Investigating EMS Treatment Disparities by Patient Race/Ethnicity for Traumatic and Painful Emergencies

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Introduction

In the US, when compared to White patients, racial minorities are at a greater risk of receiving lower quality medical care.[1,2] While many areas of medical practice (e.g. Emergency Departments, Cardiology, and Oncology, among others) have hundreds of documented studies indicating racial treatment disparities, the field of Emergency Medical Services (EMS) remains relatively unexamined with only two published studies investigating racial disparities in EMS treatment. First, Young et al. (2013)[3] investigated the use of morphine in blunt trauma calls for adults in Contra Costa County, CA, and found that African American patients were half as likely to receive morphine compared to White patients when a pain score was documented. This study also found that African Americans were only 15% as likely as White patients to receive morphine when a pain score was not documented. This was the first study to find convincing evidence of racial disparities in EMS pain treatment, and the results are consistent with other studies documenting evidence of racial differences in pain management practices found in hospital-based emergency medicine.[4–6]

More recently, Hewes et al. (2018)[7] investigated patient race as a risk factor in the medication-based treatment of pain in select traumatic injuries (fracture, burns, and penetrating trauma) in both adults and children. Using a large national dataset of standardized EMS medical records from the National Emergency Medical Services Information System (NEMSIS), Hewes et al. found that all adult (defined as $\geq$ 15 years of age) racial minority patients received pain medications significantly less often than White patients after controlling for pain as a documented symptom. Children (defined as < 15 years of age) who were charted as racial minorities were also found to receive pain medications significantly less often, with 10.9% of African American children receiving pain medications compared to 25% of White children.

While these studies represent important initial steps to better understand racial disparities in EMS treatment, they did not isolate a common confounder to race - socioeconomic status (SES). Socioeconomic status has a known significant impact on the quality of medical care received: patients that are perceived to occupy lower SES positions receive a lower quality of medical care.[8,9] Given that racial minorities have a disproportionately large representation at lower SES levels compared to Whites, without adequate methodological controls to adjust for this difference in SES, it is unclear from both studies how much of the effects reported are influenced by the patient's SES versus the patient's race.

The current study extends the existing literature by evaluating the racial equity of pain treatment practices for traumatic and painful conditions treated by multiple EMS agencies while adjusting for many confounders including a patient's SES. Specifically, this study investigates EMS pain management treatment for racial minority patients including (1) pain assessment, (2) pain medication administration, and (3) opioid pain medication administration for traumatic or painful injuries. Using the Oregon NEMSIS dataset containing Patient Care Reports (PCRs) from 63 reporting EMS agencies in Oregon, this study presents the results of regression models adjusting for a number of covariates to isolate race as a risk factor in the receipt of pain medication in EMS traumatic and painful injuries.

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Methods

This study is a quantitative retrospective cross-sectional analysis of pain medication administration practices of EMS PCRs from specific call types (described below) captured in the Oregon NEMSIS dataset from January 1, 2015 through December 31, 2017. Participation in the Oregon NEMSIS dataset during this time period was a voluntary process for EMS agencies and not all EMS agencies contributed. Consequently, this convenience sample of EMS agencies may not be representative of all EMS agencies in the state. Of the estimated 359 total EMS transporting and non-transporting EMS agencies in Oregon in 2017, 67 of the 125 transporting agencies and 21 of the 234 non-transporting agencies contributed PCRs to NEMSIS. Of these 89 contributing EMS agencies, this analysis selected 100% of the PCRs that matched the inclusion criteria (described below) which resulted in PCRs from 63 unique EMS agencies used in the analysis. Given the relatively broad selection criteria below, it is likely the remaining agencies that did not have PCRs represented in this analysis had very low call volumes and thus did not have PCRs that met the inclusion criteria over the 2-year period being investigated. While caution should be taken when considering generalizing these findings to the entire state, this dataset currently represents the most comprehensive picture of EMS treatment in the State of Oregon.

Inclusion and Exclusion Criteria

As this study was focused on pain medication practices, PCRs were selected for inclusion for EMS calls for an adult patient (> 17 years of age) where the Primary Impression of the EMS provider on scene who was providing medical treatment was either a traumatic injury or a complaint of pain. The Primary Impression is a field used in PCRs that captures the EMS provider's impression of the most significant condition that the patient is suffering from after making contact and assessing the patient.

A number of exclusion criteria were utilized to ensure all PCRs used in the analysis were eligible to receive pain medications (Figure 1). The first exclusion criteria limited the sample to PCRs that indicated that EMS providers were on the scene of the emergency who were certified at the Paramedic level. The Level of Service variable within the NEMSIS dataset captures the "highest level of service the agency provides to every encounter" for a given EMS agency. The following levels of service values were suppressed to isolate EMS agencies with Paramedics: Community Paramedic, Critical Care Paramedic, EMT, EMT Intermediate, Nurse, Nurse Practitioner, and Physician. This exclusion resulted in suppressing 3,466 PCRs (3.1%). Next, as most pain medications provided in EMS are opioids (99% in this sample), a common contraindication for administering opioids is a patient with symptoms of respiratory distress or altered mental status. Any patient who had a primary symptom that indicated respiratory distress or altered mental status was suppressed from the sample, resulting in 2,484 (2.3%) PCRs being suppressed. Combining the two exclusion criteria noted above suppressed 5,910 unique PCRs (5.4%) from the sample. And finally, a systolic blood pressure (SBP) less than 90 mmHg[10], or 100 mmHg[11] in some treatment protocols, is a common contraindication for administering pain medications in EMS practice. Interestingly, while only 1.3% of PCRs in the sample contained an SBP less than 90 during the entire EMS medical encounter, neither the presence of a low SBP, or indeed the presence of any SBP, appeared to have an association with pain medication administration, and so SBP was not incorporated as a control.

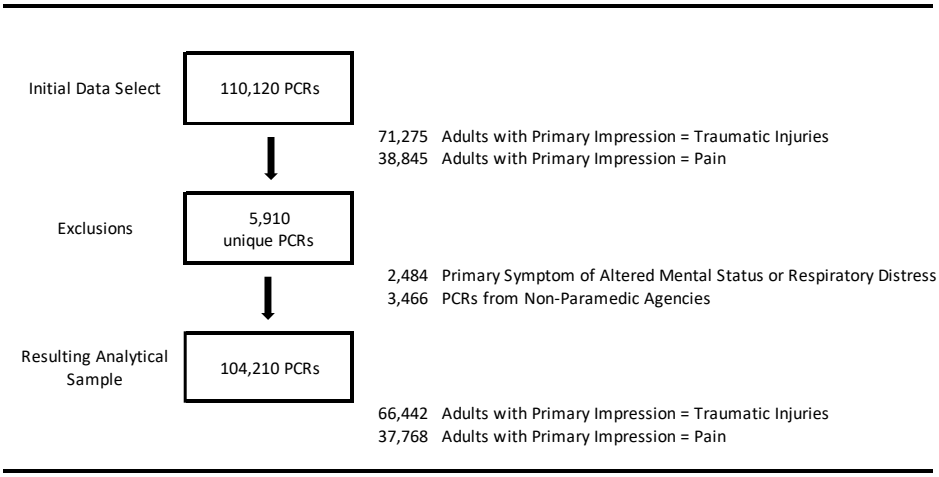

Figure 1. Data Selection Process

Outcome and Predictor Variable

The primary outcome variable was the dichotomous presence of a pain medication included on the PCR. There were 115 unique medication values in the sample of PCRs and the following medications were identified as pain medications: Acetaminophen, Ketorolac, Fentanyl, Morphine, Hydromorphone, and Ketamine.

The primary predictor value was patient race/ethnicity. The sample of PCRs used in this analysis spanned two versions of the NEMSIS data structure, versions 2 and 3, which allowed EMS medical providers to record patient race and ethnicity differently. For NEMSIS version 2, a single patient race and ethnicity value was allowed for each PCR with the following race categories: White, African American, Asian, Native American Indian, Hawaiian, Pacific Islander and Other. Ethnicity values were recorded as either Hispanic (or Latino) or non-Hispanic. Using these two variables, a third recoded variable was created with a series of mutually exclusive dichotomous values, including Hispanic, non-Hispanic White, non-Hispanic African American, non-Hispanic Asian, non-Hispanic Native American, non-Hispanic Hawaiian or Other Pacific Islander, non-Hispanic Other, and non-Hispanic Unknown.

NEMSIS version 3 grouped race and ethnicity values into a single field and allowed multiple race/ethnicity values to be selected for each patient. For analysis and reporting purposes, values that contained a single race or ethnicity value were recoded into the appropriate race/ethnicity variable with the same rules used for NEMSIS version 2. Race/ethnicity values that contained multiple race/ethnicity values (i.e. “Native Hawaiian or Other Pacific Islander, Hispanic or Latino, American Indian or Alaska Native, White”) were recoded as “other”. Charts with multiple race/ethnicity values that met this criterion represented 0.1% of the total sample of PCRs.

For both versions of NEMSIS used in this study, PCRs with race/ethnicity values of Not Recorded, Not Known, Not Applicable, and null values were recoded as Unknown. Patients coded as non-Hispanic Native American or non-Hispanic Hawaiian or Other Pacific Islander were included in the Other race/ethnicity due to small sample populations. For reporting simplicity, the term “non-Hispanic” was removed from subsequent race/ethnicity references. This recoding effort recoded 99.4% of the originally provided race/ethnicity PCRs into the final race/ethnicity categories of White, African American, Hispanic or Latinx, Asian, Other, and Unknown values (Table 1).

Control Variables

A number of control variables were incorporated to isolate the effect of our primary predictor variable. Pain scores (as charted in the PCR) were included as a control variable with values ranging from 0-10. The initial pain score that was charted in the PCR was used for this analysis as it arguably represented an influential pain score on administering pain medication, compared to an average or median pain score. Since two principal primary impressions were included (traumatic injuries and pain complaints) which each represent a wide severity of injuries, primary impression values were also included as a statistical control. The charted gender of the patient was included as a control as well as the patient's age in years. Finally, the patient's type of insurance was incorporated as a control variable with the following NEMSIS values: Private, Medicaid, Medicare, No Insurance, Government Insurance, Other Insurance, and Unknown Insurance.

In addition to providing descriptive statistics characterizing the social demographics, charted pain characteristics, and pain medication dosage variation, multiple regression models were performed stratified by zip code (the location of the scene where the patient was met by the EMS medical team) to stratify the PCR into Urban and Rural segments (as determined by the Oregon Office of Rural Health zip code definitions).

Results

Of the 110,120 PCRs provided in the initial data select, 5,910 PCRs met exclusion criteria and were suppressed, leaving an analytical sample of 104,210 PCRs for analysis (Figure 1).

Descriptive Analysis

Table 1 provides bivariate descriptive statistics for the social demographic variables of the sample by race/ethnicity. There are 63 unique EMS agencies represented in the sample and about 66% of all PCRs taking place in urban zip codes. The average patient age is 57 (SD 22) with White patients slightly older (59, SD 22) than the average in the sample and 13 years older than the average age of Black patients (46, SD 18) in the sample. A slight overall majority of the PCRs in the sample are for female patients (52%) with significant variation in gender by patient race. Patient insurance status has considerable variation by race, and, notably, rates of private insurance for Black patients are approximately one half that of White patients, while rates of Medicaid (16.7 versus 7.1) and No Insurance (23.3 versus 15.0) are considerably higher for Black patients when compared to White patients.

Table 2 presents the bivariate descriptive statistics on pain assessment and pain treatment variables by patient race/ethnicity. Overall, 64% of the sample is comprised of Traumatic Injuries (versus a primary impression of Pain) as described by the EMS provider on scene with mild variation by patient race. A pain score of 0-10 was charted for 38% of the sample with essentially equal representation for Black (40.6) and White (40.3) patients. Black patients reported a higher average pain score (6.3) when compared to White (4.7) patients. And finally, 18% of sample received pain medications, 99% of which were opioids, with 19% of Whites receiving pain medications while fewer Blacks (14%), Hispanics (15%) and Asians (14%) received pain medications (Figure 2).

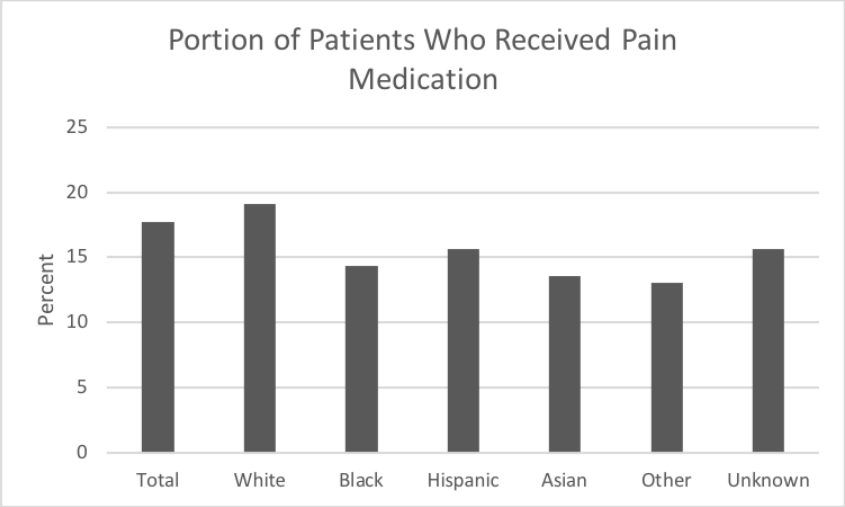

Figure 2. Pain Medication Administration by Race

The dose variation of fentanyl by patient race/ethnicity is presented in Table 3 and graphically represented in Figure 3 and Figure 4 below. Of the pain medication options demonstrated in the sample, fentanyl is by far the most common pain medication provided; fentanyl is given approximately 90% of the time when a pain medication is administered. The average amount of fentanyl provided for the entire medical encounter is 123 mcg with significant variation by urban and rural locations as well as patient race. Of the primary race/ethnicity variables analyzed, Black patients statistically received the largest average quantity (134 mcg) of fentanyl while Asian patients received the smallest quantity (114 mcg).

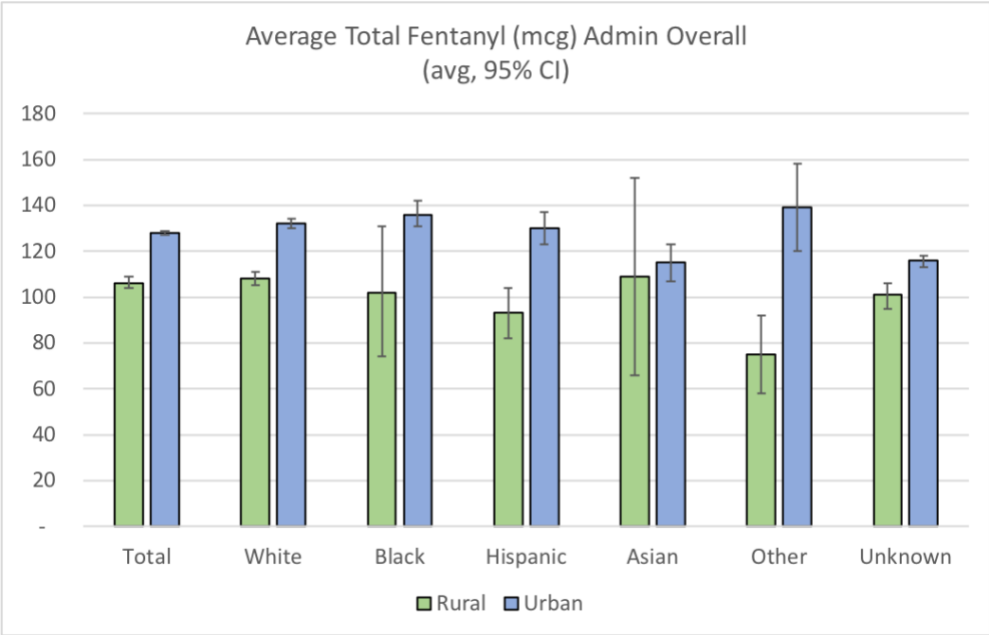

Figure 3. Average total quantity of fentanyl administered over the entire call, by race and demographic region.

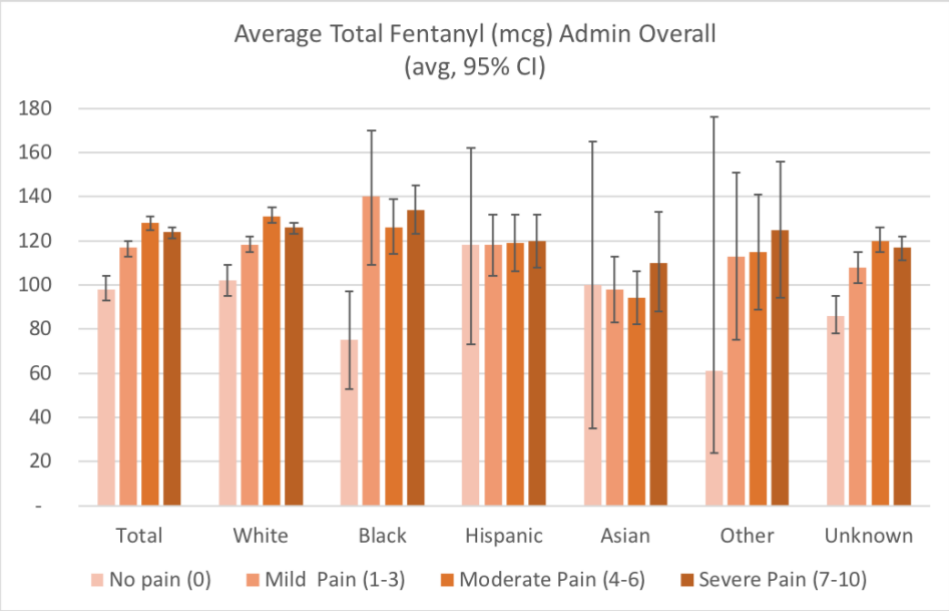

Figure 4. Average total quantity of fentanyl administered over the entire call, by race and first recorded pain score.

Regressions

Three multivariate logistic regressions were performed: (1) on the overall sample, (2) on the rural zip codes, and (3) on the urban zip codes to investigate geographical differences on the use of pain medication by patient race/ethnicity. Table 4, model 1 shows the unadjusted regression results for the overall sample by the baseline predictor variable. Importantly, it reports that patients in every racial minority category included in the analysis are less likely to receive pain medication compared to White patients. Model 2 (Table 4 and Figure 5 below) adjusts for pain medication variation from variations in pain scores, primary impressions, patient gender, anatomical location of the complaint, age of the patient, and the insurance status of the patient finding that all patient minorities, except Hispanic patients, remain less likely than White patients to receive pain medications. The largest adjusted disparity reported is for Black patients, who were 30% less likely (OR 0.60, 95% CI 0.53 – 0.68) to receive any type of pain medication compared to White patients in our sample, followed by Asian patients, who were 26% less likely (OR 0.64, 95%CI 0.50 – 0.83).

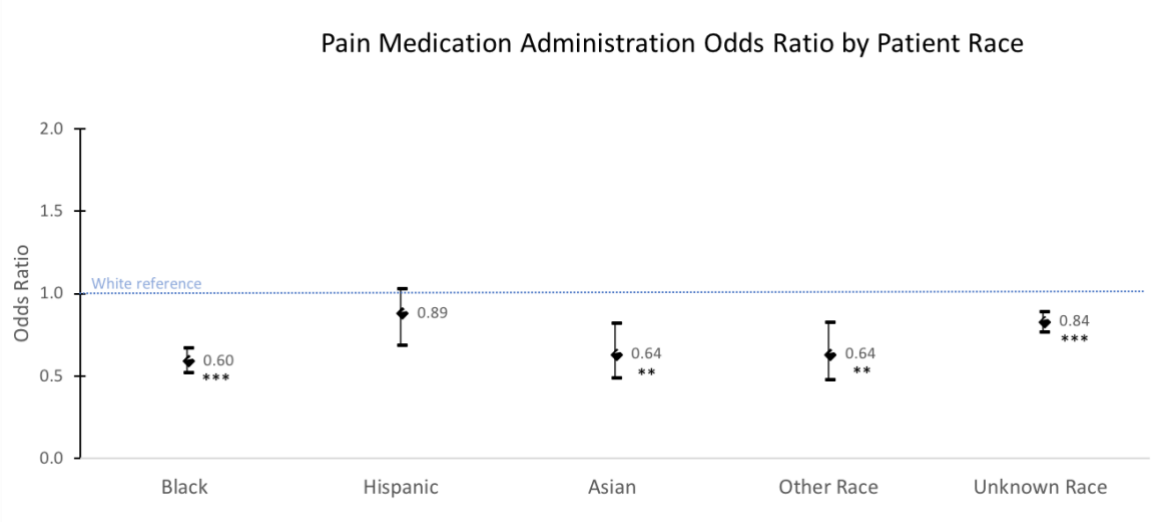

Figure 5. Analysis of adjusted pain medication administration practices by race. Odds ratios are presented with White patients as reference (bars indicate 95% confidence intervals).

In a similar fashion, Table 5 Model 1 reports on the unadjusted baseline regression results of patient race/ethnicity on pain medication administration. Given the small sample of racial minority patients in rural zip codes (12% of the racial minority population in the sample were in rural zip codes) they were combined into a single minority variable for the analysis on Table 5 and graphically represented in Figure 6 below along with results from Urban zip codes. Despite this aggregation, the adjusted odds ratio for racial minorities was not significant compared to White patients.

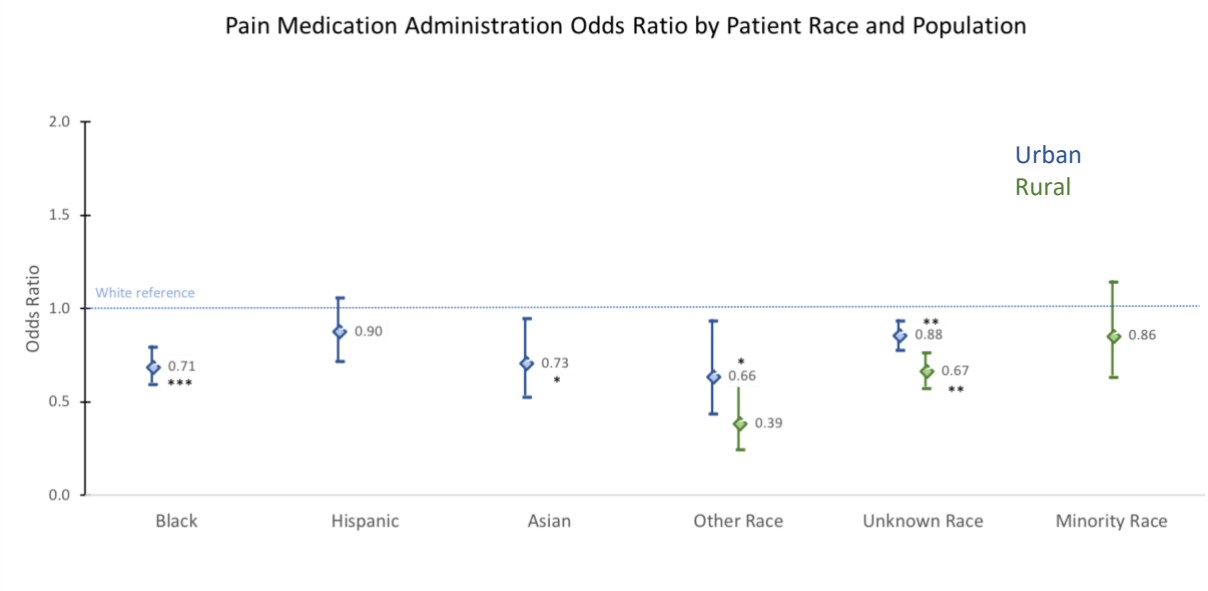

Figure 6. Analysis of adjusted pain medication administration practices by race, and demographic region (urban and rural). Odds ratios are presented with White patients as reference (bars indicate 95% confidence intervals)

Table 6 reports the regression results for PCRs in urban zip codes, again in two models (unadjusted and adjusted). Model 1 reports significant disparities for all racial minority patients when compared to White patients. Model 2 reports persistent and increasing disparities for Black patients (OR 0.71, 95%CI 0.62 – 0.82) and Asian patients (OR 0.73, 95%CI 0.55 – 0.97) but not Hispanic patients (OR 0.90, 95%CI 0.74 – 1.08) once controls are incorporated.

And finally, Table 7 reports the adjusted results from a separate regression analysis of pain medication administration by patient race/ethnicity and insurance status, finding evidence that Black patients with private insurance are 54% as likely (OR 0.46, p< .001), and Asian patients are 55% as likely (OR 0.45, p< .05) to receive any pain medication as White patients with private insurance. Black patients without insurance are 44% less likely (OR 0.56, p< .001) to receive any pain medication as White patients without insurance. And finally, both Black patients (OR 0.60, p< .001) and Asian patients (OR 0.64, p< .01) on Medicaid are significantly less likely to receive pain medications compared to White patients on Medicaid. There was no evidence of pain medication administration disparities by patient race for Medicare patients in the sample.

Discussion

This investigation explored racial differences in pain medication administration practices of EMS providers from NEMSIS-contributing EMS agencies in Oregon for 911-initiated calls for a traumatic injury or a complaint of pain.

The primary finding in this analysis is evidence of EMS treatment differences in the receipt of pain medication for Black and Asian patients engaging with EMS for a traumatic injury or for a complaint of pain. Specifically, Black patients suffer the most severe treatment disparity and were 40% less likely to receive any pain medication compared to White patients when controlling for pain severity, primary impressions, patient gender, anatomical location of the complaint, age of the patient, and the insurance status of the patient. There was no evidence for EMS pain treatment disparities for Hispanic / Lantinx patients in urban or rural locations in Oregon. Results were inconclusive for pain treatment disparities for the aggregate racial minority variable (Hispanic, Asian and Black patients) in rural zip codes, where the sample population of Black and Asian patients in rural zip codes was extremely small, likely contributing to a lack of statistically significant findings.

While the primary regression analysis (Tables 4-6) controlled for the contribution that a patient's insurance status had on that patient's receipt of pain medication, the secondary analysis (Table 7) investigated adjusted racial treatment differences for patients who were matched on insurance status. Interestingly, for patients with private health insurance, an indication of the presence of a full-time job for the patient or their immediate family member, there is evidence to support that the treatment disparity for both Black and Asian patients compared to White patients is larger than when compared to all insurance types. Evidence of this increased treatment disparity was also present in Black and White patients that indicated that they do not have health insurance.

Both the primary and secondary findings indicate that prior EMS studies on differences in treatment by patient race that did not incorporate patient insurance status, or other proxy measure of SES, likely underestimated the treatment disparity. This study also adds to the body of evidence supporting the unique contribution race has, above and beyond SES, on impacting medical treatment for racial minorities.

While this study is focused on determining the presence of treatment differences in EMS practice by patient race, there are a number of resources, rooted in a long history of examining disparities that should help guide our understanding of why this takes place, and which, in turn, can serve to inform our next steps. Some of the most promising research, in my view, related to addressing the challenge of treatment disparities suggests an increase in provider awareness of treatment disparities, an understanding that some call types are more likely to produce disparities, and correcting false understandings of race as a biological versus social construct can be important next steps for EMS agencies seeking to reduce treatment disparities.[1,12–14]

Limitations

This study is not without limitations. First, it utilizes a retrospective convenience sample of PCRs, that, while statewide in scope, was not generated randomly. This may limit the generalizability of the findings as EMS agencies that contribute to the NEMSIS dataset may have unforeseen, and thus likely unaccounted for, commonalities. Also, NEMSIS PCR data is event-based and not patient-based, thus allowing two different EMS agencies to upload a PCR on the same patient as two different events. While this presents some data challenges, it is unlikely to influence the data for one patient race over another. Another limitation is either the inconsistent use of, or the inconsistent charting of, systolic blood pressure (SBP). While most EMS protocols in Oregon have a minimum SBP for which opioids can be administered, there was a larger percentage of patients that received opioids that did not have any charted SBP in their PCR than patients that did have a charted SBP. For this reason, SBP was not incorporated as an exclusion criterion. For the majority of patients included in this analysis who were suffering from traumatic injuries and/or pain it is likely that their SBP be biased toward higher versus lower blood pressures and there is no clear indication that excluding SBP as an exclusion criterion would influence the data for one race over another. Finally, the use of the patient's insurance status in an attempt to control for differences in the patient's SES may have been incomplete, leaving an unknown portion of the treatment variability results due to variation in SES and not patient race alone.

Conclusions

In summary, these results indicate a consistent reduction in pain medication treatment by EMS medical providers for patients characterized as racial minorities suffering from traumatic injuries or with a complaint of pain. This evidence is consistent with treatment disparities by race found in other areas of medicine, as well as the limited EMS literature published on this topic. Next steps should include further investigation of disparities on other EMS call types, evaluation of the efficacy of mitigation practices (including provider awareness and training efforts), and to inform county and state policy mechanisms to motivate EMS agencies to provide equitable high-quality care for all patients.

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Table 1: Patient Demographics by Race

	Total (n)	White (%)	Black (%)	Hispanic (%)	Asian (%)	Other (%)	Unknown (%)
Total PCRs	104,210	63.8	4.9	3.6	1.4	1.2	25.2
Unique EMS Agencies (#)	63	59	32	46	30	43	35
Calls in Urban Zip codes*	69,475	64.2	84.6	67.3	79.0	51.8	69.9
Calls in Rural Zip Codes*	25,458	27.8	3.0	24.6	7.2	37.6	20.3
Calls in Other Zip codes**	9,277	8.0	12.3	11.7	13.8	10.6	9.8
Patient Age in Years - (mean, SD)	57, 22	59, 22	46, 18	42, 18	57, 22	48, 20	57, 23
Female Gender	54,451	53.1	47.6	41.9	56.9	49.5	53.3
Private Insurance	14,261	16.8	8.8	13.1	13.5	17.1	6.6
Medicaid Insurance	7,500	7.1	16.7	11.5	9.7	15.2	4.5
Medicare Insurance	17,557	21.3	11.7	7.6	17.8	11.5	8.1
Other Government Insurance	1,302	1.5	1.0	1.3	1.0	2.0	0.7
No Insurance	16,146	15.0	23.3	29.5	26.2	17.5	12.4
Unknown or Other insurance	47,444	38.3	38.4	37.1	31.7	36.8	67.7

Source: OR State NEMSIS data set

* ORH zip code urban rural definition

** zip codes in the PCR that were not located in the ORH zip code file

Table 2: Patient Pain Descriptives by Race

	Total (n)	White (%)	Black (%)	Hispanic (%)	Asian (%)	Other (%)	Unknown (%)
Total PCRs	104,210	63.8	4.9	3.6	1.4	1.2	25.2
Primary Impression = Traumatic Injury	66,442	58.8	48.5	63.4	58.5	60.9	79.8
Primary Impression = Pain	37,768	41.2	51.5	36.6	41.5	39.1	20.2
PCRs with Charted Pain Measurement*	40,061	40.3	40.6	37.2	34.4	39.6	33.6
mean pain score (avg, SD)**	4.9, 3.2	4.7, 3.2	6.3, 3.1	5.3, 3.1	4.6, 3.0	5.3, 3.2	4.9, 3.2
No pain (0)	5,782	15.0	6.9	10.1	13.8	11.2	15.5
Mild Pain (1-3)	8,604	22.8	13.4	19.6	23.0	20.3	19.8
Moderate Pain (4-6)	11,797	29.5	25.4	32.4	34.1	26.9	29.8
Severe Pain (7-10)	13,878	32.8	54.3	37.9	29.1	41.6	34.9
Received Pain Medications	18,482	19.1	14.3	15.6	13.6	13.0	15.6
Received Non-Opioids	145	0.2	0.1	0.3	0.0	0.4	0.0
Received Opioids#	18,356	19.0	14.3	15.4	13.6	12.6	15.6

Source: OR State NEMSIS data set

* at least one charted pain score

** 1st recorded pain score

while Ketamine is not an opioid it is included in this analysis as such due to it's inclusion in the treatment of severe pain.

Table 3: Patient Fentanyl Dose Variation by Race (n=104,210)

	Total	White	Black	Hispanic	Asian	Other	Unknown	X^2
Cases Receiving Opioids (%)	17.6	19.0	14.3	15.4	13.6	12.6	15.6	p <.001
Portion of Opioid Admin that are Fentanyl (%)	89.5	87.5	97.6	87.3	97.0	79.1	94.6	p <.001
Average Total Fentanyl (mcg) Admin Overall (avg, 95% CI)	123 (122 - 125)	126 (125-128)	134 (129 - 140)	124 (119 - 130)	114 (106 - 121)	125 (111 - 140)	114 (112 - 116)	p <.001
Rural zip codes	106 (104 - 109)	108 (105 - 111)	102 (74 - 131)	93 (82 - 104)	109 (66 - 152)	75 (58 - 92)	101 (95 - 106)	p <.026
Urban zip codes	128 (127 - 129)	132 (130 - 134)	136 (131 - 142)	130 (123 - 137)	115 (107 - 123)	139 (120 - 158)	116 (113 - 118)	p <.001
Average Total Fentanyl Admin by Pain Score Category*								
No pain (0)	98 (93 - 104)	102 (95 - 109)	75 (53 - 97)	118 (73 - 162)	100 (35 - 165)	61 (24 - 176)	86 (78 - 95)	p < .136
Mild Pain (1-3)	117 (113 - 120)	118 (115 - 122)	140 (109 - 170)	118 (104 - 132)	98 (83 - 113)	113 (75 - 151)	108 (101 - 115)	p < .023
Moderate Pain (4-6)	128 (125 - 131)	131 (128 - 135)	126 (114 - 139)	119 (106 - 132)	94 (82 - 106)	115 (89 - 141)	120 (115 - 126)	p < .003
Severe Pain (7-10)	124 (121 - 126)	126 (123 - 128)	134 (123 - 145)	120 (108 - 132)	110 (88 - 133)	125 (94 - 156)	117 (111 - 122)	p < .021

Source: OR State NEMSIS data set

* 1st recorded pain score

Table 4: Multivariate Logistic Regression of Patient Race on Pain Medication Administration (all zip codes)

	Model 1			*Model 2*		
Regressor	*log-odds*	*OR*	*CI 95%*	*log-odds*	*OR*	*CI 95%*
White (referent)						
Black	-0.35	0.71***	(0.65 - 0.77)	-0.51	0.60***	(0.53 - 0.68)
Hispanic	-0.24	0.78***	(0.72 - 0.86)	-0.12	0.89	(0.70 - 1.04)
Asian	-0.41	0.66***	(0.57 - 0.77)	-0.45	0.64**	(0.50 - 0.83)
Other Race	-0.46	0.63***	(0.53 - 0.74)	-0.45	0.64**	(0.49 - 0.84)
Unknown Race	-0.25	0.78***	(0.75 - 0.81)	-0.18	0.84***	(0.78 - 0.90)
Pain Score[#]				0.60	1.06***	(1.05 - 1.07)
Primary Impression				0.31	1.36***	(1.28 - 1.46)
Female Patient				0.85	1.09**	(1.03 - 1.15)
Anatomical Location				0.22	1.25***	(1.23 - 1.26)
Patient Age				0.00	1.00	(1.00 - 1.00)
Private Insurance (referent)						
Medicaid Insurance				-0.67	0.50***	(0.45 - 0.57)
Medicare Insurance				-0.49	0.61***	(0.56 - 0.67)
No Insurance				-0.42	0.66***	(0.60 - 0.72)
Other Government Insurance				-0.04	0.97	(0.78 - 1.20)
Unknown or Other Insurance				-0.57	0.57***	(0.53 - 0.61)
Constant		-1.534			-1.303	
Number of Cases		104,210			34,503	
-2 log likelihood		97,139			33,958	
Pseudo R2 (Nagelkerke)		0.004			0.080	

Note: log-odds= logistic regression coefficient and OR=odds ratio

* p< .05, ** p< .01, *** p< .001

= initial pain score

Table 5: Multivariate Logistic Regression of Patient Race on Pain Medication Administration (rural zip codes)

	Model 1			*Model 2*			*Model 3*		
Regressor	*log-odds*	*OR*	*CI 95%*	*log-odds*	*OR*	*CI 95%*	*log-odds*	*OR*	*CI 95%*
White (referent)									
Black	0.16	1.17	(0.82 - 1.67)	-0.60	0.94	(0.45 - 1.98)			
Hispanic	-0.35	0.71***	(0.59 - 0.84)	-0.18	0.84	(0.61 - 1.16)			
Asian	-0.39	0.68	(0.41 - 1.13)	-0.41	0.96	(0.32 - 2.85)			
Other Race	-0.71	0.49***	(0.38 - 0.65)	-0.93	0.39***	(0.25 - 0.63)	-0.93	0.39***	(0.25 - 0.63)
Unknown Race	-0.48	0.62***	(0.57 - 0.67)	-0.40	0.67***	(0.58 - 0.77)	-0.40	0.67***	(0.58 - 0.77)
Minority Race[##]							-0.15	0.86	(0.64 - 1.15)
Pain Score[#]				0.17	1.18***	(1.16 - 1.20)	0.17	1.18***	(1.16 - 1.20)
Primary Impression				0.23	1.26**	(1.10 - 1.44)	0.24	1.27**	(1.10 - 1.44)
Female Patient				-0.04	0.96	(0.86 - 1.07)	-0.04	0.96	(0.86 - 1.07)
Anatomical Location				0.21	1.23***	(1.20 - 1.26)	0.21	1.23***	(1.20 - 1.26)
Patient Age				0.00	1.00	(1.00 - 1.00)	0.00	1.00	(1.00 - 1.00)
Private Insurance (referent)									
Medicaid Insurance				-0.54	0.58***	(0.44 - 0.78)	-0.54	0.58***	(0.44 - 0.78)
Medicare Insurance				-0.35	0.71***	(0.60 - 0.84)	-0.35	0.71***	(0.60 - 0.84)
No Insurance				-0.08	0.92	(0.76 - 1.13)	-0.07	0.94	(0.76 - 1.13)
Other Government Insurance				0.09	1.09	(0.74 - 1.62)	0.08	1.09	(0.74 - 1.62)
Unknown or Other Insurance				-0.54	0.58***	(0.50 - 0.68)	-0.53	0.59***	(0.50 - 0.68)
Constant		-1.3			-1.05			-1.05	
Number of Cases		25,458			8,436			8,436	
-2 log likelihood		26,275			8,649			8,649	
Pseudo R2 (Nagelkerke)		0.011			0.165			0.165	

Note: log-odds= logistic regression coefficient and OR=odds ratio

* p< .05, ** p< .01, *** p< .001

= initial pain score

includes Black, Hispanic, and Asian races

Table 6: Multivariate Logistic Regression of Patient Race on Pain Medication Administration (urban zip codes)

	Model 1			*Model 2*		
Regressor	*log-odds*	*OR*	*CI 95%*	*log-odds*	*OR*	*CI 95%*
White (referent)						
Black	-0.27	0.77***	(0.70 - 0.84)	-0.34	0.71***	(0.62 - 0.82)
Hispanic	-0.17	0.85**	(0.75 - 0.95)	-0.11	0.90	(0.74 - 1.08)
Asian	-0.25	0.78***	(0.66 - 0.92)	-0.31	0.73*	(0.55 - 0.97)
Other Race	-0.46	0.63***	(0.50 - 0.81)	-0.41	0.66*	(0.46 - 0.96)
Unknown Race	-0.18	0.84***	(0.80 - 0.88)	-0.13	0.88**	(0.80 - 0.96)
Pain Score[#]				0.02	1.02*	(1.00 - 1.03)
Primary Impression				0.27	1.31***	(1.20 - 1.42)
Female Patient				0.13	1.14***	(1.06 - 1.22)
Anatomical Location				0.22	1.25***	(1.23 - 1.27)
Patient Age				0.00	1.00	(1.00 - 1.00)
Private Insurance (referent)						
Medicaid Insurance				-0.54	0.59***	(0.51 - 0.67)
Medicare Insurance				-0.50	0.61***	(0.54 - 0.69)
No Insurance				-0.34	0.71***	(0.63 - 0.80)
Other Government Insurance				0.02	1.02	(0.78 - 1.34)
Unknown or Other Insurance				-0.43	0.65***	(0.59 - 0.72)
Constant		-1.58			-1.352	
Number of Cases		69,475			22,145	
-2 log likelihood		63,425			21,561	
Pseudo R2 (Nagelkerke)		0.002			0.065	

Note: log-odds= logistic regression coefficient and OR=odds ratio

* p< .05, ** p< .01, *** p< .001

= initial pain score

Table 7: Adjusted Odds Ratios of Patient Race on Pain Medication Administration by Patient Insurance Status

Regressor [#]	*Private Insurance*	*No Insurance*	*Medicaid*	Medicare
White (referent)				
Black	0.46***	0.56***	0.60***	0.80
Hispanic	0.78	0.99	0.89	0.70
Asian	0.45*	0.70	0.64**	1.07
Other Race	0.68	0.55	0.64**	0.69
Unknown Race	0.99	0.82*	0.84***	0.88
cases (n)	5,635	2,867	4,969	6,064

* p< .05, ** p< .01, *** p< .001

adjusted for pain score, primary impression, patient gender, anatomical location of injury, and age