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Clinician and Caregiver Determinations of Acuity for Children Transported by Emergency Medical Services: A Prospective Observational Study

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Abstract

Objectives—Many Emergency Medical Services (EMS) agencies have developed alternative disposition processes for patients with non-emergent problems, but there is a lack of evidence demonstrating EMS clinicians can accurately determine acuity in pediatric patients. Our study objective was to determine EMS and other stakeholder ability to identify low acuity pediatric EMS patients.

Methods—We conducted a prospective, observational study of children transported to a pediatric emergency department (ED) by EMS. *Acuity* was defined using a composite measure that included data from patient vitals and exam, resources used (labs, radiographs, etc.), and disposition. For each patient, an EMS clinician, patient caregiver, ED nurse, and ED provider completed a survey as soon as possible after patient arrival to the ED. The survey asked respondents two questions: (1) to state their level of agreement that a patient was low acuity and (2) could the patient have been managed by various alternative dispositions. For each respondent group, we calculated the sensitivity, specificity, positive and negative predictive values (PPV and NPV) for low acuity versus the composite measure.

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Conflict of Interest:

CW reports no conflict of interest

GB reports no conflict of interest

MT reports no conflict of interest

KB reports no conflict of interest

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JC reports no conflict of interest

Results—From August 2020 through September 2021, we approached 1,015 caregivers, of whom 996 (99.8%) agreed to participate and completed a survey. Survey completion varied between 78.7% and 84.1% for EMS and ED nurses and providers. Mean patient age was 7 years, 62.6% were non-Hispanic black, and 60% were enrolled in public insurance programs. Of the 996 patient encounters, 33% were determined to be low acuity by the composite measure. The positive predictive value (PPV) for EMS clinicians when identifying low acuity children was 0.60 (95% CI 0.58, 0.67). The PPV for ED nurses and providers was 0.67 (95% CI 0.61, 0.72) and 0.68 (95% CI 0.63, 0.74) respectively. The NPV for EMS clinicians when identifying not low acuity children was 0.62 (95% CI 0.58, 0.67). The NPV for ED nurses and providers was 0.72 (95% CI 0.68, 0.76) and 0.73 (95% CI 0.70, 0.77) respectively. Caregivers had the lowest PPV (0.34 [95% CI 0.30, 0.40]) but the highest NPV (0.82 [95% CI 0.79, 0.85]). EMS clinicians, ED nurses & providers were more likely than caregivers to think that a child with a low acuity complaint could have been safely managed by alternative disposition.

Conclusions—All four groups studied had a limited ability to identify which children transported by EMS will have no emergency resource needs, and support for alternative disposition was limited. For children to be included in alternative disposition processes, novel triage tools, training, and oversight will be required to prevent undertriage.

INTRODUCTION

Background

Emergency Medical Services (EMS) responds to more than 28 million 9-1-1 dispatches annually in the US.¹ Many of these patients do not require emergency treatment. The use of Emergency Medical Services (EMS) for non-emergent problems can be unsafe and inefficient.^{2,3} Both the federal government and research leaders have called for alternative EMS disposition programs.⁴⁻⁷ Potential alternatives include taxis, transporting to clinics rather than the emergency department (ED), and leaving patients at the scene. Children, however, have been excluded from most alternative disposition programs.³

Importance

The National Association of EMS Physicians (NAEMSP) has noted a paucity of peer-reviewed literature showing that EMS clinicians can reliably determine the necessity for emergent transportation.³ Furthermore, most previous studies have been restricted to adult patients, used an inadequate reference standard (such as physician opinion or hospital admission⁸⁻¹⁸), or focused on predicting patients with critical care needs.^{19,20} The only study specifically measuring the accuracy of paramedic determinations of medical necessity in children compared paramedic accuracy to a base station physician, who's assessment was based only on EMS report.²¹ It is, therefore, currently unknown whether EMS clinicians can identify low acuity children who might be candidates for alternative dispositions. Furthermore, it is also unknown how whether other stakeholders, including patient caregivers, can accurately determine patient acuity.

There is also little evidence describing stakeholders' attitudes regarding including children in alternative EMS disposition programs. Most previous studies have been surveys of adult patients and included limited pediatric caregivers.²²⁻²⁴ Many of these surveys found that

patients generally supported alternative EMS dispositions but did not ask about views related to a specific clinical encounter or patient. Furthermore, the views of EMS and ED clinicians about including children in alternative EMS disposition programs are poorly described. Stakeholder engagement and acceptance have been essential in previous successful EMS system innovations.²⁵⁻²⁷ Therefore, understanding whether there are different levels of support between stakeholder groups will be important when designing and implementing alternative EMS disposition programs for children.

Goals of This Investigation

The primary objective of this study is to determine whether the acuity impressions of EMS clinicians, caregivers, and ED nurses and providers predict children transported by EMS who ultimately have no urgent or emergent resource needs. The secondary objective of this study is to determine the level of support among EMS clinicians, caregivers, and ED nurses and providers for specific alternative dispositions for children with no urgent or emergent resource needs.

METHODS

Study Design and Setting

We conducted a planned secondary analysis of data collected during a prospective, observational study of children transported by EMS to a single pediatric ED. The ED's parent institution is an urban academic freestanding children's hospital and a Level 1 Pediatric Trauma Center. The institution provides EMS medical direction for pediatric patients and receives almost all pediatric EMS transports from the District of Columbia (DC) and most pediatric EMS transports from two neighboring counties in Maryland. Most EMS transports to the study site are from four EMS agencies, all of which are two-tiered ALS and BLS systems. Three of these agencies are entirely staffed by career EMS clinicians, and one comprises both career and volunteer staff. The local Institutional Review Board approved this study. This report is presented consistent with the STROBE guidelines for observational studies.

Selection of Participants—Patients were eligible for enrollment if they were less than 18 years old and transported to the pediatric ED by EMS. We excluded interfacility transports and patients with an Emergency Severity Index (ESI) score of 1 (requires immediate life-saving interventions).²⁸ We also excluded caregivers with a primary language other than English or Spanish. Caregivers of eligible children were approached consecutively for consent by research staff on weekdays from 8 am to 11 pm and on weekends from 2 pm to 10 pm. If caregivers agreed to participate, the EMS clinician, ED nurse, and provider caring for the patient were also asked to complete a study survey.

Data Source—The data for this study were collected from participant surveys and the electronic health care records of enrolled children. The survey had four questions – one question about whether their child could be considered to have a low acuity complaint and three on alternative dispositions (Supplemental Figure 1). These four survey questions

closely match survey items developed in a previously validated survey.²⁹ The survey questions were pilot tested to optimize face validity.

The EMS clinician, ED triage nurse, and ED provider were provided with a study preamble and asked the same four survey questions. The survey preamble described potential EMS alternative dispositions that have been developed for low acuity patients. Respondents were asked to base their answers on their overall impression of the specific patient encounter, not with reference to a specific protocol. Research associates approached eligible caregivers on arrival in the ED, for enrollment and survey completion. EMS clinicians completed the survey prior to leaving the ED. Research associates asked ED nurses and providers to complete the survey as soon as possible after EMS. All surveys were completed before to final patient disposition from the ED. The survey was either completed by the participant directly on a tablet device or read to the participant, with the research staff entering responses based on the participant preference. Subjects were blinded to the answers of other study participants for a given patient.

After each encounter, trained research staff (blinded to survey results) reviewed both the ED medical record and EMS care report to collect additional information. Data extracted electronically from the ED medical record included: arrival time, patient demographics, zip code of residence, insurance status, all vital signs, ESI triage level, medications administered, radiographic procedures performed, procedures completed, and any return visits within five days of the index visit. Data extracted from EMS care report included: the chief complaint, all vital signs, medications administered, and procedures performed. Median household income was obtained by linking the zip code of residence with US census data (Table s1903 in the American community survey).

Outcome Measures—The primary objective of this study was to determine the ability of each of four stakeholder groups to identify low acuity pediatric patients. Our gold standard for patient acuity, to compare with stakeholder assessment, was a novel composite measure based on the results of the Neely Conference.³⁰⁻³³ The composite measure consisted of a patient: (1) not having unstable vital signs, (2) not requiring any urgent or emergent resources by EMS or in the ED, and (3) not having a final ED disposition of admission to the hospital or death. Urgent or emergent resources included both EMS procedures or medications and ED blood-based laboratory tests, radiographs, intravenous medications or procedures. A final ED disposition of admission to the hospital could be either on the date of the initial EMS encounter or as a result of a return ED visit within five days. We defined *unstable vital signs* as any oxygen saturation less than 96%, systolic blood pressure less than the 5th percentile for age, or vital signs that triggered the automated sepsis alert in the ED. *EMS procedures* included any airway intervention, placement of a peripheral intravenous catheter, and application of a splint or cervical collar. *EMS medications* included all medications administered, regardless of route of administration. *ED procedures* included laceration repair, fracture reduction, and procedural sedation. We defined *low acuity* as a patient having none of the three components of the composite measure, i.e., vitals signs were stable, no procedures or testing was performed by EMS, no radiographs, intravenous medications or procedures were performed in the ED, and the patient was discharged home from the ED.

Analysis—We first tabulated all survey responses and patient data and generated standard descriptive statistics. We then calculated the sensitivity, specificity, and positive and negative predictive value [with 95% confidence intervals (CI)] of stakeholder agreement that their child was low acuity versus the composite measure. For all analyses, we defined *agreement* as caregiver responding “agree” or “strongly agree” that the patient was low acuity and *disagreement* as the caregiver responding “neutral”, “disagree”, or “strongly disagree”. We compared testing characteristics among stakeholder groups. EMS clinicians are less comfortable managing very young children compared to their school aged counterparts.^{34,35} We therefore also calculated the four testing characteristics for the sub-group of patients less than 2 years old.

For the subset of patients classified as low acuity by the composite measure, we used the survey results to calculate the level of agreement by stakeholder group that these children would be acceptable candidates for alternative EMS dispositions. We again grouped “strongly agree” and “agree” responses and “neutral”, “disagree”, and “strongly disagree” responses. Support between stakeholder groups was compared using percentage agreement and kappa coefficients. All statistical analyses were conducted using SAS software, Version 9.3 (SAS Institute, Inc, Cary, NC). The target sample size for the parent study was 1000 patient encounters.

RESULTS

Characteristics of Study Subjects

We approached 1,015 caregivers between August 2020 and September 2021, of which 996 (98.1%) agreed to participate in the study. All enrolled caregivers completed the survey. Survey completion rates for the other stakeholder groups were: 84.1% for EMS clinicians, 83.3% for ED providers, and 78.7% for ED nurses. Of the EMS respondents, 22.8% were Paramedics and 77.2% were Emergency Medical Technicians (EMTs). Of the ED providers, 54.6% were Pediatric Emergency Medicine attending physicians, 19.5% were pediatricians, 16.7% were Pediatric Emergency Medicine fellows, and 9.3% were nurse practitioners or physician assistants.

Mean patient age was 7 years (standard deviation 5.5), and 52.1% were male (Table 1). The most common race/ethnicity responses were non-Hispanic Black (62.6%) and Hispanic (17.5%). Most patients were enrolled in public insurance programs (60.0%), and 39.5% of patients arrived in the ED outside of usual primary care office hours. The sample characteristics for race/ethnicity and insurance status are similar to overall patient demographics for patients presenting to our ED.

Main Results

Of the enrolled children, 32.9% (95% CI 30.0, 36.0) were low acuity by the composite measure. The most common reasons patients were not low acuity were ED radiographic (35.8%) or blood based testing (29.5%; Table 2). Of enrolled children, 230 (23.1%) were admitted to the hospital. There were no return visits leading to admission or patient deaths. A small proportion of all groups agreed that children receiving either medications or

procedures from EMS were low acuity (8.8 – 17.9%). The highest levels of agreement that a child was low acuity were observed for radiographic testing (18.5 – 40.9%), completion of procedures in the ED (20.4 – 53.3%), and the presence of systolic hypotension (3.7 – 47.6%). For children admitted to the hospital there was significant variability in whether groups agreed that the child was low acuity (ranging from 7.9% for ED providers to 21.9% for EMS clinicians).

The positive predictive value (PPV) for EMS clinicians for identifying low acuity children compared to the composite measure was 0.60 (95% CI 0.58, 0.67). The PPV for ED nurses and providers was similar (0.67 [95% CI 0.61, 0.72] and 0.68 [95% CI 0.63, 0.74], respectively) (Table 3). Caregivers had the lowest PPV across stakeholder groups when identifying low acuity children with a PPV of 0.34 (95% CI 0.30, 0.40). The NPV in identifying not low acuity children was slightly higher for ED providers (0.73 [95% CI 0.70, 0.77]) and nurses (0.72 [95% CI 0.68, 0.76]) when compared to EMS clinicians (0.62 [95% CI 0.58, 0.67]). Caregivers had the highest NPV (0.82, 95% CI 0.79, 0.85). The results did not differ substantially for children under 2 years of age. (Supplemental Table 1)

For the 328 low acuity patients, caregivers showed low levels of support for all potential alternative EMS dispositions. Only 16.5% of caregivers supported allowing EMS to treat and leave children at the scene, with slightly higher levels of support for transporting by private vehicle or taxi (23.2%) or taking children to a clinic (27.4%). When compared to caregivers, EMS providers were more likely to support the use of a taxi (51.7%) or taking children to a clinic (53.4%). The support for leaving children at the scene was similar to caregivers (22.1%).

ED nurses and providers showed the highest levels of support for alternative EMS dispositions. Both ED nurses and providers were much more likely to think the use of a taxi for a low acuity child was appropriate when compared to caregivers (73.6% and 70.2%, respectively). Similarly, both ED nurses and providers were more likely to think low acuity children could be seen in a clinic rather than the ED (66.5% and 60.5% respectively). The alternative disposition option with the lowest levels of support from ED nurses and providers was allowing EMS to leave patients at the scene. Both ED nurses and providers, however, were still more likely to think this was an acceptable option when compared to caregivers (32.3% and 25.3% respectively). We observed no agreement ($K < 0$) or slight agreement ($K = 0 - 0.2$) when comparing caregiver perceptions with EMS clinicians. We observed slight or fair agreement ($K = 0.21 - 0.4$) when comparing ED nurse and provider perceptions with EMS clinicians (Table 4).

LIMITATIONS

Our study has several limitations. First, this was a single-center study undertaken in an urban area with mainly career-staffed EMS agencies. Caution should be taken extrapolating these findings to other populations. Second, this was a study comparing the overall clinical impression of stakeholders with an objective reference standard based on urgent or emergent resources needed. Clinicians may perform differently if assessing accuracy when using a specific triage protocol. Third, our study was conducted during the COVID-19

pandemic. The pandemic has resulted in changes in overall EMS call volumes and patient characteristics.^{36,37} This may have impacted all variables assessed, including stakeholder assessments of acuity and the level of support for alternative EMS dispositions. Fourth, there are specific limitations related to our survey methodology. Caregivers were approached in the ED when research staff were available. While our patient sample had similar demographics to our overall ED patient data, there may be differences between night shifts and other shifts, for example. Participants caring for a patient did not complete the survey at the same time. ED nurses and physicians may differ in their assessments of acuity and been more supportive of alternative dispositions because they had additional information regarding the patient's clinical condition. Survey respondents were also not blinded to interventions performed on the patient, which may have lead us to over-estimate the ability of stakeholders to identify low acuity patients. The impact of this was minimized by not sharing the study definition of low acuity with participants. We are also missing survey responses for up to 22.3% by provider type, which may have introduced non-response bias. Finally, there may have been acquiescence bias with caregivers and clinical providers believing that the research team wanted to hear approval of alternative dispositions. The low rate of support for alternative dispositions by caregivers suggests that this was not a significant problem.

DISCUSSION

All stakeholder groups – patient caregivers, EMS clinicians, and ED nurses and providers – had a limited ability to identify which children transported by EMS would be low acuity by our composite measure. EMS clinicians, ED nurses and providers had comparable levels of accuracy when assessing a patient as low acuity, while caregivers had the lowest accuracy. Caregivers were more accurate than EMS clinicians and ED staff when assessing their child as not low acuity. For low acuity patients, caregiver support for alternative disposition was very low, with ED nurses and providers generally more supportive. This is not surprising given that only 35% of caregivers agreed that children classified as having no urgent or emergent resource needs could be considered low acuity. Across all stakeholder groups, the least popular alternative disposition option was leaving children at the scene with support, ranging from 17% (caregivers) to 32% (ED nurses).

The PPV of 0.60 for EMS clinicians identifying low acuity children is lower than in previous studies. A 2012 meta-analysis of 13 studies reported an overall predictive value of 0.91 (95% CI 0.71, 0.98) for paramedic determination of patients not requiring ambulance transport and 0.68 (0.48, 0.83) for patients not needing ED evaluation.³⁸ The lower value in our study may stem from differences in how the reference standard for low acuity was defined. We deliberately used a conservative definition to capture only the lowest acuity patients, i.e., children who did not have unstable vital signs, required no testing or procedures by EMS or in the ED, and were discharged home from the ED. For example, in our study a child who needed a radiograph for an ankle injury would have been excluded from the low acuity group but may be generally perceived as low acuity. There may also be differences in the patient populations studied. Most of the included studies were conducted with adult patients.⁸⁻¹⁸ The only previous study assessing paramedic determinations of medical necessity in children reported a predictive value of 0.98 when identifying children

who could be safely left at scene but relied on a verbal report from EMS to determine accuracy.²¹ Another explanation for the lower predictive value in our study may be that we included both paramedics and EMTs, whereas most previous studies were restricted to paramedics. We included EMTs in our study as approximately 20% of pediatric non-transported in the US currently are seen by BLS units.³⁹ Finally, we were not able to study children already left at the scene and not transported. Not including this group of children, who probably had very low acuity complaints, may have resulted lower NPVs for all groups.

The levels of caregiver support for alternative EMS disposition in our study are also lower than have been reported.²²⁻²⁴ Previous studies found that caregiver support for specific elements of alternative EMS disposition programs ranged from 50 to 70% and did not vary significantly by patient race/ethnicity or insurance status.²²⁻²⁴ The lower levels of caregiver support in our study may indicate that caregivers are less supportive of alternative EMS dispositions when considering a specific clinical encounter than when considering the general concept. When considering the views of other stakeholders, many studies have shown that EMS clinicians and ED physicians believe that a substantial proportion of EMS patients do not require emergent transport by ambulance to the ED.⁴⁰⁻⁴⁴ Very few of these studies, however, have specifically assessed stakeholder support for alternative disposition programs, and none compare agreement levels between groups. One recent study noted a lack of agreement among EMS clinicians about whether children should be included in such programs.²⁹

There has been a recent proliferation of alternative EMS disposition programs in the U.S.. This expansion is partly attributable to the federal Emergency Triage, Treat, and Transport (ET3) Program.⁴ The COVID-19 pandemic has further heightened interest in alternative EMS dispositions, with caregivers and families eager to avoid unnecessary ambulance transport to the ED.³⁶ Children, however, have been excluded from most pilot programs.³ Notwithstanding this exclusion, recent studies have found that approximately one-third of children assessed by EMS are not transported.^{45,46} Given the lack of validated pediatric non-transport protocols, most of these non-transport decisions are likely reliant on the clinical gestalt of EMS clinicians and caregivers. Our findings suggest that relying on clinical gestalt alone of EMS providers may result in significant under-triage. The lower limit of the 95% confidence interval for the PPV for EMS clinicians in this study was 0.58, indicating the under-triage rate for children could be as high as 42%. This is concerning, although there is no consensus on how to define under-triage and what rates of under-triage would be acceptable.³² Augmenting EMS judgment with ED nurse or provider input, through real-time telemedicine consults^{47,48}, may not result in significantly better performance given the similar PPVs we found for these groups. Our findings suggest that EMS clinician gestalt may need to be paired with evidence-based triage protocols (and possible scoring systems) to sort those patients with no resource needs from those with urgent and emergent resource needs. Such tools could then be applied to both low acuity children who are currently left at scene (to address potential under-triage) and those transported by EMS (to address potential over-triage). There is an urgent need to develop and validate such protocols.

In addition to having evidence-based triage tools, successful EMS system innovation will also require the support of key stakeholders.²⁵⁻²⁷ Our study suggests that caregivers perceive

patient acuity differently to EMS and ED clinicians. We also found that caregivers and EMS clinicians both have significant concerns about including children in non-transport programs. In addition, individuals with public insurance or non-white race/ethnicity have higher rates of EMS utilization for non-emergent complaints.⁴⁹⁻⁵² These populations could be disproportionately impacted by any expansion in alternative EMS disposition programs. Further qualitative research is required to understand the concerns of caregivers and EMS clinicians regarding alternative disposition programs. This could allow non-transport triage protocols to be modified to increase acceptability to these groups and to ensure that any changes are implemented equitably.

In conclusion, relying on the overall clinical gestalt of EMS clinicians, caregivers, or ED clinicians when developing pediatric alternative disposition programs may result in undertriage of pediatric EMS calls. There is, therefore, an urgent need to develop and validate pediatric non-transport protocols for children with low acuity complaints. These will need to be assessed for feasibility and then reliability and validity with EMS clinicians. Further qualitative research is needed to evaluate the concerns of both caregivers and EMS clinicians regarding including children in alternative EMS disposition programs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Characteristics of enrolled children transported to the emergency department (ED) by Emergency Medical Services (EMS) (Total n = 996)

<i>Variable</i>	
Age (years)	<i>N (%)</i>
< 1	125 (12.6)
1 – 3	297 (29.8)
4 – 6	133 (13.4)
7 – 12	230 (23.1)
13 – 18	211 (21.2)
Mean age (std)	7.0 (5.5)
Gender	
Male	519 (52.1)
Race	
Black/African-American, NH	623 (62.6)
Caucasian, NH	111 (11.1)
Hispanic	174 (17.5)
Other	74 (7.4)
Not Documented	14 (1.4)
Interpreter	
Yes	85 (8.5)
Insurance status	
Private insurance	195 (19.6)
Public	688 (69.1)
No insurance	58 (5.8)
Unknown	55 (5.5)
Median household income by zip code	
Fourth quartile	237 (23.8)
Third quartile	224 (22.5)
Second quartile	219 (22.0)
First quartile	233 (23.4)
Missing	83 (8.3)
Date/time arrival	
Office Hours (<i>Mon-Fri, 8 am – 5 pm</i>)	603 (60.5)
Chief Complaint	
Behavioral/psychiatric	46 (4.6)
CNS/Neurologic	148 (14.9)
Global/general	171 (17.2)
Musculoskeletal/skin	370 (37.2)
Pulmonary	136 (13.7)
Other	51 (5.1)
Injury	

<i>Variable</i>	
Age (years)	<i>N (%)</i>
Yes	386 (38.8)
Motor vehicle crash victim	
Yes	67 (6.7)
ESI triage level	
2	132 (13.2)
3	520 (52.2)
4	319 (32.0)
5	25 (2.5)

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Stakeholder level of agreement that a child transported to the ED by EMS was low acuity, for individual components of the study reference standard of having no urgent or emergent resource needs

Table 2:

Component of reference standard for children being classified as “not low acuity” (N, (%))	Caregiver	EMS ^d	ED Nurse ^a	ED Provider ^a
EMS Interventions				
Administration of any medication (160 (16.1%))	14/160 (8.8%)	17/131 (13.0%)	18/125 (14.4%)	20/129 (15.5%)
Procedure completed ^b (104 (10.4%))	12/104 (11.5%)	13/76 (17.1%)	14/80 (17.5%)	15/84 (17.9%)
Patient vital signs				
Hypoxia, SpO2 < 96% (147 (14.8%))	21/147 (14.3%)	28/121 (23.1%)	18/124 (14.5%)	15/123 (12.2%)
Systolic hypotension < 5 th percentile for age (27 (2.7%))	1/27 (3.7%)	7/21 (33.3%)	10/21 (47.6%)	9/20 (45%)
Vital signs triggered ED “Sepsis Alert” (14 (1.4%))	1/14 (7.1%)	2/11 (18.2%)	0/11 (0%)	1/12 (8.3%)
ED Interventions				
Radiographic testing (357 (35.8%))	66/357 (18.5%)	114/279 (40.9%)	69/280 (24.6%)	73/297 (24.6%)
Blood or CSF testing (294 (29.5%))	36/294 (12.2%)	57/232 (24.6%)	39/232 (16.8%)	31/243 (12.8%)
Administration of intravenous medications (266, (26.7%))	26/266 (9.8%)	57/201 (28.4%)	22/211 (10.4%)	23/226 (10.2%)
Procedure completed ^c (98 (9.8%))	20/98 (20.4%)	40/75 (53.3%)	26/73 (35.6%)	36/82 (43.9%)
Patient Disposition				
Admission to hospital (230 (23.1%))	26/230 (11.3%)	40/183 (21.9%)	15/186 (8.1%)	15/191 (7.9%)
TOTAL (all patients with 1 or more indicators for being excluded from low acuity group) (668 (67.1%))	118/668 (17.7%)	204/543 (37.6%)	148/527 (28.1%)	146/553 (26.4%)

^aFor EMS clinicians, ED nurses and providers the survey completion rate was < 100% so the relevant denominator is included for each cell.

^bEMS Procedures included airway interventions, placement of a peripheral intravenous catheter, application of a splint or cervical collar.

^cED procedures included laceration repair, fracture reduction, and procedural sedation.

^dA patient could be excluded for multiple reasons (e.g., hypoxia and admission to hospital); thus, the total of each individual component is > 668

Table 3:

Ability of stakeholders to predict pediatric patients transported by emergency medical services (EMS) with no emergent resource needs

	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Caregiver (<i>N</i> = 996)	0.50 (0.43, 0.56)	0.72 (0.69, 0.75)	0.34 (0.30, 0.40)	0.82 (0.79, 0.85)
EMS Clinician (<i>N</i> = 837)	0.46 (0.41, 0.51)	0.74 (0.70, 0.78)	0.60 (0.58, 0.67)	0.62 (0.58, 0.67)
ED Nurse (<i>N</i> = 781)	0.53 (0.48, 0.59)	0.82 (0.78, 0.85)	0.67 (0.61, 0.72)	0.72 (0.68, 0.76)
ED Provider (<i>N</i> = 829)	0.57 (0.51, 0.62)	0.82 (0.79, 0.86)	0.68 (0.63, 0.74)	0.73 (0.70, 0.77)

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Percentage agreement and Kappa coefficient for stakeholder assessments of suitability for children defined as low acuity in the study being managed by alternative disposition

Table 4:

	EMS Clinician* (N=328)	Caregiver (N=294 paired observations)			ED Nurse (N=226 paired observations)			ED Provider (N=246 paired observations)		
		% Agree	% Agreement	Kappa (95%CI)	% Agree	% Agreement	Kappa (95%CI)	% Agree	% Agreement	Kappa (95%CI)
This child's complaint could be considered "low acuity."	59.5	34.8	0.11 (0.01, 0.20)	66.5	65.9	0.28 (0.15, 0.41)	68.4	66.3	0.28 (0.16, 0.41)	
It would have been acceptable for this child to be transported in a commercial ride-sharing service rather than an ambulance today.	51.7	23.2	0.12 (0.01, 0.23)	73.6	58.9	0.18 (0.06, 0.31)	70.2	60.2	0.20 (0.08, 0.33)	
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	27.4	0.16 (0.05, 0.27)	66.5	61.1	0.20 (0.07, 0.33)	60.5	64.2	0.28 (0.16, 0.40)	
It would have been acceptable for EMS to have assessed and treated this child today and left them at home.	22.1	16.5	-0.05 (-0.16, 0.05)	32.3	72.1	0.30 (0.15, 0.45)	25.3	69.5	0.16 (0.01, 0.32)	

* Reference group