



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Patterns of opioid prescribing in emergency departments during the early phase of the COVID-19 pandemic

Tucker Lurie, MD ^{a,*}, Naomi Bonnin, BS ^b, Jeffrey Rea, MD ^{c,d,e}, Gurshawn Tuteja, BS ^f, Zachary Dezman, MD, MS, MS ^{c,d}, R. Gentry Wilkerson, MD ^{c,d}, Adelina Buganu, MD ^{c,d}, Rose Chasm, MD ^{c,d}, Daniel J. Haase, MD ^{c,d,e}, Quincy K. Tran, MD, PhD ^{c,d,e,g}

^a Wellspan York Hospital, Department of Emergency Medicine, 1001 South George Street, York, PA, 17403, USA

^b University of Maryland Global Campus, 1616 McCormick Dr, Largo, MD 20774, USA

^c University of Maryland School of Medicine, 655 West Baltimore Street, Baltimore, MD 21201, USA

^d Department of Emergency Medicine, University of Maryland School of Medicine, 110 South Poca Street, 6th Floor, Suite 200, Baltimore, MD 21201, USA

^e Program in Trauma, The R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, 22 South Greene Street, Baltimore, MD 21201, USA

^f Medical College of Georgia, 1120 15th St, Augusta, GA 30912, USA

^g The Research Associate Program in Emergency Medicine & Critical Care, University of Maryland School of Medicine, 22 South Greene Street, suite P1G01, Baltimore, MD 21201, USA

ARTICLE INFO

Article history:

Received 6 December 2021

Received in revised form 9 March 2022

Accepted 20 March 2022

Keywords:

Opioid prescriptions
COVID-19 pandemic
Interrupted time series

ABSTRACT

Introduction: The COVID-19 pandemic was superimposed upon an ongoing epidemic of opioid use disorder and overdose deaths. Although the trend of opioid prescription patterns (OPP) had decreased in response to public health efforts before the pandemic, little is known about the OPP from emergency department (ED) clinicians during the COVID-19 pandemic.

Methods: We conducted a pre-post study of adult patients who were discharged from 13 EDs and one urgent care within our academic medical system between 01/01/2019 and 09/30/2020 using an interrupted time series (ITS) approach. Patient characteristics and prescription data were extracted from the single unified electronic medical record across all study sites. Prescriptions of opioids were converted into morphine equivalent dose (MED). We compared the “Covid-19 Pandemic” period (C19, 03/29/2020–9/30/2020) and the “Pre-Pandemic” period (PP, 1/19/2020–03/28/2020). We used a multivariate logistic regression to assess clinical factors associated with opioid prescriptions.

Results: We analyzed 361,794 ED visits by adult patients, including 259,242 (72%) PP and 102,552 (28%) C19 visits. Demographic information and percentages of patients receiving opioid prescriptions were similar in both groups. The median [IQR] MED per prescription was higher for C19 patients (70 [56–90]) than for PP patients (60 [60–90], $P < 0.001$). ITS demonstrated a significant trend toward higher MED prescription per ED visit during the pandemic (coefficient 0.11, 95% CI 0.05–0.16, $P = 0.002$). A few factors, that were associated with lower likelihood of opioid prescriptions before the pandemic, became non-significant during the pandemic.

Conclusion: Our study demonstrated that emergency clinicians increased the prescribed amount of opioids per prescription during the COVID-19 pandemic compared to the pre-pandemic period. Etiologies for this finding could include lack of access to primary care and other specialties during the pandemic, or lower volumes allowing for emergency clinicians to identify who is safe to be prescribed opioids.

© 2022 Elsevier Inc. All rights reserved.

Abbreviations: COVID-19, Coronavirus disease of 2019; ED, emergency department; CDC, Centers for Disease Control and Prevention; PDMP, prescription drug monitoring programs; HOPE, Maryland Heroin and Opioid Prevention Effort; OUD, opioid use disorders; UMMS, University of Maryland Medical System; EHR, electronic health record; SQL, Structured Query Language; ESI, Emergency severity index; ICD-10, International Classification of Diseases, version 10; MED, morphine equivalent dose; IQR, interquartile range; ITS, interrupted time series; VIF, Variance Inflation Factor; AUROC, area under the receiver operating curve.

* Corresponding author at: 1001 South George Street, York, PA 17403, USA.

E-mail addresses: tlurie@wellspan.org (T. Lurie), jrea@umm.edu (J. Rea), GTUTEJA@augusta.edu (G. Tuteja), ZDezman@som.umaryland.edu (Z. Dezman),

Gwilkerson@som.umaryland.edu (R.G. Wilkerson), Rchasm@som.umaryland.edu (R. Chasm), DHaase@som.umaryland.edu (D.J. Haase), Qtran@som.umaryland.edu (Q.K. Tran).

1. Introduction

The World Health Organization declared the Coronavirus disease of 2019 (COVID-19) a pandemic on March 11, 2020. Stay-at-home orders and social distancing measures enacted to decrease the transmission of the virus greatly affected medical health systems in the United States. During the early months of the pandemic, there was a 21% reduction in primary care visits [1] and a 42% decrease in emergency department (ED) visits [2]. In a survey performed in the same period, 6% of primary care clinics had closed due to a reduction in visits [3].

The United States [4] was in the midst of an ongoing opioid epidemic when the COVID-19 pandemic began. To address this issue on a national level, The Centers for Disease Control and Prevention (CDC) published guidelines for prescribing opioids for patients with chronic non-cancer pain in 2016 [5]. Similarly, individual states created prescription drug monitoring programs (PDMPs) to assist physicians in prescribing opioids appropriately by tracking patients' opioid prescriptions across multiple providers. While PDMPs have been shown to decrease opioid prescribing in individual states such as Iowa [6] or Florida [7], among multiple states [8], and indeed nationally [9], their effectiveness in reducing opioid-related harms has been called into question [10], as the rise in synthetic and non-pharmaceutical opioids may have rendered these programs inconsequential. To combat factors outside of physician prescribing, the state of Maryland passed the Heroin and Opioid Prevention Effort (HOPE) Act in 2017, which mandated hospitals create discharge plans for patients with opioid use disorders (OUD) and increase access to treatment through the funding of outpatient substance use disorder programs [11].

The COVID-19 pandemic exacerbated underlying socioeconomic, mental health, and access to care issues that have contributed to the opioid epidemic. Our study aimed to describe the opioid prescriptions written for patients in the University of Maryland emergency departments and how these patterns changed during the COVID-19 pandemic. We hypothesized there would be an increase in the amount of opioid prescribed per prescription for patients during the pandemic.

2. Methods

2.1. Study design and patient selection

We conducted a pre-post study of patients who presented to the EDs and one urgent care within The University of Maryland Medical System (UMMS) between January 01, 2019, and September 30, 2020 (Supplementary Table 1). The fourteen sites within this system use a unified electronic health record (EHR) system and share data with a centralized database, EPIC (www.epic.com, Wisconsin, USA). We extracted patients' encounter data in an automated fashion using Structured Query Language (SQL). The study EDs included teaching and community sites, as well as urban and rural facilities, as defined by the Health Resources & Services Administration [12].

We included all patients ≥ 18 years of age who presented to and were discharged to home from any of the study sites. We excluded admitted patients because our focus was on ED prescriptions. We only included each patient's first encounter during the study period and excluded any repeat visits, to reduce a known confounding factor, as previous studies had shown the association between high utilizers and prescriptions from the ED [13,14]. Demographic information (age, gender, race, insurance status, zip codes, date and time of visit, teaching vs. non-teaching ED) and clinical information (Emergency severity index [ESI], presenting complaints, pain level at triage, number of past medical and past surgical history [i.e., the number of medical conditions, number of past surgical procedures], number of medications given during ED visits, discharge diagnoses) were extracted from patients' electronic health records. We obtained the median income of patients' home ZIP

codes as a proxy for socioeconomic status. We categorized the discharge diagnoses using International Classification of Diseases, version 10 (ICD-10) and categorized for any pain related to trauma or non-trauma conditions, and any diagnosis of overdose.

We defined the pre-pandemic (pre-event) period as January 01, 2019 until March 29, 2020. The pandemic event (post-event) started on March 30, 2020 until September 30, 2020. Our state entered a mandatory "stay-at-home" period between March 30, 2020 - May 15, 2020 [15]. During this "stay-at-home" period, all clinics and primary care physicians' offices were closed. After this "stay-at-home" period, businesses and physicians' offices were still operating at limited capacity in observation of strict social distancing regulations. Our study was considered exempt by our Institutional Review Board (IRB).

2.2. Primary outcome

The primary outcome was the total morphine equivalent dose (MED) prescribed per ED visit. We defined any analgesics and their conversion to MED as previously described: [16] codeine, hydrocodone, hydrocodone with acetaminophen, hydromorphone, morphine, oxycodone, oxycodone with acetaminophen, tramadol, fentanyl, methadone, buprenorphine/naloxone. The total prescribed MED during the study period also included the MED from any refills. For example, patients whose prescriptions specified a certain number of refills, we also considered the MED from the refills. For patients whose prescriptions did not specify a refill, we would consider that prescription to have no refill. Our secondary outcome was the percentage of patients who were prescribed opioids at ED discharge.

2.3. Statistical analysis

We presented our data as mean (standard deviation) or median [interquartile range (IQR)] as appropriate. We used Student *t*-test or Mann Whitney *U* test to compare continuous data and Pearson's Chi-square test for categorical data, when indicated. We categorized the continuous variables age according to prior Census reports [17], and time of visit according to shift times within the UMMS EDs.

To compare the trend of MED for the pre-pandemic period versus the pandemic period, we conducted a single-series interrupted time series (ITS) analysis [6]. In our interrupted time series analysis, total weekly MED for the pre-pandemic period was compared with the weekly MED during the pandemic period. The ITS would yield a coefficient for the trend of the actual MED being prescribed.

We performed a multivariate logistic regression to assess the association of patients' demographic and clinical information with their likelihood of receiving opioid prescription at ED discharge (dichotomous outcome of Yes opioid prescription versus No opioid prescription). All demographic and clinical factors were entered into our multivariate logistic regression models. We expressed our results as odds ratio (OR) and 95% Confidence Intervals (CI). If the same independent variable was significantly associated with patients' likelihood of receiving opioid prescriptions, we compared the variables' coefficients, which served as the magnitude for the likelihood of prescribing opioids. A positive coefficient signified higher likelihood of opioid prescriptions while a negative coefficient suggested a lower likelihood of opioid prescriptions. We also examined collinearity of each independent variable by its Variance Inflation Factor (VIF). Any independent variable with VIF > 5 would be considered to have high collinearity and was removed from the model. We evaluated the goodness-of-fit of our models using the area under the receiver operating curve (AUROC). A good model would have an AUROC approaching 1.0.

All statistical analyses were performed using Minitab version 19 (www.minitab.com, Pennsylvania, USA). All *P*-values < 0.05 were considered statistically significant.

3. Results

3.1. Patient demographics

We identified 435,851 patients from January 01, 2019, to September 30, 2020. We included 361,794 adult patients in our final analysis (Fig. 1). There were 259,242 (72%) pre-pandemic adult patient encounters and 102,552 (28%) post-pandemic visits. Females comprised 45% of all patients. 47% of patients were Black or African American, 47% were white. Overall, patients' characteristics were similar before and during the pandemic (Table 1).

When comparing demographics among the pre-pandemic period and the during pandemic period, the proportion of unique patient visits by Black patients decreased from 48% to 43%, while the proportion of unique patient visits by White patients increased from 45% to 50%. The proportion of unique patient visits to Urban Teaching and Rural sites decreased during the pandemic (28 vs 23% and 25 vs 21%, respectively), while the proportion of unique patient visits to Suburban sites increased (32 vs 43%). The median pain level was higher during the pandemic (4, [IQR] 0–8) when compared to pre-pandemic (0, [IQR] 0–7). The median income of patients' home ZIP was higher, on average, after the pandemic (\$73,900 vs \$76,000).

3.2. Opioid prescribing data

Opioids were prescribed for 12% of patient visits. The median prescription was for 60 MED (Table 2). The median MED per prescription (MED/Rx) increased significantly from pre-pandemic (60, [IQR] 56–90) to during pandemic period (70, [IQR] 60–90). Patients' genders, races, and shift times were associated with increases in MED/Rx.

3.3. Outcomes

3.3.1. Primary outcome

Based on the historical data in 2019 and up to March 30, 2020, the interrupted time series forecasted that there would be less MED per

ED visit for the study period (Fig. 2, counterfactual line #1). However, the interrupted time series demonstrated a significant trend of higher number of MED per ED visit (Coefficient [coeff] 0.11, 95% CI 0.05–0.16, $P = 0.002$) since the start of the “stay-at-home” period in our state, and this trend continued toward the end of our study period on September 30, 2020 (Fig. 2, line#2).

3.3.2. Secondary outcomes

Our multivariate logistic regressions identified multiple factors that were associated with patients' likelihood of being prescribed an opioid before the pandemic (Table 3). Urban ED settings (coeff 0.8, OR 2.4, 95% CI 2.3–2.5, $P = 0.001$), a diagnosis of pain from either a traumatic cause (coeff 0.5, OR 1.7, 95% CI 1.6–1.76, $P = 0.001$) or a non-traumatic cause (coeff 0.3, OR 1.4, 95% CI 1.3–1.4, $P = 0.001$) were among predictors strongly associated with higher likelihood of opioid prescription before the pandemic. These same factors remained strongly associated with opioid prescription during the pandemic (Table 3, Fig. 3A).

Before the pandemic, patients who presented to a “teaching ED” (coeff –1.6, OR 0.2, 95% CI 0.19–0.21, $P = 0.001$) and patients having a diagnosis of “overdose” (coeff –1.6, OR 0.2, 95% CI 0.1–0.3, $P = 0.001$) were strongly associated with a lower likelihood to receive opioid prescriptions. These factors remained strongly associated with a lower likelihood of opioid prescriptions during the pandemic (Fig. 3A). In contrast, presenting to the ED between 7 am–3 pm shifts or 3 pm–11 pm shifts were associated with a lower likelihood of receiving opioid prescriptions before the pandemic, but these factors became non-statistically significant during the pandemic (Table 3, Fig. 3B), which suggested that emergency clinicians working these shifts would be more inclined to prescribe an opioid during these shifts. Similarly, patients who had “self-pay” insurance were associated with lower likelihood of receiving an opioid prescription before the pandemic, but this barrier became non-statistically significant during the pandemic. Again, it suggested that emergency clinicians became more willing to prescribe opioids to this particular patient population.

In contrast, patients whose ages were 55 years or above (coeff –0.04, OR 0.95, 95% CI 0.90–1.001, $P = 0.055$) were not associated with a statistically significant lower likelihood for opioid prescriptions before the pandemic, but these patients were associated with a significantly lower likelihood of opioid prescriptions during the pandemic (coeff –0.3, OR 0.76, 95% CI 0.70–0.83, $P = 0.001$) (Fig. 3B).

3.4. Discussion

Our study demonstrated that emergency clinicians prescribed more MED per opioid prescription for patients who presented to the 13 EDs within our academic medical system during the early months of the COVID-19 pandemic. Furthermore, there was a change in opioid prescription patterns among emergency clinicians.

The reasons for a change in emergency clinicians' pattern of opioid prescribing are multifactorial. Due to “stay-at-home” orders and social distancing mandates in many states, independent physician practices were drastically reduced [18], causing patients to seek continuation of therapy or acute pain treatment in EDs more often. Furthermore, emergency clinicians, when faced with the uncertainty of independent physician practices, may have opted to prescribe a higher number of opioid tablets so patients can stay at home longer. Additionally, the overall decline of ED visits during the early pandemic of up to 42% [2] might have allowed clinicians more time to scour patients' records in our state's health information exchange, which included the PDMP, to provide more personalized treatment regimens. Overall, our findings provided further evidence to support other authors' assertions [19] that emergency clinicians may need more training to treat patients with chronic pain, acute pain, or substance use disorder more effectively during the current COVID-19 pandemic and any future crisis.

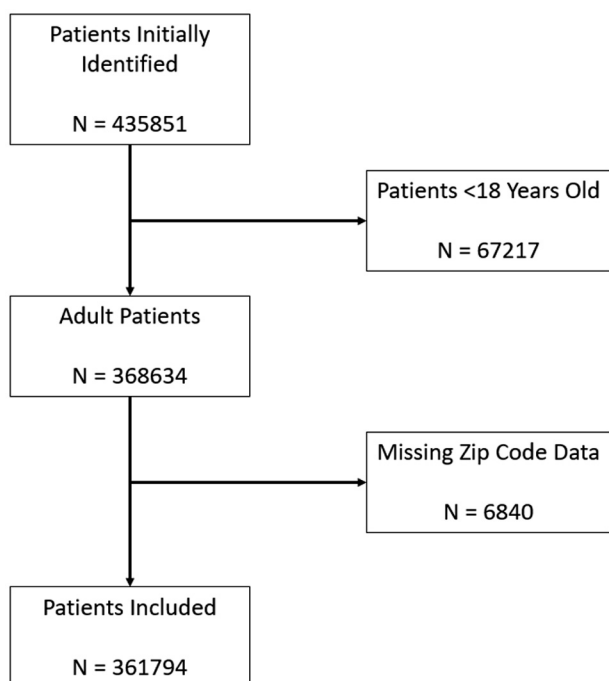


Fig. 1. Patient Selection Diagram, patients' index visits, University of Maryland Medical System (UMMS) (January 01, 2019, and September 30, 2020).

Table 1
Demographic and Clinical Factors of Patients' Index Visits, University of Maryland Medical System (UMMS) (January 01, 2019, and September 30, 2020).

	Total Population	Pre-pandemic	Pandemic	P
Total, N (%)#	361.8 (100.0)	259.2 (71.6)	102.6 (28.4)	<0.01
<i>Age, N (%)</i>				
18–24	47.5 (13.1)	34.8 (13.4)	12.7 (12.4)	0.50
25–34	78.4 (21.7)	56.4 (21.8)	22.0 (21.4)	0.82
35–44	60.6 (16.7)	42.7 (16.5)	17.8 (17.4)	0.74
45–54	56.2 (15.5)	40.2 (15.5)	16.0 (15.6)	1.0
55–64	55.4 (15.3)	39.6 (15.3)	15.8 (15.4)	1.0
65+	63.7 (17.6)	45.5 (17.5)	18.2 (17.8)	0.86
<i>Race, N (%)</i>				
Black	168.4 (46.6)	124.8 (48.1)	43.6 (42.6)	0.01
White	168.8 (46.7)	117.3 (45.2)	51.5 (50.2)	0.02
Other*	24.5 (6.8)	17.2 (6.6)	7.4 (7.2)	0.59
<i>ED Setting, N (%)</i>				
Urban Teaching	96.5 (26.7)	72.8 (28.1)	23.6 (23.1)	0.01
Urban Non-Teaching	51.6 (14.3)	38.5 (14.9)	13.0 (12.7)	0.15
Suburban	127.6 (35.3)	83.7 (32.3)	43.9 (42.8)	<0.01
Rural	86.2 (23.8)	64.2 (24.7)	22.0 (21.4)	0.07
<i>Presenting Complaints, N (%)</i>				
Pain: Traumatic	31.1 (8.6)	22.3 (8.6)	8.8 (8.6)	1.0
Pain: Non-Traumatic	35.9 (9.9)	26.3 (10.1)	9.6 (9.4)	0.59
Non-Pain Complaint	294.8 (81.5)	210.6 (81.2)	84.1 (82.1)	0.60
<i>Other Factors</i>				
Prescribed Opioids, N (%)	44.4 (12.3)	32.0 (12.3)	12.4 (12.1)	0.89
Female, N (%)	162.1 (44.8)	115.0 (44.3)	48.1 (46.9)	0.24
Income of Home ZIP, mean (SD)	74.5 (27.7)	73.9 (28.0)	76.0 (26.9)	<0.01
Insured, N (%)	331.5 (91.6)	237.5 (91.6)	93.7 (91.5)	0.92
Median ESI [IQR]	3 [3–4]	3 [3–4]	3 [3–4]	<0.01
Median Triage Pain [IQR]	0 [0–7]	0 [0–7]	4 [0–8]	<0.01

#All counts are in x1000s.

Abbreviations: 95% CI – 95% confidence interval; ED, emergency department; ESI, Emergency Severity Index; IQR – Interquartile Range.

* Includes Latinx, Asian, Native America, Pacific Islander, patients who identify as other, patients who identify as 2+ races, unknown, and patients who wished not to be identified.

It is unclear whether a pattern of increasing ED opioid prescriptions during the pandemic would be a direct cause of increased opioid overdose presentations. While there is evidence that opioids prescribed in the ED carry a moderate risk for development of long-term opioid use [20], ED opioid prescriptions were 46% less likely to progress to long-term use than non-ED opioid prescriptions (eg. inpatient, outpatient, ambulatory surgery, dentistry) [21]. In the state of Maryland, 93% of opioid-related deaths involved fentanyl [22], which may suggest illicit opioids play a larger role in overdose presentations and deaths than prescribed opioids. Further, a study of 7 EDs in the Washington D.C./Baltimore region [23] saw an increase in presentations for substance use disorder in general, but the proportion of presentations for opioids

specifically remained statistically the same. This implies substance use disorders worsened in general during the pandemic, likely owed to a combination of psychosocial and economic stressors, and it is less likely that an increase in ED opioid prescriptions is the primary driving factor in increased presentations for opioid overdoses and fatalities.

Our study also showed a gender and race disparity in the patterns of opioid prescriptions among the 13 EDs and urgent care within our medical system. Previous studies suggested that men and women have similar prevalence of opioid use disorder [24,25]. However, men were more likely to receive opioid prescriptions in our population. Furthermore, compared to white patients, Black and African American patients were less likely to receive opioid prescriptions in our study, which agreed

Table 2

Morphine equivalent dose per prescription across demographic groups, reported as median with interquartile range, University of Maryland Medical System (UMMS) (January 01, 2019, and September 30, 2020).

	Total population	Pre-pandemic	During pandemic	Between groups' P
Total MED/Rx, Median [IQR]	60.0 [60.0–90.0]	60.0 [56.0–90.0]	70.0 [60.0–90.0]	<0.01
Sex (MED/Rx), Median [IQR]				
Female	60.0 [60.0–90.0]	60.0 [54.0–90.0]	60.0 [60.0–90.0]	<0.01
Male	60.0 [60.0–90.0]	60 [60–90]	70.0 [60.0–90.0]	<0.01
Race (MED/Rx), Median [IQR]				
Black	60.0 [60.0–90.0]	60.0 [53.0–90.0]	60.0 [60.0–90.0]	<0.01
White	60.0 [60.0–90.0]	60.0 [60.0–90.0]	75.0 [60.0–90.0]	<0.01
Other*	60.0 [60.0–90.0]	60.0 [60.0–90.0]	70 [60.0–90.0]	<0.01
Shift Time (MED/Rx), Median [IQR]				
Shift 1 (7a–3p)	60.0 [60.0–90.0]	60.0 [60.0–90.0]	75.0 [60.0–90.0]	<0.01
Shift 2 (3p–11p)	60.0 [54.0–90.0]	60.0 [50.0–90.0]	70.0 [60–90.0]	<0.01
Shift 3 (11p–7a)	60.0 [60.0–90.0]	60.0 [54.0–90.0]	60.0 [54.0–90.0]	<0.01
Day of Week (MED/Rx), Median [IQR]				
Weekday	60.0 [60.0–90.0]	60.0 [60.0–90.0]	70.0 [60.0–90.0]	<0.01
Weekend	60.0 [60.0–90.0]	60.0 [54.0–90.0]	75.0 [60.0–90.0]	<0.01
Opioid (MED/Rx)*, Median [IQR]				
APAP/ Codeine	54.0 [36.0–68.0]	60 [37–68]	54 [45–68]	<0.01
APAP/ Hydrocodone	60.0 [40.0–60.0]	60.0 [40.0–60.0]	60.0 [45.0–60.0]	0.15
APAP/ Oxycodone	60.0 [40.0–60.0]	60.0 [40.0–60.0]	60.0 [45.0–60.0]	<0.01
Buprenorphine/Naloxone	520.0 [260.0–960.0]	640.0 [220.0–1000.0]	420.0 [330.0–540.0]	0.62
Hydromorphone	96.0 [80.0–144.0]	96.0 [80.0–160.0]	96.0 [80.0–120.0]	0.05
Morphine	120.0 [90.0–120.0]	120.0 [90.0–120.0]	120.0 [90.0–120.0]	0.31
Oxycodone	90.0 [60.0–113.0]	90.0 [60.0–113.0]	90.0 [75.0–105.0]	0.56
Tramadol	60.0 [60.0–60.0]	60.0 [60.0–60.0]	60.0 [60.0–60.0]	0.68

Abbreviations: APAP, acetaminophen; MED, Morphine equivalent dose; Rx, Prescription.

* Methadone, Fentanyl, Butorphanol, Meperidine and Tapentadol were not included because they did not have sufficient prescriptions written to be able to perform Mann-Whitney U test.

with recent reports [26,27]. This represents a physician bias and is possibly explained by a higher prevalence of substance use disorder screening in Baltimore/Washington EDs among Black and African Americans when compared to white patients [23]. Emergency clinicians should recognize this bias and carefully review which patients are appropriate for opioid prescriptions from the ED.

3.5. Limitations

Our study was limited to EDs and one urgent care, therefore our findings may not be generalizable to other practice environments. Additionally, it is assumed that the orders given at the onset of the pandemic are driving the measured changes. We were not able to control for other interventions occurring simultaneously to the “stay-at-home” order. We only examined patients' index ED visits, as such, we were not able to examine the effect of high ED utilization and the opioid prescriptions or prescription refills. However, the effects and association of high ED

utilizers and prescriptions had been described previously [13,14]. Further, it was beyond the scope of this review to include individual diagnoses and their relation to receiving opioids, so the population level data may not be applicable on an individual basis. One final limitation was our study period was during a period of “stay-at-home” orders and limited opening for businesses and physicians' offices. If we examined for a longer period of time, the effect might have changed as patients may have more access to their primary care physicians or other substance use disorder clinics.

4. Conclusion

Our study demonstrated that the COVID-19 pandemic affected how emergency clinicians changed their opioid prescribing patterns during the early period of the pandemic. Emergency clinicians wrote for higher amounts of opioids with each prescription, and prescribed opioids for categories of patients that they would not have before the pandemic.

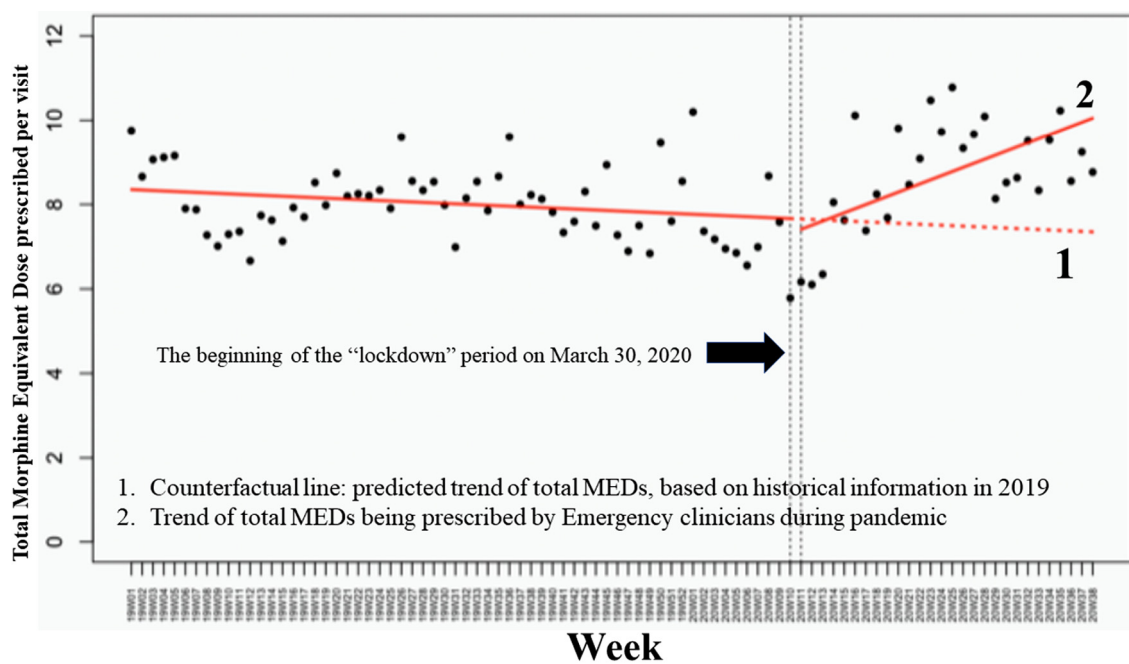


Fig. 2. Interrupted time series for total morphine equivalent dose prescribed per Emergency Department visit, week to week, University of Maryland Medical System (UMMS) (January 01, 2019, and September 30, 2020).

Table 3
Multivariate logistic regression results for patients given opioid prescriptions during Emergency Department visits, University of Maryland Medical System (UMMS) (January 01, 2019, and September 30, 2020).

Variables	Pre pandemic period ¹					During Pandemic period ²				
	Coefficient	OR	95% CI	P	VIF	Coefficient	OR	95% CI	P	VIF
Increased likelihood to receive opioid prescriptions										
ESI	0.4	1.5	1.4–1.5	0.001	1.2	0.4	1.5	1.4–1.5	0.001	1.2
Pain	0.1	1.1	1.13–1.14	0.001	1.1	0.3	1.3	1.31–1.34	0.001	1.1
Number of past surgical history	0.02	1.02	1.01–1.02	0.001	1.9	0.02	1.02	1.01–1.02	0.001	2
Weekend	0.05	1.05	1.02–1.07	0.001	1	0.08	1.09	1.03–1.13	0.001	1.1
Urban	0.8	2.4	2.3–2.5	0.001	2.7	0.8	2.2	2.04–2.4	0.001	2.8
Suburban	0.4	1.5	1.4–1.6	0.001	1.8	0.4	1.5	1.4–1.6	0.001	1.9
Gender - male	0.04	1.04	1.01–1.07	0.002	1.1	0.1	1.1	1.06–1.15	0.001	1.1
Race - White	0.14	1.1	1.09–1.21	0.001	4.2	0.3	1.3	1.2–1.4	0.001	4.3
Insurance - Worker's compensation	0.26	1.3	1.1–1.5	0.001	1.1	0.03	1.03	0.8–1.3	0.86	1.5
Number of medications given in ED	0.2	1.2	1.21–1.22	0.001	1.1	0.2	1.2	1.18–1.20	0.001	1.1
Diagnosis - Any Pain from trauma cause	0.5	1.7	1.6–1.76	0.001	1.1	0.4	1.6	1.4–1.7	0.001	1.1
Diagnosis - Any pain from non-trauma cause	0.3	1.4	1.3–1.4	0.001	1.1	0.08	1.1	1.01–1.2	0.02	1.1
Decreased likelihood to receive opioid prescriptions										
ED shift 7 am–3 pm	−0.06	0.94	0.91–0.98	0.02	1.9	0.05	1.1	0.9–1.1	0.09	1.9
ED shift 3 pm–11 pm	−0.08	0.92	0.8–0.95	0.001	1.9	0.003	0.99	0.94–1.06	0.93	1.9
Teaching ED	−1.6	0.2	0.19–0.21	0.001	2.1	−1.5	0.2	0.20–0.25	0.001	2.1
Age group - 18–24	−0.8	0.4	0.42–0.48	0.001	2.1	−0.9	0.4	0.3–0.4	0.001	1.9
Age group - 25–34	−0.3	0.74	0.70–0.78	0.001	3.1	−0.6	0.56	0.51–0.61	0.001	2.8
Age group - 35–44	−0.1	0.86	0.82–0.91	0.001	2.7	−0.5	0.63	0.58–0.69	0.001	2.6
Age group - 45–54	−0.07	0.93	0.88–0.98	0.014	2.5	−0.3	0.75	0.68–0.81	0.001	2.5
Age group - 55 and above	−0.04	0.95	0.90–1.001	0.055	2.3	−0.3	0.76	0.70–0.83	0.001	2.2
Number of past medical history	−0.02	0.98	0.97–0.99	0.001	2.1	−0.02	0.98	0.97–0.98	0.001	2.1
Insurance - Medicaid	−0.2	0.8	0.72–0.88	0.001	1.1	−0.3	0.8	0.64–0.91	0.003	1.1
Insurance - Medicare	−0.2	0.78	0.74–0.82	0.001	2.6	−0.3	0.71	0.66–0.78	0.001	2.5
Insurance - Self pay	−0.1	0.86	0.82–0.92	0.001	1.1	0.02	1.02	0.94–1.11	0.61	1.5
Diagnosis - Any overdose	−1.6	0.2	0.1–0.3	0.001	1.5	−2.2	0.11	0.3–0.46	0.002	1

Abbreviations: ED - Emergency Department; ESI - Emergency Severity Index.

¹ Area Under Receiver Operating Curve = 0.76.

² Area Under Receiver Operating Curve = 0.83.

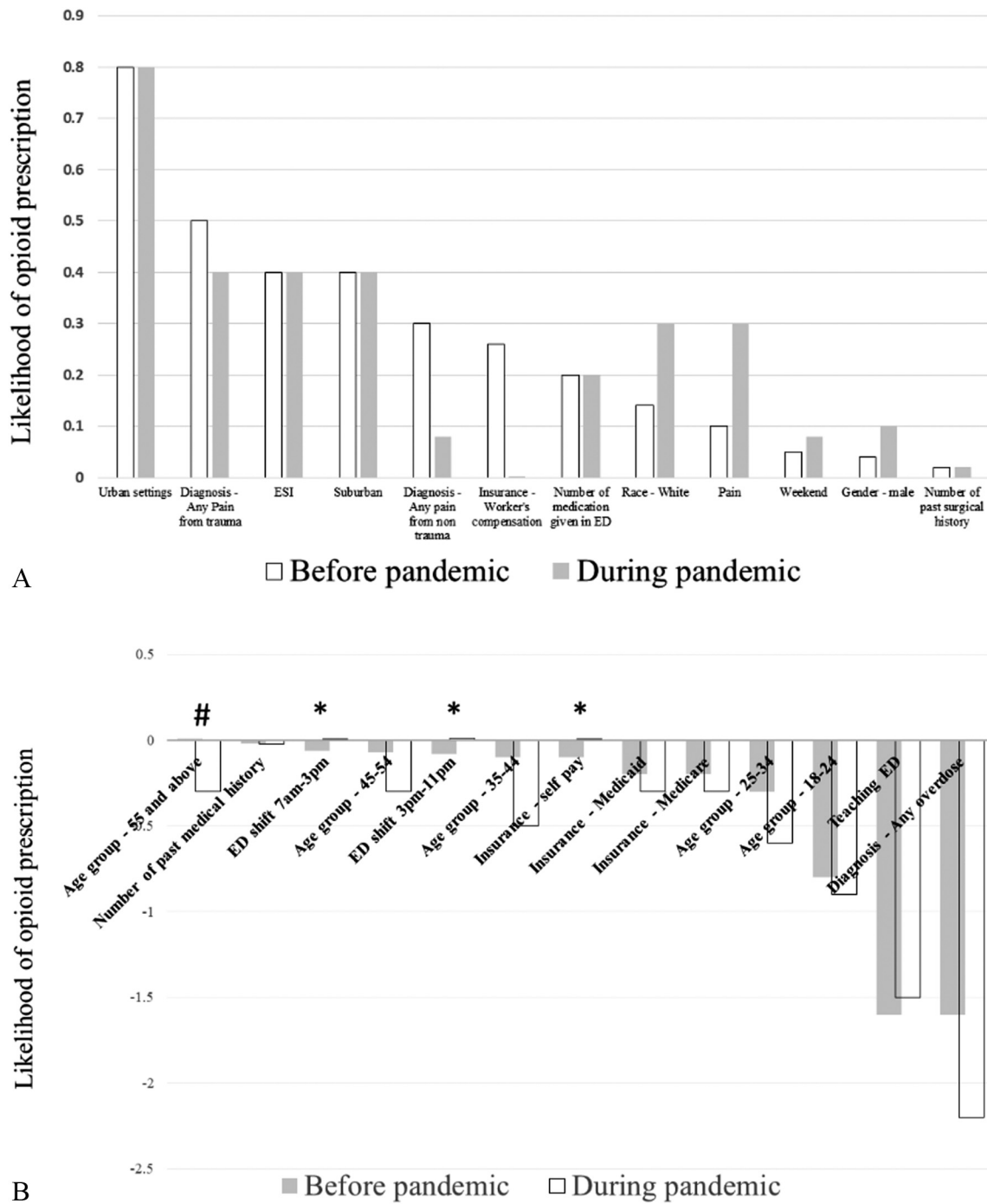


Fig. 3. Comparison of predictors' statistically significant coefficients associated with likelihood of opioid prescriptions before or after the onset of the 2020 coronavirus pandemic. 3A. Comparison of predictors with higher likelihood of opioid prescription (positive coefficients) before the pandemic with the same predictors' coefficient for patients who presented to EDs during the pandemic. Higher positive coefficients indicated higher likelihood. Abbreviations: ED, emergency department; ESI, Emergency Severity Index. 3B. Comparison of predictors with lower likelihood of opioid prescription (negative coefficients) before the pandemic with the same predictors' coefficient for patients who presented to EDs during the pandemic. More negative coefficients demonstrated lower likelihood of opioid prescription. Coefficients from non-statistically significant predictors were assigned a value of zero for illustration. #Coefficient changed from non-statistically significant before pandemic to lower likelihood of opioid prescription during the pandemic. *Coefficient changed from lower likelihood for opioid prescription before the pandemic to non-statistically significant during the pandemic. Abbreviations: ED, emergency department; ESI, Emergency Severity Index.

Further studies are needed to determine clinical factors associated with increased opioid prescriptions, as well as the effect of this change in prescription patterns during a pandemic.

Funding source

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Presentation

The data has not been presented previously.

CRedit authorship contribution statement

Tucker Lurie: Conceptualization, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision. **Naomi Bonnin:** Methodology, Investigation, Formal analysis, Writing – original draft. **Jeffrey Rea:** Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Gurshawn Tuteja:** Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Visualization. **Zachary Dezman:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **R. Gentry Wilkerson:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Adelina Baganu:** Investigation, Data curation, Writing – original draft, Writing – review & editing. **Rose Chasm:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Daniel J. Haase:** Conceptualization, Methodology, Resources, Writing – original draft, Writing – review & editing. **Quincy K. Tran:** Conceptualization, Methodology, Investigation, Data curation, Writing – original draft, Writing – review & editing, Project administration.

Declaration of Competing Interest

The authors have no conflicts to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ajem.2022.03.040>.

References

- Alexander GC, Tajanlangit M, Heyward J, Mansour O, Qato DM, Stafford RS. Use and content of primary care office-based vs telemedicine care visits during the COVID-19 pandemic in the US. *JAMA Netw Open*. 2020;3(10). <https://doi.org/10.1001/jamanetworkopen.2020.21476>.
- Hartnett K, et al. Impact of the COVID-19 pandemic on emergency department visits – United States, January 1, 2019–may 30, 2020. *Morb Mortal Wkly Rep*. 2020;69(23):699–704. <https://doi.org/10.15585/mmwr.mm6923e1>.
- Armour S. Coronavirus victims include health clinics in minority communities. *Wall Street J*. 2020. <https://www.wsj.com/articles/coronavirus-victims-include-health-clinics-in-minority-communities-11594465201>. (accessed Oct. 22, 2021), online newspaper.
- Vivolo-Kantor AM, et al. Nonfatal drug overdoses treated in emergency departments – United States, 2016–2017. *MMWR Morb Mortal Wkly Rep*. 2020;69(13). <https://doi.org/10.15585/mmwr.mm6913a3>.
- Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain–United States, 2016. *JAMA*. 2016;315(15). <https://doi.org/10.1001/jama.2016.1464>.
- Ranapurwala SI, Carnahan RM, Brown G, Hinman J, Casteel C. Impact of Iowa's prescription monitoring program on opioid pain reliever prescribing patterns: An interrupted time series study 2003–2014. *Pain Med (United States)*. 2019;20(2). <https://doi.org/10.1093/pm/pny029>.
- Rutkow L, Chang HY, Daubresse M, Webster DW, Stuart EA, Alexander GC. Effect of Florida's Prescription Drug Monitoring Program and pill mill laws on opioid prescribing and use. *JAMA Intern Med*. 2015;175(10). <https://doi.org/10.1001/jamainternmed.2015.3931>.
- Strickler GK, Kreiner PW, Halpin JF, Doyle E, Paulozzi LJ. Opioid prescribing behaviors–Prescription behavior surveillance system, 11 states, 2010–2016. *MMWR Surveill Summ*. 2020;69(1). <https://doi.org/10.15585/mmwr.ss6901a1>.
- Wen H, Hockenberry JM, Jeng PJ, Bao Y. Prescription drug monitoring program mandates: Impact on opioid prescribing and related hospital use. *Health Aff*. 2019;38(9). <https://doi.org/10.1377/hlthaff.2019.00103>.
- Rhodes E, Wilson M, Robinson A, Hayden JA, Asbridge M. The effectiveness of prescription drug monitoring programs at reducing opioid-related harms and consequences: A systematic review. *BMC Health Serv Res*. 2019;19(1). <https://doi.org/10.1186/s12913-019-4642-8>.
- Hogan Jr LJ. Heroin and opioid prevention effort (HOPE) and treatment act of 2017. *Baltimore*; 2017..
- H. R. & S. Administration. Defining rural population. <https://www.hrsa.gov/rural-health/about-us/definition/index.html>. (accessed Nov. 27, 2021).
- Olsen JC, Ogarek JL, Goldenberg EJ, Sulo S. Impact of a chronic pain protocol on emergency department utilization. *Acad Emerg Med*. 2016;23(4). <https://doi.org/10.1111/acem.12942>.
- Ringwalt C, et al. A randomized controlled trial of an emergency department intervention for patients with chronic noncancer pain. *J Emerg Med*. 2015;49(6). <https://doi.org/10.1016/j.jemermed.2015.03.004>.
- L. J. Hogan Jr., Order of the governor of the state of MARYLAND number 20-03-30-01. *Baltimore*.
- Centers for Medicare and Medicaid Services. Opioid oral morphine milligram equivalent (MME) conversion factors. *Centers for Medicare and Medicaid Services*; 2018..
- Howden L, Meyer J. Age and Sex Composition: 2010. *2010 Census Briefs*. *U.S. Census Bureau*, no. May; 2011..
- Rubin R. COVID-19's crushing effects on medical practices, some of which might not survive. *JAMA*. 2020;324(4). <https://doi.org/10.1001/jama.2020.11254>.
- Ornell F, Moura HF, Scherer JN, Pechansky F, Kessler FHP, von Diemen L. The COVID-19 pandemic and its impact on substance use: Implications for prevention and treatment. *Psychiatry Res*. 2020;289. <https://doi.org/10.1016/j.psychres.2020.113096>.
- Meisel ZF, Lupulescu-Mann N, Charlesworth CJ, Kim H, Sun BC. Conversion to persistent or high-risk opioid use after a new prescription from the emergency department: evidence from Washington medicaid beneficiaries. *Ann Emerg Med*. 2019;74(5). <https://doi.org/10.1016/j.annemergmed.2019.04.007>.
- Jeffery MM, et al. Opioid prescribing for opioid-naïve patients in emergency departments and other settings: characteristics of prescriptions and association with long-term use. *Ann Emerg Med*. 2018;71(3). <https://doi.org/10.1016/j.annemergmed.2017.08.042>.
- Maryland Opioid Operational Command Center - 2020 Annual Report; 2020..
- Chandran K, Mazer-Amirshahi M, Shankar N, Desale S, Nelson L, Mete M. Impact of COVID-19 pandemic on emergency department substance use screens and overdose presentations. *Am J Emerg Med*. 2021;50. <https://doi.org/10.1016/j.ajem.2021.08.058>.
- Back SE, Payne RL, Simpson AN, Brady KT. Gender and prescription opioids: findings from the national survey on drug use and Health. *Addict Behav*. 2010;35(11). <https://doi.org/10.1016/j.addbeh.2010.06.018>.
- Tetrault JM, Desai RA, Becker WC, Fiellin DA, Concato J, Sullivan LE. Gender and non-medical use of prescription opioids: results from a national US survey. *Addiction*. 2008;103(2). <https://doi.org/10.1111/j.1360-0443.2007.02056.x>.
- Smith BC, Vigotsky AD, Apkarian AV, Schnitzer TJ. Temporal factors associated with opioid prescriptions for patients with pain conditions in an urban emergency department. *JAMA Netw Open*. 2020;3(3). <https://doi.org/10.1001/jamanetworkopen.2020.0802>.
- Morden NE, Chyn D, Wood A, Meara E. Racial inequality in prescription opioid receipt – Role of individual health systems. *N Engl J Med*. 2021;385(4). <https://doi.org/10.1056/nejmsa2034159>.