that include clear endpoints, incorporate vital sign parameters, and can be integrated into the electronic record. (Ward, Singletary, et al., 2022) Tools such as the Paediatric Observation Priority Score (POPS) have been pilot-tested in the prehospital setting with some success, (Morgan & Cutter, 2023) but further research is needed to validate their use in standard EMS protocols.

Third, pediatric alternative EMS disposition programs may be challenging to implement if EMS clinicians continue to show only modest support for these alternative management options. (Martin & O'Meara, 2019; O'Meara et al., 2015) Further qualitative research is needed to understand EMS clinician perspectives on pediatric non-transport. It will be important that any pediatric non-transport protocols and triage tools are developed

with paramedics and EMT input and assessed for acceptability and feasibility with these distinct groups of EMS clinicians.

Finally, our results highlight the need for comprehensive pediatric readiness in EMS agencies. The recently launched National Pediatric Prehospital Readiness Project (NPPRP) provides an opportunity for EMS agencies to assess pediatric readiness. The project is based on a combined policy statement addressing pediatric readiness in EMS systems issued by the American Academy of Pediatrics (AAP), American College of Emergency Physicians (ACEP), Emergency Nurses Association (ENA), National Association of EMS Physicians (NAEMSP) and National Association of Emergency Medical Technicians (NAEMTs) (Moore et al, 2020). The survey assesses readiness in several key domains including: education and competencies for providers, equipment and supplies, interactions with systems of care, coordination of pediatric emergency care, patient and family-centered care, patient and medication safety, policies, procedures and protocols, and quality improvement/performance improvement. On completing this survey, EMS agencies will be provided with benchmark data, a gap report and links to resources to improve readiness.

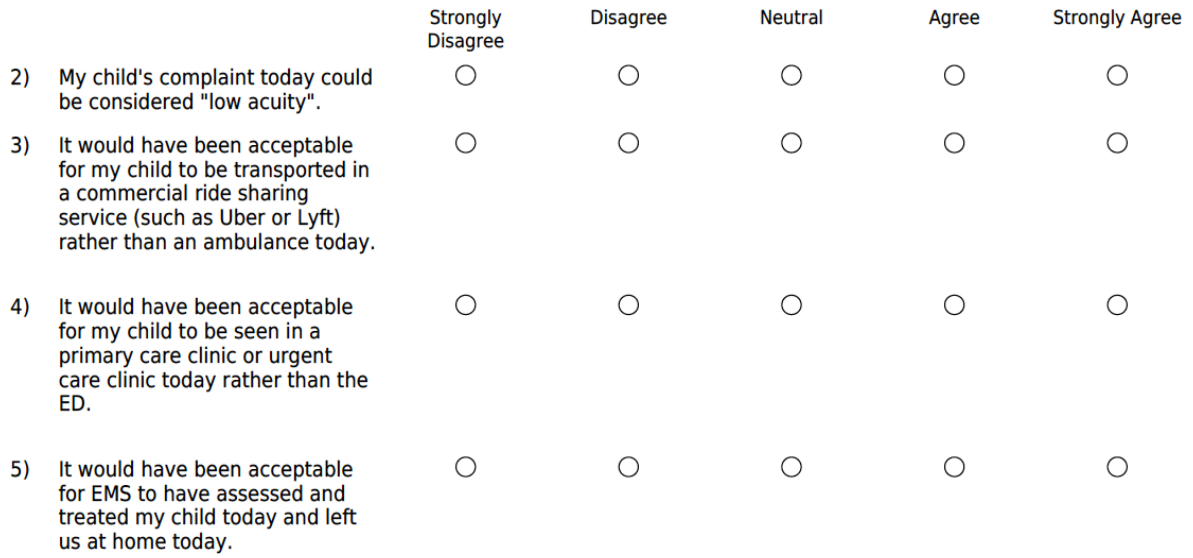
Limitations

This study has several limitations. First, this single-center study was conducted in an urban setting with two-tiered EMS agencies with robust pediatric skills verification programs. Care should be taken extrapolating findings beyond this setting. Second, this study compared EMS clinical impressions against a more objective composite reference standard for low-acuity. Although we observed limited accuracy for paramedics and EMTs, this does not mean that EMS clinicians cannot apply triage protocols with fidelity to triage patients accurately. Third, this study was conducted during the COVID-19 pandemic, which altered both call volume and call types for EMS. (Lerner et al., 2020; Satty et al., 2021) This may have impacted EMS clinicians' acuity assessments and levels of support for alternative EMS dispositions. Fourth, this study was restricted to children transported to the ED by EMS. Excluding non-transported children, most of whom have low-acuity complaints, (Ward et al., 2022) may bias our results. Finally, there are limitations related to our survey methodology. Participants were enrolled during windows when research staff were available. Although the overall demographics of the enrolled participants were similar to overall ED data, there may have been differences in the patients enrolled and EMS clinicians between these enrollment windows and overnight periods. Second, EMS clinicians were not blinded to interventions performed on the participants, which may have led to us overestimating accuracy in identifying low-acuity children. We minimized this impact by not sharing the study definition of low-acuity with EMS clinicians. In addition, when completing the study survey EMS clinicians may have been influenced by the clinical impressions of other EMS clinicians involved in patient care prior to transport.

CONCLUSIONS

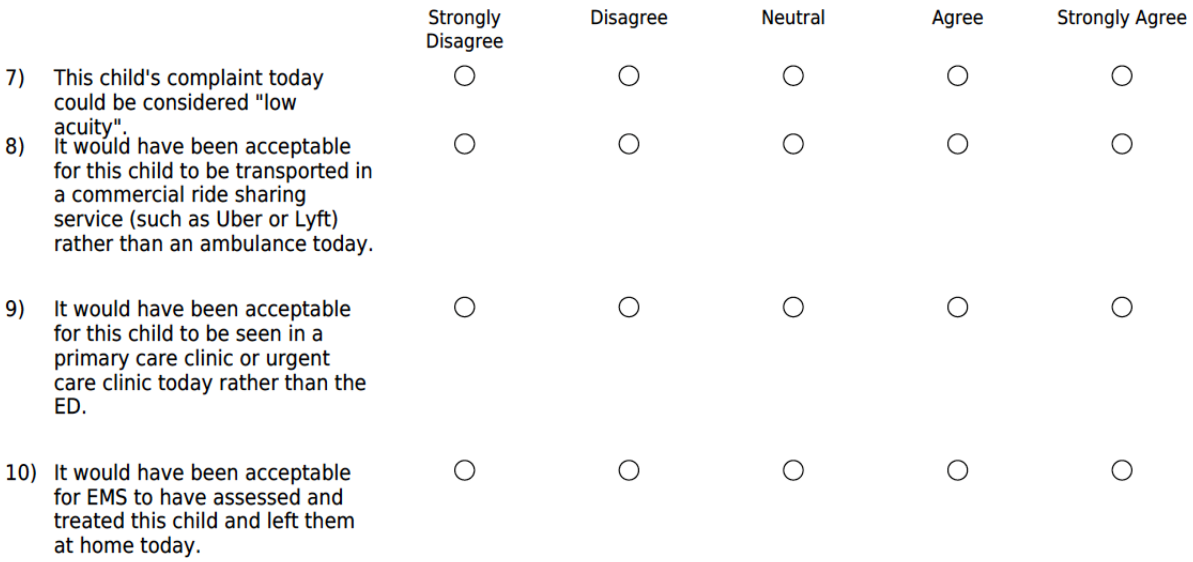
This prospective observational study is the first to show that both paramedics and EMTs have low accuracy when identifying children with low-acuity complaints. This may result in both overtriage and undertriage of pediatric EMS calls. We also observed limited support from both paramedics and EMTs for including children in alternative EMS

dispositions programs, with less support from both paramedics and EMTs for treatment in place/non-transport when compared to transport to alternative locations and transport via alternative means. These findings suggest significant challenges to implementing pediatric alternative EMS disposition programs. There is an urgent need for further research to develop and validate non-transport protocols and triage tools for children with low-acuity conditions. Our findings suggest that such triage tools must be assessed for feasibility, reliability, and validity with paramedics and EMTs.



		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
2)	My child's complaint today could be considered "low acuity".	○	○	○	○	○
3)	It would have been acceptable for my child to be transported in a commercial ride sharing service (such as Uber or Lyft) rather than an ambulance today.	○	○	○	○	○
4)	It would have been acceptable for my child to be seen in a primary care clinic or urgent care clinic today rather than the ED.	○	○	○	○	○
5)	It would have been acceptable for EMS to have assessed and treated my child today and left us at home today.	○	○	○	○	○

Figure 3. Survey questions administered to caregivers.



		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7)	This child's complaint today could be considered "low acuity".	○	○	○	○	○
8)	It would have been acceptable for this child to be transported in a commercial ride sharing service (such as Uber or Lyft) rather than an ambulance today.	○	○	○	○	○
9)	It would have been acceptable for this child to be seen in a primary care clinic or urgent care clinic today rather than the ED.	○	○	○	○	○
10)	It would have been acceptable for EMS to have assessed and treated this child and left them at home today.	○	○	○	○	○

Figure 4. Survey questions administered to EMS clinicians.

REFERENCES

Alpert, A., Morganti, K. G., Margolis, G. S., Wasserman, J., & Kellermann, A. L. (2013). Giving EMS Flexibility In Transporting Low-Acuity Patients Could Generate Substantial Medicare Savings. *Health Affairs, 32*(12), 2142–2148. https://doi.org/10.1377/hlthaff.2013.0741

Brown, L. H., Hubble, M. W., Cone, D. C., Millin, M. G., Schwartz, B., Patterson, P. D., Greenberg, B., & Richards, M. E. (2009). Paramedic Determinations of Medical Necessity: A Meta-Analysis. *Prehospital Emergency Care, 13*(4), 516–527. https://doi.org/10.1080/10903120903144809

Cone, D. (2004a). Developing research criteria to define medical necessity in emergency medical services*1. *Prehospital Emergency Care, 8*(2), 116–125. https://doi.org/10.1016/j.prehos.2003.12.002

Cone, D. (2004b). Field triage systems: Methodologies from the literature*1. *Prehospital Emergency Care, 8*(2), 130–137. https://doi.org/10.1016/j.prehos.2003.12.004

Crowe, R. P., Bower, J. K., Cash, R. E., Panchal, A. R., Rodriguez, S. A., & Olivo-Marston, S. E. (2018). Association of Burnout with Workforce-Reducing Factors among EMS Professionals. *Prehospital Emergency Care, 22*(2), 229–236. https://doi.org/10.1080/10903127.2017.1356411

Crowe, R. P., Fernandez, A. R., Pepe, P. E., Cash, R. E., Rivard, M. K., Wronski, R., Anderson, S. E., Hogan, T. H., Andridge, R. R., Panchal, A. R., & Ferketich, A. K. (2020). The association of job demands and resources with burnout among emergency medical services professionals. *Journal of the American College of Emergency Physicians Open, 1*(1), 6–16. https://doi.org/10.1002/emp2.12014

Derlet, R. W., & Richards, J. R. (2000). Overcrowding in the nation's emergency departments: Complex causes and disturbing effects. *Annals of Emergency Medicine, 35*(1), 63–68. https://doi.org/10.1016/s0196-0644(00)70105-3

Duong, H. V., Herrera, L. N., Moore, J. X., Donnelly, J., Jacobson, K. E., Carlson, J. N., Mann, N. C., & Wang, H. E. (2018). National Characteristics of Emergency Medical Services Responses for Older Adults in the United States. *Prehospital Emergency Care, 22*(1), 7–14. https://doi.org/10.1080/10903127.2017.1347223

Gilboy, N., Tanabe, P., Travers, D., & Rosenau, A. (2011). Emergency Severit Index 9ESI): A Triage Tool for Emergency Department Care, Version 4. *Implementation Handbook*. Agency for Healthcare Research and Quality. https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/esi/esihandbk.pdf

Goldman, S., Doetzer, G., Parekh, A., Carr, B., & Alley, D. (2020). Right Care, Right Place, Right Time: The CMS Innovation Center Launches the Emergency Triage, Treat, and Transport Model. *Annals of Emergency Medicine, 75*(5), 609–611. https://doi.org/10.1016/j.annemergmed.2019.09.006

Haines, C. J., Lutes, R. E., Blaser, M., & Christopher, N. C. (2006). Paramedic Initiated Non-Transport of Pediatric Patients. *Prehospital Emergency Care, 10*(2), 213–219. https://doi.org/10.1080/10903120500541308

Hansen, M., Meckler, G., Dickinson, C., Dickenson, K., Jui, J., Lambert, W., & Guise, J.-M. (2015). Children's Safety Initiative: A National Assessment of Pediatric Educational Needs among Emergency Medical Services Providers. *Prehospital Emergency Care, 19*(2), 287–291. https://doi.org/10.3109/10903127.2014.959223

Jensen, J. L., Carter, A. J. E., Rose, J., Visintini, S., Bourdon, E., Brown, R., McVey, J., & Travers, A. H. (2015). Alternatives to Traditional EMS Dispatch and Transport: A Scoping Review of Reported Outcomes. *CJEM, 17*(5), 532–550. https://doi.org/10.1017/cem.2014.59

Jeruzal, J. N., Boland, L. L., Frazer, M. S., Kamrud, J. W., Myers, R. N., Lick, C. J., & Stevens, A. C. (2019). Emergency Medical Services Provider Perspectives on Pediatric Calls: A Qualitative Study. *Prehospital Emergency Care, 23*(4), 501–509. https://doi.org/10.1080/10903127.2018.1551450

Kahalé, J., Osmond, M. H., Nesbitt, L., & Stiell, I. G. (2006). What are the characteristics and outcomes of nontransported pediatric patients? *Prehospital Emergency Care, 10*(1), 28–34. https://doi.org/10.1080/10903120500373322

Kamper, M., Mahoney, B. D., Nelson, S., & Peterson, J. (2001). Feasibility of Paramedic Treatment and Referral of Minor Illnesses and Injuries. *Prehospital Emergency Care, 5*(4), 371–378. https://doi.org/10.1080/10903120190939535

Lerner, E. B., Newgard, C. D., & Mann, N. C. (2020). Effect of the Coronavirus Disease 2019 (COVID-19) Pandemic on the U.S. Emergency Medical Services System: A Preliminary Report. *Academic Emergency Medicine, 27*(8), 693–699. https://doi.org/10.1111/acem.14051

Levine, S. D., Colwell, C. B., Pons, P. T., Gravitz, C., Haukoos, J. S., & McVaney, K. E. (2006). How well do paramedics predict admission to the hospital? A prospective study. *The Journal of Emergency Medicine, 31*(1), 1–5. https://doi.org/10.1016/j.jemermed.2005.08.007

Mann, N. (2004). Defining research criteria to characterize medical necessity in emergency medical services: A consensus among experts at the neely conference*1. *Prehospital Emergency Care, 8*(2), 138–153. https://doi.org/10.1016/j.prehos.2003.12.005

Martin, A., & O'Meara, P. (2019). Perspectives from the frontline of two North American community paramedicine programs: An observational, ethnographic study. *Rural and Remote Health*. https://doi.org/10.22605/RRH4888

Mell, H. K., Mumma, S. N., Hiestand, B., Carr, B. G., Holland, T., & Stopyra, J. (2017). Emergency Medical Services Response Times in Rural, Suburban, and Urban Areas. *JAMA Surgery, 152*(10), 983. https://doi.org/10.1001/jamasurg.2017.2230

Millin, M. G., Brown, L. H., & Schwartz, B. (2011). EMS Provider Determinations of Necessity for Transport and Reimbursement for EMS Response, Medical Care, and Transport: Combined Resource Document for the National Association of EMS Physicians Position Statements. *Prehospital Emergency Care, 15*(4), 562–569. https://doi.org/10.3109/10903127.2011.598625

Morgan, R., & Cutter, J. (2023). Prehospital use of the paediatric observation priority score. *Journal of Paramedic Practice, 15*(8), 330–336. https://doi.org/10.12968/jpar.2023.15.8.330

National Registry of Emergency Medical Technicians. (2023). *National Registry Data, Dashboard and Maps*. https://www.nremt.org/maps

O'Meara, P., Stirling, C., Ruest, M., & Martin, A. (2015). Community paramedicine model of care: An observational, ethnographic case study. *BMC Health Services Research, 16*(1), 39. https://doi.org/10.1186/s12913-016-1282-0

Patterson, P. D., Baxley, E. G., Probst, J. C., Hussey, J. R., & Moore, C. G. (2006). Medically Unnecessary Emergency Medical Services (EMS) Transports Among Children Ages 0 to 17 Years. *Maternal and Child Health Journal, 10*(6), 527–536. https://doi.org/10.1007/s10995-006-0127-6

Pointer, J. E., Levitt, M. A., Young, J. C., Promes, S. B., Messana, B. J., & Adèr, M. E. J. (2001). Can paramedics using guidelines accurately triage patients? *Annals of Emergency Medicine, 38*(3), 268–277. https://doi.org/10.1067/mem.2001.117198

Power, B., Bury, G., & Ryan, J. (2019). Stakeholder opinion on the proposal to introduce 'treat and referral' into the Irish emergency medical service. *BMC Emergency Medicine, 19*(1), 81. https://doi.org/10.1186/s12873-019-0295-5

Price, T. G., Hooker, E. A., & Neubauer, J. (2005). Prehospital Provider Prediction of Emergency Department Disposition: *Prehospital Emergency Care, 9*(3), 322–325. https://doi.org/10.1080/10903120590962012

Rahman, A., Curtis, S., DeBruyne, B., Sookram, S., Thomson, D., Lutz, S., & Ali, S. (2015). Emergency Medical Services Provider Comfort with Prehospital Analgesia Administration to Children. *Prehospital and Disaster Medicine, 30*(1), 66–71. https://doi.org/10.1017/S1049023X14001277

Richards, J. R., & Ferrall, S. J. (1999). Triage ability of emergency medical services providers and patient disposition: A prospective study. *Prehospital and Disaster Medicine, 14*(3), 174–179.

SAS/STAT 15.3 User's Guide. (2023). [Computer software]. SAS Institute Inc.

Satty, T., Ramgopal, S., Elmer, J., Mosesso, V. N., & Martin-Gill, C. (2021). EMS responses and non-transports during the COVID-19 pandemic. *The American Journal of Emergency Medicine, 42*, 1–8. https://doi.org/10.1016/j.ajem.2020.12.078

Schmidt, T. (2004). Criteria currently used to evaluate dispatch triage systems: Where do they leave us?*1. *Prehospital Emergency Care, 8*(2), 126–129. https://doi.org/10.1016/j.prehos.2003.12.003

Seltzer, A. G., Vilke, G. M., Chan, T. C., Fisher, R., & Dunford, J. V. (2001). Outcome study of minors after parental refusal of paramedic transport. *Prehospital Emergency Care, 5*(3), 278–283. https://doi.org/10.1080/10903120190939797

Totten, A. M., Cheney, T. P., O'Neil, M. E., Newgard, C. D., Daya, M., Fu, R., Wasson, N., Hart, E. L., & Chou, R. (2018). *Physiologic Predictors of Severe Injury: Systematic Review.* Agency for Healthcare Research and Quality (AHRQ). https://doi.org/10.23970/AHRQEPCCER205

Ward, C. E., Badolato, G. M., Taylor, M. F., Brown, K. M., Simpson, J. N., & Chamberlain, J. M. (2022). Clinician and Caregiver Determinations of Acuity for Children Transported by Emergency Medical Services: A Prospective Observational Study. *Annals of Emergency Medicine, S0196-0644*(22)01088-5. https://doi.org/10.1016/j.annemergmed.2022.09.002

Ward, C. E., Singletary, J., Campanella, V., Page, C., & Simpson, J. N. (2023). Caregiver Perspectives on Including Children in Alternative Emergency Medical Services Disposition Programs: A Qualitative Study. *Prehospital Emergency Care, 0*(ja), 1–17. https://doi.org/10.1080/10903127.2023.2206480

Ward, C. E., Singletary, J., Hatcliffe, R. E., Colson, C. D., Simpson, J. N., Brown, K. M., & Chamberlain, J. M. (2022). Emergency Medical Services Clinicians' Perspectives on Pediatric Non-Transport. *Prehospital Emergency Care*, 1–22. https://doi.org/10.1080/10903127.2022.2108180

Ward, C., Zhang, A., Brown, K., Simpson, J., & Chamberlain, J. (2022). National Characteristics of Non-Transported Children by Emergency Medical Services in the United States. *Prehospital Emergency Care, 26*(4), 537–546. https://doi.org/10.1080/10903127.2021.1985666

Zachariah, B. S., Bryan, D., Pepe, P. E., & Griffin, M. (1992). Follow-up and Outcome of Patients Who Decline or Are Denied Transport by EMS. *Prehospital and Disaster Medicine, 7*(4), 359–364. https://doi.org/10.1017/S1049023X00039777

Zaritsky, A. (1994). A Statewide Evaluation of Pediatric Prehospital and Hospital Emergency Services. *Archives of Pediatrics & Adolescent Medicine, 148*(1), 76. https://doi.org/10.1001/archpedi.1994.02170010078019