



Selected Topics: Prehospital Care

IMPACT OF RACE AND ETHNICITY ON EMERGENCY MEDICAL SERVICES ADMINISTRATION OF OPIOID PAIN MEDICATIONS FOR INJURED CHILDREN

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Abstract—Background: Treatment with analgesics for injured children is often not provided or delayed during prehospital transport. **Objective:** Our aim was to evaluate racial and ethnic disparities with the use of opioids during transport of injured children. **Methods:** We conducted a prospective study of injured children transported to 1 of 10 emergency departments from July 2019 to April 2020. Emergency medical services (EMS) providers were surveyed about prehospital pain interventions during transport. Our primary outcome was the use of opioids. We performed multivariate regression analyses to evaluate the association of patient demographic characteristics (race, ethnicity, age, and gender), presence of a fracture, EMS provider type (Advanced Life Support [ALS] or non-ALS) and experience (years), and study site with the use of opioids. **Results:** We enrolled 465 patients; 19% received opioids during transport.

The adjusted odds ratios (AORs) for Black race and Hispanic ethnicity were 0.5 (95% CI 0.2–1.2) and 0.4 (95% CI 0.2–1.3), respectively. The presence of a fracture (AOR 17.0), ALS provider (AOR 5.6), older patient age (AOR 1.1 for each year), EMS provider experience (AOR 1.1 for each year), and site were associated with receiving opioids. **Conclusions:** There were no statistically significant associations between race or ethnicity and use of opioids for injured children. The presence of a fracture, ALS provider, older patient age, EMS provider experience, and site were associated with receiving opioids. © 2022 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>)

Keywords—emergency medical services; disparities; race; ethnicity; pain management; pediatrics

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INTRODUCTION

Nearly 400,000 injured children are transported by emergency medical services (EMS) per year in the United

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6 States (1). EMS providers are trained to recognize,
7 quantify, and manage acute pain in children (2). EMS
8 evidence-based guidelines recommend that all EMS
9 providers should assess pain and provide opioids to in-
10 jured children with moderate or severe pain (3). Inade-
11 quate management of pain in children is associated with
12 long-term negative effects, including hyperalgesia, emo-
13 tional trauma, alterations in pain processing, and fear of
14 future medical encounters (4,5).

15 In spite of the importance of prehospital pain manage-
16 ment, injured children are often not provided pain medi-
17 cation and provision of opioid analgesia is significantly
18 lower compared with injured adults (2,6). Furthermore,
19 among injured children transported by EMS, prior stud-
20 ies have identified specific demographic characteristics as
21 risk factors for receiving less pain management. These
22 characteristics included younger patient age, lower so-
23 cioeconomic status, and Black race (7–9). However, these
24 results were based on retrospective studies and qualitative
25 surveys.

26 Our objective was to evaluate patient and provider
27 characteristics related to the administration of opioid pain
28 medications during the prehospital transport of injured
29 children, with a specific focus on evaluating for racial and
30 ethnic disparities.

31 MATERIALS AND METHODS

32 *Study Design and Setting*

33 We conducted a prospective study enrolling a conve-
34 nience sample of injured children with scene transport to 1
35 of 10 urban, academic emergency departments (EDs) be-
36 tween July 2019 and April 2020. The study protocol was
37 approved by the local Institutional Review Boards (IRBs)
38 at 6 sites. The xxx IRB served as the single IRB of record
39 for the remaining 4 sites. EMS providers provided consent
40 to participate in the study. The study was conducted under
41 waiver of written documentation of informed consent for
42 the EMS providers and waiver of consent for the patients.

43 *Study Setting and Population*

44 Study sites were affiliated with the Pediatric Emer-
45 gency Care Applied Research Network and included mul-
46 tiple regions of the United States (10). EMS agencies
47 transporting patients in this study represented a variety
48 of agencies that were fire-based, private, third-service, or
49 public utility systems. All participating EDs were level I
50 pediatric trauma centers.

51 We included patients aged 1 month to 18 years who
52 were transported directly by an EMS agency from the
53 scene with a traumatic injury. We excluded patients in

traumatic arrest, those with opioid allergies, and pregnant 54
patients. 55

56 *Study Procedures and Measurements*

57 Trained research coordinators at participating hospi- 58
tals screened and identified eligible patients on arrival to 59
the ED. Once a patient was determined to be eligible for 60
enrollment, the transporting EMS providers completed a 61
brief electronic survey at the time of ED handoff. Survey 62
questions identified prehospital pain interventions given 63
during transport. Survey questions were developed jointly 64
by study investigators and pilot tested by EMS provider 65
focus groups prior to the start of the study. Screening by 66
research coordinators varied across the 10 enrolling sites, 67
between 12 and 19 h per day on weekdays and 8–19 h per 68
day on weekends and holidays.

69 We abstracted patient injury and demographic char- 70
acteristics, including race and ethnicity, from hospital 71
records. Race was coded as White, Black, Other Race, 72
and Not Documented. American Indian or Alaskan Na- 73
tive, Asian, Native Hawaiian or Other Pacific Islander, 74
and multiracial were included as Other Race due to low 75
prevalence within each of those racial groups. Ethnic- 76
ity was coded as Hispanic or not Hispanic. We collected 77
EMS provider characteristics via provider self-report on 78
the electronic survey.

79 Our primary outcome was the administration of pre- 80
hospital opioid pain medication, which was either fen- 81
tanyl or morphine. The route of administration could be 82
intravenous, intramuscular, or intranasal.

83 *Analysis*

84 We formatted the data and recoded the variables us- 85
ing Stata statistical software, version 13.1 (StataCorp). 86
Descriptive statistics were used to characterize the study 87
population overall. Non-normal interval data were re- 88
ported with medians and interquartile ranges. We assumed 89
data were missing at random.

90 We first evaluated predictor variables on univariate 91
analysis, including patient demographic characteristics 92
(race, ethnicity, age, and gender), presence of a fracture, 93
EMS provider type (Advanced Life Support [ALS] or 94
non-ALS [includes nonparamedic EMS providers, such 95
as emergency medical technicians and advanced emer- 96
gency medical technicians]) and experience (years), and 97
study site with administration of opioid pain medications. 98
To assess the impact of race and ethnicity, we used a 99
multivariate regression model using chained equations to 100
impute missing data for seven predictor variables and one 101
outcome variable with missing data: race (n = 13), eth- 102
nicity (n = 13), age (n = 6), gender (n = 6), presence of a 103
fracture (n = 8), EMS level of training (n = 12), years of

104 EMS provider experience ($n = 12$), and prehospital treat-
105 ment with opioids ($n = 23$) (11). Adjusted odds ratios
106 (AOR) and 95% CIs were calculated. We included study
107 site as an auxiliary registry variable to potentially explain
108 missingness of variables included in the multiple impu-
109 tation model. Ten separate and complete data sets were
110 created through the multiple imputation process.

111 We conducted five separate sensitivity analyses to eval-
112 uate the robustness of the primary analysis, also using a
113 multivariate regression model using chained equations to
114 impute missing variables. First, we conducted a sensitivity
115 analysis that included only patients with the survey com-
116 pleted by ALS providers because EMS agencies generally
117 do not allow non-ALS providers to administer opioid pain
118 medications. Second, we included only patients that were
119 ultimately diagnosed with humerus, radius, ulna, femur,
120 or tibia fractures to identify patients most likely to require
121 opioid pain medications. Third, we conducted a sensi-
122 tivity analysis including only patients with prehospital
123 reported moderate to severe pain (4 or higher) to isolate
124 patients reporting higher levels of pain. Fourth, we con-
125 ducted the primary analysis using complete data only, to
126 check the results using imputed data did not differ greatly.
127 Fifth, we included transport by ALS provider as the pri-
128 mary outcome of interest to evaluate whether racial or
129 ethnic disparities existed in ALS transport.

130 We planned to include eight predictor variables, thus
131 we estimated that, given an expected outcome prevalence
132 rate of 25%, we would require a minimum of 320 patients
133 to have 10 outcomes per variable evaluated in the model.
134 Because our sample size estimate was low for the outcome
135 of interest, we increased the sample size to 465 patients to
136 ensure that a sufficient number of patients who received
137 opiates (at least 80 patients) were included in the sample
138 for analysis.

139 RESULTS

140 *Characteristics of the Study Participants*

141 There were 508 patients who met inclusion criteria,
142 of which 43 were excluded (41 non-scene transport, 1
143 traumatic arrest, and 1 hypersensitivity to opioid medica-
144 tions), leaving 465 patients enrolled. The mean (SD) age
145 of the cohort was 10 (5) years, 270 patients (59%) were
146 male, and 74 patients (16%) were admitted to the hospi-
147 tal (Table 1). There were 220 White patients (49%), 134
148 Black patients (34%), and 120 Hispanic patients (27%)
149 (Table 1).

150 *Main Results*

151 Overall, 83 patients (19%) received opioid pain medi-
152 cations during transport. On univariate analysis, older age

Table 1. Patient and Provider Characteristics of Injured Children Administered Opioid Pain Medications by Emergency Medical Services ($n = 465$)

Characteristic (Missing Observations)	n (%)
Patient characteristics	
Age (y), mean (SD) ($n = 6$)	10 (5)
Younger than 2 y	36 (7)
Male ($n = 6$)	270 (59)
Race ($n = 13$)	
White	220 (49)
Black	134 (30)
Other	24 (5)
Not documented	74 (16)
Hispanic ($n = 13$)	120 (27)
ED disposition ($n = 6$)	
Discharge	369 (80)
Admission	74 (16)
Eloped	9 (2)
Transfer	7 (2)
Insurance status ($n = 13$)	
Public	259 (57)
Private	165 (37)
No insurance	9 (2)
Not documented	19 (4)
English speaking ($n = 14$)	402 (89)
Fracture ($n = 8$)	87 (19)
Received opioid medications from EMS ($n = 23$)	83 (19)
Received nonpharmacological intervention ($n = 31$)	227 (52)
Had pain score assessed ($n = 9$)	364 (80)
Provider characteristics	
Age (y), mean (SD) ($n = 39$)	33 (9)
Male ($n = 20$)	345 (78)
Advanced Life Support provider ($n = 12$)	300 (66)
Years of experience ($n = 12$)	10 (8)

ED = emergency department; EMS = emergency medical services.

(2 years or older), fracture, ALS provider, White race, and EMS provider experience (3 years or more) were more likely to receive opioid pain medications, and patients of Black or undocumented races and Hispanic ethnicity were less likely to receive opioid medications (Table 2).

On adjusted analysis, the AORs for Black race and Hispanic ethnicity were 0.5 (95% CI 0.2–1.2) and 0.4

Table 2. Univariate Analysis Comparing Specific Variables and the Receipt of Opioid Pain Medications (n = 442)*

Variable [†]	Opioid Pain Medications (n = 83)		No Opioid Pain Medications (n = 359)		Difference, % (95% CIs)
	n/N [‡]	% (95% CI)	n/N [‡]	% (95% CI)	
Aged 2 y or older	80/83	96 (32 to 100)	326/359	91 (88 to 94)	5 (0.6 to 11)
Male	54/83	65 (55 to 75)	203/357	57 (52 to 62)	8 (−3 to 20)
Fracture	44/83	53 (42 to 64)	40/355	11 (8 to 15)	41 (30 to 53)
ALS provider	75/82	91 (85 to 98)	217/358	61 (56 to 66)	31 (23 to 39)
White race	54/83	65 (55 to 75)	160/357	45 (40 to 50)	20 (9 to 32)
Black race	16/83	19 (11 to 28)	113/357	32 (27 to 36)	−12 (−22 to −3)
Other race	6/83	7 (2 to 13)	18/357	5 (3 to 7)	2 (−4 to 8)
Not documented	7/83	8 (2 to 14)	66/357	18 (14 to 23)	−10 (−17 to −3)
Hispanic ethnicity	13/83	16 (8 to 23)	106/357	30 (25 to 34)	−14 (−23 to −5)
Provider experience 3 y or more	77/83	93 (87 to 98)	304/359	85 (81 to 88)	8 (1 to 15)

ALS = Advanced Life Support.

* Receipt of opioid pain medications is missing in 23 patients.

[†] Variables refer to patient characteristics except for ALS provider.

[‡] Differences in denominators are due to missing data.

160 (95% CI 0.2–1.3), respectively. The presence of a frac-
161 ture (OR 17.0; 95% CI 7.9–36.7), ALS provider (OR
162 5.6; 95% CI 1.9–16.7), older patient age (OR 1.1 for
163 each year of age; 95% CI 1.0–1.2), EMS provider ex-
164 perience (OR 1.1 for each year of experience; 95%
165 CI 1.0–1.1), and specific sites (OR range 0.1–4.1)
166 were associated with receiving opioid medication (Table
167 3). Using the highest-enrolling site as the reference,
168 there were three sites where it was less likely for pa-
169 tients to receive opioid medications during transport
170 (Table 3).

171 In our sensitivity analysis including only patients with
172 the survey completed by ALS providers, there were no
173 statistically significant differences associated with race
174 and ethnicity. There were several sites where patients
175 were less likely to receive opioid medications (eTable
176 1). In the sensitivity analysis evaluating only patients
177 with specific fractures, the AORs for Black race and
178 Hispanic ethnicity were 0.3 (95% CI 0.1–1.7) and 0.2
179 (95% CI 0.0–1.9), respectively (eTable 2). In the sen-
180 sitivity analysis including only patients with prehospi-
181 tal reported moderate to severe pain, Hispanic patients
182 were less likely to receive opioid medications compared
183 with non-Hispanic patients (OR 0.3; 95% CI 0.1–0.8)
184 (eTable 3). In the sensitivity analysis using only com-
185 plete data, the results were not significantly different
186 compared with the primary analysis using imputed data
187 (eTable 4). We also evaluated for disparities in ALS trans-
188 port and found no differences between races or ethnicities
189 (eTable 5).

DISCUSSION

190

191 Our study was innovative in that we prospectively eval-
192 uated the impact of race and ethnicity on prehospital
193 opioid use across a geographically diverse network of
194 EMS agencies and hospitals. Although our primary ad-
195 justed analysis did not find any statistically significant
196 association between race or ethnicity and the administra-
197 tion of prehospital opioid medications, certain aspects of
198 our results should be noted. Black patients had an OR
199 of 0.5 (95% CI 0.2–1.2) and Hispanic patients had an
200 OR of 0.4 (95% CI 0.2–1.3), suggesting the possibility
201 that Black and Hispanic patients were less likely to re-
202 ceive opioid medications compared with White patients,
203 while controlling for several other factors. However, due
204 to smaller numbers (and wide CIs) these findings were not
205 statistically significant.

206 Our sensitivity analyses, however, did find some dis-
207 parities based on race and ethnicity, particularly the anal-
208 ysis limited to patients with moderate to severe pain, in
209 which Hispanic patients were found to be less likely to
210 receive opioids. In other sensitivity analyses, the point
211 estimates were concerning that Black (fracture OR 0.3
212 and moderate to severe pain OR 0.4) and Hispanic pa-
213 tients (fracture OR 0.2 and moderate to severe pain OR
214 0.3) were less likely to receive opioid pain medications
215 compared with White patients, but these did not reach
216 statistical significance. These results may be concern-
217 ing, as these are children in most need of opioid pain
218 medications.

Table 3. Adjusted Odds Ratios from a Multivariate Logistic Regression Using Chained Equations to Impute Missing Variables with Prehospital Opioid Medications as the Outcome (n = 465)

Variable	Adjusted Odds Ratio (95% CIs)
Fracture	17.0 (7.9–36.7)
ALS provider	5.6 (1.9–16.7)
Patient age (per year)	1.1 (1.0–1.2)
Provider experience (per year)	1.1 (1.0–1.1)
Race*	
Black	0.5 (0.2–1.2)
Other	2.1 (0.5–8.2)
Not documented	0.9 (0.2–3.1)
Hispanic	0.4 (0.2–1.3)
Male patient	0.8 (0.4–1.7)
Site†	
2	0.2 (0.1–0.6)
3	0.2 (0.1–0.8)
4	0.5 (0.2–1.5)
5	2.1 (0.7–6.5)
6	0.3 (0.1–1.7)
7	0.2 (0.1–0.9)
8	4.1 (0.4–42.0)
9	2.5 (0.8–8.4)
10	0.1 (0.1–1.1)

ALS = Advanced Life Support.

* White race was the most common race and was used as the reference.

† Site 1 had the highest enrollment and was used as the reference site.

pediatric ED patients with long-bone fractures (14). Multiple studies in adults have also reported less treatment with opioid medications for Black patients compared with White patients for various painful conditions (12,15–17).

The results of our study identified potential areas for improvement. Future studies should further explore racial, ethnic, and socioeconomic disparities using a large, diverse cohort of children transported by EMS providers. Examination of barriers to appropriate pain treatment, whether at the EMS provider or agency level, should be examined. If racial, ethnic, or socioeconomic disparities exist, appropriate education or training may reduce these disparities (18,19). Future areas of study should also include the bias that providers may have based on injury type, how level of training impacts care, and reasons for site-to-site variability in practice that may be due to EMS agency culture or bias inherent to geography.

In our study, patients who were younger and treated by less experienced EMS or non-ALS providers were less likely to receive prehospital opioid pain medications. This may be a result of discomfort among EMS providers with providing opioid pain medications to younger children. Pain assessment and weight estimation is more difficult in younger children (3). Use of age-appropriate pain assessment scales and age-based or length-based weight estimates may help alleviate some of these gaps of care among younger children. Although non-ALS providers are generally unable to provide prehospital opioid pain medications, we felt it was important to include patients transported by non-ALS providers, as there may be disparities in which children get transported by ALS providers. Our sensitivity analysis, however, did not identify racial or ethnic disparities for ALS transport. We also saw variation of opioid pain treatment between sites, suggesting system-based interventions or training may be useful. Browne et al. reported that incorporation of EMS pain treatment guidelines across EMS agencies led to increased pain assessments and use of appropriate treatment with opioid pain medications (20). Similar implementation of guidelines may reduce pain management variability between sites.

Limitations

These results should be interpreted in the context of several limitations. First, race and ethnicity were abstracted from the electronic medical record rather than asking parents or guardians directly, which is considered the preferred method for determining race and ethnicity. Furthermore, this would be the hospital-based assessment of race and ethnicity and not the EMS providers' perception of patient race and ethnicity. We had 0–5% missing data for key variables, and thus we required the use of multiple imputations to account for missingness. Race

219 Prior studies found racial and ethnic disparities in
220 the treatment of pain with analgesic medications. Us-
221 ing the National Emergency Services Information Sys-
222 tem database to identify patients transported by EMS for
223 painful conditions (e.g., fracture, burn, or penetrating in-
224 jury), Hewes et al. found that Black children were less
225 likely to be treated with analgesics compared with White
226 patients (7). In a study using the National Hospital Am-
227 bulatory Medical Care Society database, Pletcher et al.
228 found that Black and Hispanic children were less likely to
229 receive opioid pain medications in the ED during a pain-
230 related visit (12). This racial disparity among children
231 being treated in the ED for a painful condition persisted
232 even in hospitals with a high proportion of Black patients
233 (13). Goyal et al. also found similar racial disparities in

was also frequently not documented; it is possible that certain races may be more represented in this group. Due to the relatively small number of outcomes, we were unable to explore other potential predictor variables, such as socioeconomic status, based on patient's home ZIP code, language preference, insurance status, or EMS provider race and ethnicity, which may have been important predictor variables. It was also difficult to control for the severity of pain among patients. However, we did conduct sensitivity analyses limiting the cohort to just those with fractures and those with moderate to severe pain, but this occurred in a relatively small proportion of patients. Finally, we did not assess patient or parental preferences, which may have influenced treatment with opioid pain treatment.

CONCLUSIONS

In our multicenter study, there was no statistically significant association between race or ethnicity and the use of opioid pain medications for injured children transported by EMS. The presence of a fracture, ALS provider, older patient age, EMS provider experience, and site were associated with receiving opioid pain medications during transport.

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SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.jemermed.2022.10.011](https://doi.org/10.1016/j.jemermed.2022.10.011).

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ARTICLE SUMMARY**1. Why is this topic important?**

Prehospital pain medications for injured children are often not provided or delayed. Ensuring equal and appropriate care to all racial and ethnic groups is important.

2. What does this study attempt to show?

We evaluated for racial and ethnic disparities related to the administration of opioid pain medications during the prehospital transport of injured children.

3. What are the key findings?

There were no statistically significant associations between race or ethnicity and the use of opioid pain medications for injured children transported by emergency medical services (EMS). The presence of a fracture, Advanced Life Support provider, older patient age, EMS provider experience, and site were associated with receiving opioid pain medications during transport.

4. How is patient care impacted?

There may be variation of prehospital pain medications in injured children across EMS agencies, providers, and racial and ethnic groups. Future work should be directed toward standardizing treatment to ensure adequate pain control for these patients.