Opioid Prescription Reduction After Implementation of a Feedback Program in a National Emergency Department Group

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Study objective: Reducing excessive opioid prescribing in emergency departments (ED) may prevent opioid addiction. We evaluated the largest personalized feedback and peer comparison intervention to date on emergency clinician opioid prescription rates in a national emergency clinician group.

Methods: This interrupted time series analysis of a quality improvement intervention included data from adults discharged from 102 EDs in 17 states from January 1, 2019, to July 31, 2021. From June 16, 2020, to November 30, 2020, site-level ED directors received emails on local opioid prescription rates. From December 1, 2020, to July 31, 2021, all clinicians were granted electronic dashboard access, which showed prescription rates compared with peers, and national ED leaders sent emails to high-prescribing clinicians and engaged in one-on-one conversations. The primary outcome was opioid prescriptions per 100 discharges.

Results: The study included 5,328,288 ED discharges from 924 physicians and 472 advanced practice providers. Opioid prescription rates did not change meaningfully in the site-level director feedback period (mean difference = −0.3, 95% confidence interval [CI] −0.6 to −0.1). During the direct clinician feedback period, opioid prescription rates declined from 10.4 per 100 discharges to 8.4 per 100 discharges (mean difference = −2.0, 95% CI −2.4 to −1.5), a 19% relative reduction. Among prescribers in the highest initial quintile, opioid prescribing reduced by 35% among physicians and 41% among advanced practice providers in the direct feedback period.

Conclusion: We demonstrated a large, sustained reduction in opioid prescribing by emergency clinicians using direct, personalized feedback to clinicians and an electronic dashboard for peer comparison. [Ann Emerg Med. 2022;79:420-432.]

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INTRODUCTION

Background

In the past 30 years, US opioid prescribing rates have quadrupled and overdose deaths increased by 200% from 2000 to 2014.[1,2] More recently, opioid overdoses have increased during the coronavirus disease 2019 (COVID-19) pandemic.[3-5] Previous studies have suggested that physician prescribing behavior may cause or exacerbate addiction, driving opioid mortality.[1,2] Although emergency clinicians (physicians, physician assistants, and nurse practitioners) typically prescribe small numbers of pills per prescription, they account for approximately one fifth of overall opioid prescriptions.[6] Higher opioid prescribing by individual clinicians has been associated with long-term opioid use and addiction and may contribute to the opioid epidemic.[1,7] Large variation has also been observed in emergency clinician prescribing, suggesting room for improvement by addressing high prescribing in outlier clinicians.[8]

Importance

Several emergency department (ED) interventions to reduce opioid prescription variability, frequency, and quantity have been implemented. These include state prescription drug monitoring programs, guidelines on opioid prescribing, educational interventions, nudges within electronic health records, and feedback programs.[9-24] These interventions have been successful to varying degrees in reducing opioid prescribing. Studies on feedback of individual prescribing practices with comparison relative to peers have been particularly effective.[22-25] One study found that 65% of attending physicians, residents, and advanced practice providers at 4 EDs underestimated their perceived opioid prescribing compared with peers.[21] When

Editor's Capsule Summary

What is already known on this topic

Emergency care is one key opportunity to address prescriptive opioid use.

What question this study addressed

Does a feedback program using peer data on opioid prescribing fed directly to each clinician alter emergency department (ED) later opioid prescribing?

What this study adds to our knowledge

Using a time series approach from a large emergency services contract group and more than 5 million ED encounters, both physicians and advanced practice providers displayed drops in prescribing, especially in the highest pre-effort prescribers.

How this is relevant to clinical practice

Personal comparative information to ED prescribers of opioids can be a better tool than other generalized prescribing reduction efforts.

shown their actual rates and peer group norms, opioid prescribing decreased more than controls. However, studies to date on peer feedback have been largely from academic settings and in small numbers of clinicians. One of the largest interventions was a multipronged strategy that included sharing dashboards allowing for clinician peer comparison of opioid prescribing rates, direct feedback to outliers from medical directors, and electronic medical record nudges at 14 EDs in a single system, which reduced opioid prescriptions by 7%.[17] To our knowledge, no study has examined interventions aimed at reducing ED opioid prescriptions across a large number and variety of practice settings, health systems, clinicians, and clinician types on a national scale.

Goals of This Investigation

We evaluated the effect of an audit and feedback quality improvement program for emergency clinicians on opioid prescribing rates in a national emergency medicine (ED) group. We also examined clinician-, regional-, and condition-level factors associated with declines in opioid prescribing.

MATERIALS AND METHODS

Study Design and Intervention

We conducted an evaluation of a 2-phase intervention to reduce opioid prescribing in a national ED practice organization that provides emergency physician and advanced practice provider staffing to a large sample of US EDs staffed by a single national ED group (Figure 1). The primary purpose was to reduce opioid prescribing, particularly among clinicians who were outlier prescribers. The definition of an outlier prescriber was determined by national clinical leadership team examination of the data and discussion. Ultimately, outlier prescribers were defined as prescribing 20 or more opioid prescriptions per 100 ED discharges. This represented approximately twice the preintervention mean and was approximately the top eighth percentile of prescribing.

The intervention was conducted in 2 phases. In the first phase, which began on June 16, 2020, quarterly data on clinician prescribing of opioids were emailed to site-level physician directors at each included ED. Data were reported only for clinicians who had discharged 100 or more patients in the quarter. This included both a blinded and unblinded spreadsheet containing prescribing data by clinicians at their local site as well as blinded regional and national data. National program leadership requested that site-level physician directors review the data and share the same with their clinicians in either a blinded or unblinded fashion at the site directors' discretion. No specific instructions were given to the site-level physician directors on which clinicians should be given feedback or how that feedback should be delivered. After the rollout of the first phase and continuous monitoring of opioid prescription rates, national leadership determined that a new approach would be needed to reduce outlier prescribing because solely giving data to the site-level directors was ineffective.

In the second phase, which began on December 1, 2020, a clinician-level opioid prescribing dashboard was made available to all clinicians to view their individual quarterly prescribing rates, blinded site peer clinician rates, and blinded regional/national rates. In addition, at the start of phase 2, the national leadership team emailed each outlier clinician and scheduled a 15-minute telephonic conversation to discuss their opioid prescribing. A total of 144 clinicians received emails to schedule the conversation from 1 of the 8 members of the national leadership team (A.A., J.M.P), who are all board-certified emergency physicians. These emails were not scripted, and the conversations did not follow a rigorous format. Before conducting the calls, the national leadership group did discuss qualitatively what should be discussed. Specifically, national leadership team members communicated the outlier's prescribing rate, as well as regional and national data comparisons from the group, and offered evidence supporting ED opioid prescribing and the link to long-term addiction. In addition, many of these conversations

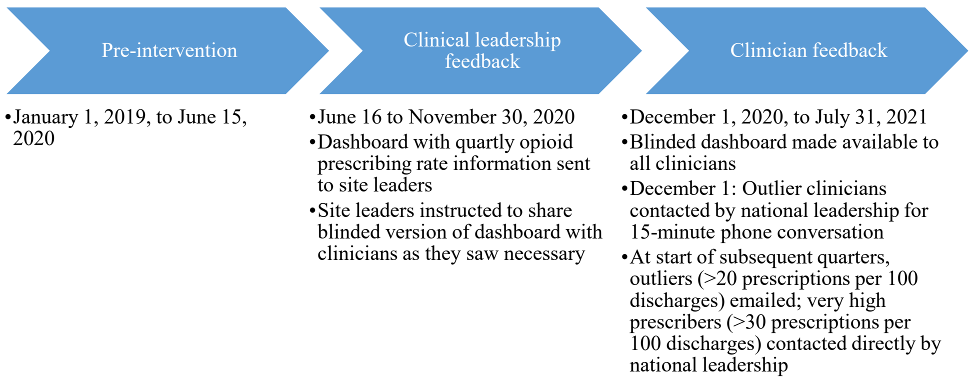

Figure 1. Intervention timeline.

explored potential reasons behind each outlier's high prescribing rates. For example, some described preferences to prescribe specific opioids (ie, tramadol), believed that their patients wanted opioids and wanted to please them, did not want to argue with patients, or believed that the local culture supported liberal prescribing. The conversations also described potential solutions (eg, avoiding specific medications such as tramadol) and pointed out educational materials on opioid prescribing available in a centralized learning management system managed by the national group. This education included using alternatives to opioids whenever feasible, using the lowest effective dose and low pill counts, using prescription drug monitoring programs prior to opioid prescribing, and optimizing communication about opioids with patients. In subsequent quarters, emails were sent to individual outlier clinicians (20 or more prescriptions per 100 discharges) about their prescribing rate and outlier status, and selected outliers with very high continued prescribing (30 or more prescriptions per 100 discharges) were contacted by national leadership for telephonic conversations.

Setting and Selection of Participants

The analysis included ED visits from 79 hospital-based and 23 freestanding EDs continuously staffed by the national ED practice organization from January 1, 2019, to July 31, 2021 (31 months). Visits studied included those treated at 7 academic and 95 community EDs as well as 12 trauma and 90 non–trauma centers across 17 US states. Visits to pediatric EDs and pediatric visits at general EDs and freestanding EDs were excluded because of differing acuity and pain management in pediatric patients. ED visits admitted to the hospital or transferred to another facility, admitted to observation status, left without being seen, or died on arrival or in the ED were also excluded. We additionally excluded visits if treated by a clinician who did not see at least 100 visits before and 100 visits after the intervention started. Finally, we removed visits treated in facilities from Texas because data on opioid prescribing were not fully captured in the electronic medical record. The study period was selected to allow for a long preintervention period (January 1, 2019, to June 15, 2020) and intervention periods through July 31, 2021. The intervention period was divided into 2 parts: site-level clinical director feedback (June 16, 2020, to November 30, 2020) and direct clinician feedback (December 1, 2020, to July 31, 2021). This study was deemed exempt by the Allegheny Health Network institutional review board as a retrospective analysis of a preplanned quality improvement intervention.

Data Sources

The study used visit-level administrative data from hospital-based and freestanding EDs staffed by this national emergency clinician group. The organization employs its own billing and coding specialists who abstract ED visit data, including patient demographics, medications prescribed at discharge, and diagnoses. Additional details of the data set and the abstraction and validation process have been described in detail previously.[26]

Methods of Measurement

Opioid prescriptions for pain management were identified using a combination of National Drug Codes (NDCs), RxNorm codes, and free-text searches for unique generic and brand names. The NDC and RxNorm code lists for opioids were obtained from the US Food and Drug Administration's National Drug Code Directory and National Library of Medicine's RxNav.[27,28] Free-text searches were developed by the clinical informatics team. Prescriptions for Suboxone (Indivior; buprenorphine and naloxone) were not considered opioid prescriptions for the purposes of this study. ED visits were flagged as either receiving or not receiving an opioid prescription at discharge, regardless of the type, strength, or amount of the opioid prescribed.

Table 1. Emergency department patient and visit characteristics.

Characteristic	Study Period		
	Preintervention*	Clinical Leadership Feedback†	Clinician Feedback‡
Total visits, No.	3,171,740	895,232	1,261,316
Patient age, y			
Mean	40.3	42.3	42.3
SD	22.8	21.7	22.1
Patient sex, %			
Male	43.6	44.6	44.1
Female	56.4	55.4	55.9
Payer source, %			
Commercial	30.4	30.7	30.3
Medicare	20.5	21.3	21.4
Medicaid	30.8	30.4	31.3
Self-pay	16.2	15.3	14.0
Other	2.1	2.3	3.0
ESI triage level, %			
1	0.2	0.2	0.2
2	10.4	11.3	11.9
3	53.2	56.1	56.5
4	33.3	29.5	29.2
5	2.9	3.0	2.2
Primary diagnosis (ICD-10-CM) body system, %			
Injury, poisoning, and certain other consequences of external causes	21.3	23.6	22.7
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	17.6	17	17.4
Diseases of the respiratory system	11.1	5.4	5.6
Diseases of the musculoskeletal system and connective tissue	8.7	8.5	8.6
Diseases of the circulatory system	6.9	7.4	7.6
Diseases of the genitourinary system	6.6	7.2	6.7
Diseases of the digestive system	5.8	5.9	6.0
Diseases of the nervous system	4.0	4.0	3.9
Diseases of the skin and subcutaneous tissue	3.6	3.6	3.3
Mental, behavioral, and neurodevelopmental disorders	2.9	3.8	4.2
Pregnancy, childbirth, and the puerperium	2.6	2.6	2.7
Endocrine, nutritional, and metabolic diseases	2.2	2.2	1.9
Diseases of the ear and mastoid process	1.7	1.2	1.2
Certain infectious and parasitic diseases	1.6	3.7	4.7
Factors influencing health status and contact with health services	1.5	2.1	2.0
Diseases of the eye and adnexa	1.0	0.8	0.8
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	0.6	0.6	0.6
Neoplasms	0.2	0.2	0.2
Certain conditions originating in the perinatal period	0.1	0.1	0.0
Congenital malformations, deformations, and chromosomal abnormalities	0.0	0.0	0.0
Unclassified	0.0	0.0	0.1

Table 1. Continued.

Characteristic	Study Period: Preintervention*	Clinical Leadership Feedback†	Clinician Feedback‡
Day of visit discharge, %			
Monday	15.2	15.1	14.6
Tuesday	14.7	14.6	14.8
Wednesday	14.3	14.4	14.6
Thursday	14.0	14.1	14.3
Friday	13.9	14.0	14.1
Saturday	13.7	13.8	13.9
Sunday	14.1	14.0	13.6
Time of visit discharge, %			
Midnight to 7 AM	20.1	19.6	20.2
7 AM to 3 PM	28.4	27.9	27.9
3 PM to midnight	51.5	52.4	51.9
Daily visit discharge volume			
Mean	83.5	70.2	69.3
SD	42.0	33.1	32.8

ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification.
*Preintervention: January 1, 2019, to June 15, 2020.
†Clinical leadership feedback: June 26, 2020, to November 30, 2020.
‡Clinician feedback: December 1, 2020, to July 31, 2021.

Patient, visit, and clinician-level factors were abstracted from administrative databases. Factors selected for statistical analyses were determined by data availability and prior literature on opioid prescribing in the ED.[1,2,29] Collected patient factors include demographics (age, sex, and payer source), Emergency Severity Index (ESI) triage level, and primary diagnosis categorized using the Agency for Healthcare Research and Quality's Clinical Classification Software Refined (CCSR) body system categories (v2021.2).[30] Patient race/ethnicity data were not available. Clinician factors collected include age, sex, race/ethnicity, and clinician type (physician or advanced practice provider). Also included was the clinician's preintervention opioid prescribing rate, categorized into quintiles. Other visit-level factors collected were the time (midnight to 7 AM, 7 AM to 3 PM, and 3 PM to midnight), calendar month, day of the week, and the ED's total visit volume on the day of the visit arrival.

Analysis

Patient, clinician, and hospital-level characteristics, as well as overall opioid prescription rates, were compared among ED visits treated during the preintervention period and the 2 intervention periods. Differences in means and proportions were used to compare patient and clinician factors between ED visits during the preintervention period and the 2 intervention periods.

To estimate the effect of the intervention on opioid prescribing, we compared the rate of visits receiving an opioid prescription at discharge during the preintervention period with that during the 2 intervention periods. Comparisons were made using a multivariable linear probability model (LPM) that regressed the patient, visit, and clinician factors described above and a facility-level fixed effect on the binary outcome variable indicating the receipt of an opioid prescription at discharge. We subsequently calculated predicted opioid prescription rates in each calendar month of the study period from the previously fit LPM model. Using these predicted monthly opioid prescription rates, we performed a single-group interrupted time series analysis to estimate changes to the overall trends and means in each time period (preintervention, site-level director feedback, and direct clinician feedback) and created graphs to visualize the opioid prescribing rates in each period.[31] In addition to examining changes to the monthly opioid prescribing rates during the intervention, we used multivariable LPM to examine changes in opioid prescribing rates within CCSR body system categories, by clinicians' preintervention prescribing quintiles, and by facility location (state).

Newey-West standard errors with a lag of 1 period were used in the interrupted time series analysis; otherwise, all

Table 2. Predicted means and mean differences in opioid prescriptions per 100 ED discharges.*

	Study Period						Mean Difference		
	Preintervention		Clinical Leadership Feedback		Clinician Feedback		(Clinician Feedback–Preintervention)		
Outcome Parameter	**Mean**	**95% CI**	**Mean**	**95% CI**	**Mean**	**95% CI**	**Mean Difference**	**95% CI**	**% Change**
Overall opioid rx	10.4	(10.2, 10.6)	10.1	(10.0, 10.2)	8.4	(8.3, 8.5)	−2.0	(−2.2, −1.8)	−19.2
Linear monthly trend	−0.05	(−0.10, 0.00)	−0.13	(−0.17, −0.08)	−0.10	(−0.14, −0.06)	−0.05	(−0.12, 0.01)	
Primary diagnosis (ICD-10-CM) body system									
Injury, poisoning, and certain other consequences of external causes	14.5	(14.1, 14.9)	14.2	(13.8, 14.7)	12.4	(12, 12.8)	−2.1	(−2.6, −1.5)	−14.5
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	5.3	(5, 5.6)	5	(4.6, 5.3)	4.0	(3.5, 4.5)	−1.3	(−1.7, −1)	−24.5
Diseases of the respiratory system	6.8	(6.3, 7.3)	4.6	(4, 5.1)	4.1	(3.5, 4.8)	−2.7	(−3.2, −2.1)	−39.7
Diseases of the musculoskeletal system and connective tissue	21.2	(19.9, 22.5)	20.4	(19.2, 21.5)	16.3	(15.5, 17)	−4.9	(−6.1, −3.7)	−23.1
Diseases of the circulatory system	2.8	(2.4, 3.3)	2.5	(2.1, 3)	1.8	(1.2, 2.5)	−1.0	(−1.3, −0.7)	−35.7
Diseases of the genitourinary system	19.6	(18.6, 20.6)	20.2	(19.2, 21.3)	17.9	(16.8, 18.9)	−1.8	(−2.3, −1.2)	−9.2
Diseases of the digestive system	17.8	(16.8, 18.9)	17.7	(16.7, 18.7)	14.6	(13.9, 15.4)	−3.2	(−4.1, −2.3)	−18.0
Diseases of the nervous system	5.1	(4.5, 5.7)	5.2	(4.5, 6)	4.2	(3.5, 4.9)	−0.9	(−1.3, −0.5)	−17.6
Diseases of the skin and subcutaneous tissue	9.9	(9.3, 10.4)	9.4	(8.6, 10.1)	7.6	(7.1, 8.1)	−2.3	(−2.9, −1.6)	−23.2
Mental, behavioral, and neurodevelopmental disorders	1.9	(1.4, 2.4)	2	(1.4, 2.7)	2.0	(1.4, 2.6)	0.1	(−0.1, 0.4)	5.3
Preintervention quintiles									
Physicians									
Quintile 1	5	(4.4, 5.6)	5.1	(4.6, 5.6)	5.0	(4.6, 5.5)	0.1	(−0.6, 0.7)	2.0
Quintile 2	6.9	(6.6, 7.2)	6.9	(6.5, 7.3)	6.5	(6.1, 6.9)	−0.4	(−0.7, −0.1)	−5.8
Quintile 3	8.8	(8.5, 9)	8.5	(8.1, 8.9)	7.6	(7.2, 7.9)	−1.2	(−1.5, −0.9)	−13.6
Quintile 4	11.1	(10.8, 11.4)	10.4	(10, 10.9)	9.1	(8.7, 9.6)	−2.0	(−2.4, −1.6)	−18.0
Quintile 5	17.1	(16.5, 17.7)	15.6	(14.7, 16.4)	11.1	(10.5, 11.8)	−5.9	(−6.8, −5.1)	−34.5
Advanced practice providers									
Quintile 1	4.1	(3.6, 4.7)	5.5	(4.6, 6.4)	5.4	(4.5, 6.3)	1.3	(0.3, 2.2)	31.7
Quintile 2	6.5	(6.1, 7)	7.1	(6.3, 7.8)	6.1	(5.4, 6.8)	−0.4	(−1.1, 0.2)	−6.2
Quintile 3	9.4	(9, 9.9)	9.2	(8.6, 9.9)	8.5	(7.7, 9.2)	−1.0	(−1.7, −0.3)	−10.6

Table 2. Continued.

Outcome Parameter	Preintervention		Clinical Leadership Feedback		Clinician Feedback		Mean Difference (Clinician Feedback–Preintervention)		
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean Difference	95% CI	% Change
Quintile 4	12.6	(12.2, 13)	12.5	(11.7, 13.2)	10.4	(9.7, 11.1)	−2.2	(−2.9, −1.5)	−17.5
Quintile 5	20.4	(19, 21.8)	18.9	(16.7, 21)	12.1	(10.6, 13.6)	−8.3	(−10, −6.7)	−40.7
ED location									
North Carolina	14.6	(14.3, 14.9)	13.8	(13.4, 14.2)	10.2	(9.4, 11)	−4.4	(−5.7, −3.1)	−30.1
Colorado	11.2	(10.8, 11.5)	10.4	(10, 10.8)	9.4	(8.7, 10.1)	−1.8	(−2.9, −0.6)	−16.1
Maryland	10.8	(10.5, 11.1)	10.8	(10.2, 11.5)	8.4	(7.5, 9.2)	−2.5	(−3.7, −1.2)	−23.1
Florida	9.9	(9.8, 10.1)	10.0	(9.5, 10.4)	8.6	(8.2, 9)	−1.3	(−1.9, −0.7)	−13.1
Ohio	9.3	(9.1, 9.4)	9.0	(8.6, 9.4)	7.9	(7.6, 8.2)	−1.3	(−1.8, −0.9)	−14.0
Pennsylvania	8.5	(8.3, 8.7)	7.8	(7.4, 8.2)	7.4	(6.9, 7.8)	−1.1	(−1.8, −0.4)	−12.9

rx, prescriptions.
*Opioid prescription rates are adjusted for patient and clinical characteristics and include a facility-level fixed effect or a facility-level random intercept. Ten most common primary diagnosis body systems are shown in this table; complete results are available in Table E3.

standard errors were clustered at the facility-level. Statistical significance was defined as a P value of less than .05. All statistical analyses were performed using Stata/MP, version 17.0 (StataCorp LLC).

RESULTS

Characteristics of Study Subjects

A total of 5,328,288 adult discharge visits treated by 1,396 clinicians (924 physicians and 472 advanced practice providers) in 102 EDs in 17 states were included. Patient and visit factors of the study population appear in Table 1. Clinician-level factors and characteristics of the 102 EDs appear in Table E1 and Table E2 (both available at http://www.annemergmed.com). The mean patient age among the included visits was 41.1 years (SD=22.4), with 56% of the patients being female. Most visits were triaged as ESI level 3 (54%), and the most common diagnoses were for injuries and poisonings (22%); symptoms, signs, and abnormal clinical and laboratory findings (17%); and diseases of the respiratory system (9%).

The majority of visits (60%) were treated by male clinicians. The average age of the clinicians was 42 years (SD=9.6). General EDs treated 89% of the visits in the sample. Most visits were treated in non–trauma centers (76%) and community hospitals (88%). More than 80% of the visits were treated in metro areas (2013 Rural-Urban Continuum Codes 1 to 3), and most visits were treated in facilities located in Ohio (19%), North Carolina (17%), Colorado (16%), Maryland (12%), Pennsylvania (10%), and Florida (9%). The remaining 16% of the visits were treated in 11 other states.

Main Results

Table 2, Figure 2, Figure 3, and Figure 4 display the results from the interrupted time series and multivariable LPMs. In the preintervention period, opioids were prescribed at discharge in 10.4 per 100 visits (95% confidence interval [CI] 10.3 to 10.5), which did not change meaningfully in the local site director feedback intervention period (mean difference = −0.3, 95% CI −0.6 to −0.1; Figure 2; Table 2; Table E3 [available at http://www.annemergmed.com]). However, during the direct clinician feedback intervention period, opioid prescription rates declined significantly to 8.4 per 100 visits (mean difference = −2.0, 95% CI −2.4 to −1.5), a 19% relative reduction from the preintervention period. The intervention was not associated with any changes to the monthly trend in the opioid prescription rate. The downward trend in the preintervention period seen in Figure 2 can be attributed to higher opioid prescription rates in the first 2 months of the 17-month preintervention

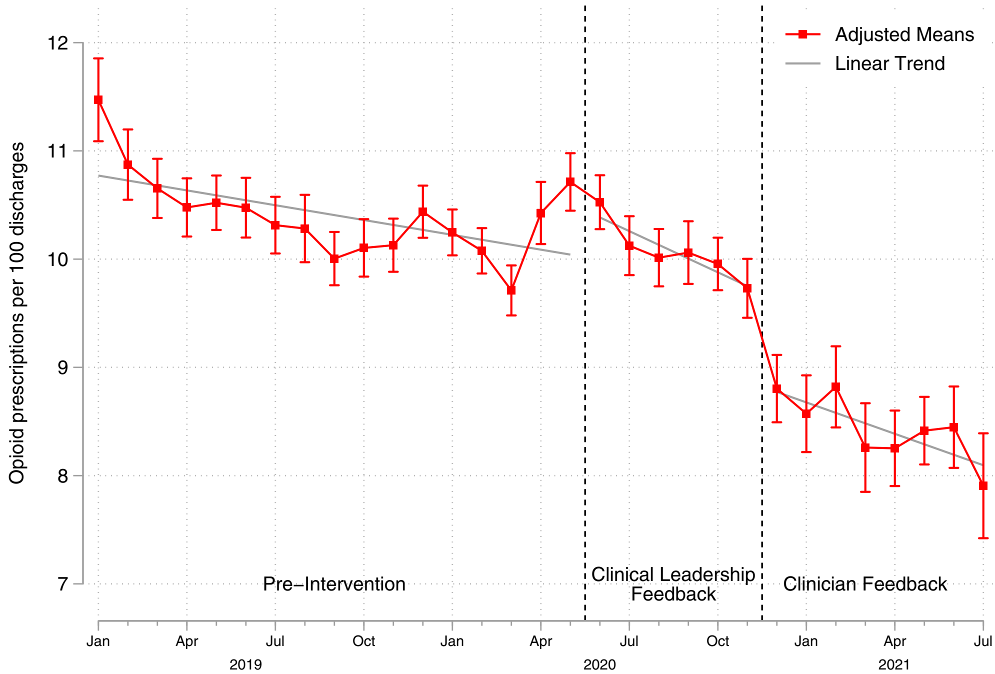

Figure 2. Predicted means in opioid prescription rates, by month. Opioid prescription rates are adjusted for patient and clinical characteristics and include a facility-level fixed effect.

period. Over the next 15 months of the preintervention period, opioid rates declined slightly before increasing again in the final 2 months. Trends were downward in both the clinical leadership feedback (ß=−0.13 prescription per month, 95% CI −0.17 to −0.08) and clinician feedback periods (ß=−0.10 prescriptions per month, 95% CI −0.14 to −0.06).

Changes in Prescribing by Clinical Condition

Of the most common diagnoses, opioids prescribed for visits for injury, poisoning, and certain other consequences of external causes declined by 15%, from an adjusted preintervention mean rate of 14.5 per 100 visits to 12.4 per 100 visits during the clinician feedback period (mean difference = −2.1, 95% CI −2.6 to −1.5; Figure 3; Table 2). Opioids prescribed for visits for symptoms, signs, and abnormal clinical and laboratory findings declined by 25%, from an adjusted preintervention mean rate of 5.3 per 100 visits to 4.0 per 100 visits during the clinician feedback period (mean difference = −1.3, 95% CI −1.7 to −1.0). Opioids prescribed for visits for diseases of the respiratory system declined by 40%, from a preintervention mean rate of 6.8 per 100 visits to 4.1 per 100 visits (mean difference = −2.7, 95% CI −3.2 to −2.1). Other diagnoses with large reductions in opioid prescribing rates included certain infectious and parasitic diseases (−54%); diseases of the circulatory system (−36%); endocrine, nutritional, and metabolic diseases (−28%); and neoplasms (−23%).

Changes by Preintervention Opioid Prescribing Rate

Opioid prescription rates in the preintervention period varied from the first to the fifth quintiles (5.0 per 100 visits to 17.1 per 100 visits for visits treated by physicians and 4.1 to 20.4 for visits treated by advanced practice providers). Significant reductions during the direct clinician feedback intervention period were found in the third, fourth, and fifth quintiles for visits treated by both physicians and advanced practice providers (Figure 4). For visits treated by physicians in the fifth quintile, opioid prescription rates reduced by 35%, from 17.1 per 100 discharges to 11.2 per 100 discharges (mean difference = −5.9, 95% CI −6.8 to −5.1). For visits treated by advanced practice providers in the fifth quintile, opioid prescription rates reduced by 41%, from 20.4 per 100 discharges to 12.1 per 100 discharges (mean difference = −8.3, 95% CI −10.0 to −6.7).

Changes in Opioid Prescribing by State

Finally, opioid prescription rates varied by state (Figure 5). In the 6 states with the largest share of visits (Ohio, North Carolina, Colorado, Maryland, Pennsylvania, and Florida), reductions between the preintervention and clinician feedback periods ranged from a decline of 1.1 opioid prescriptions per 100 discharges in facilities located in Pennsylvania (a 13% decline from the preintervention mean) to a decline of 4.4 opioid prescriptions per 100 discharges in facilities located in North Carolina (a 30% decline from the preintervention mean).

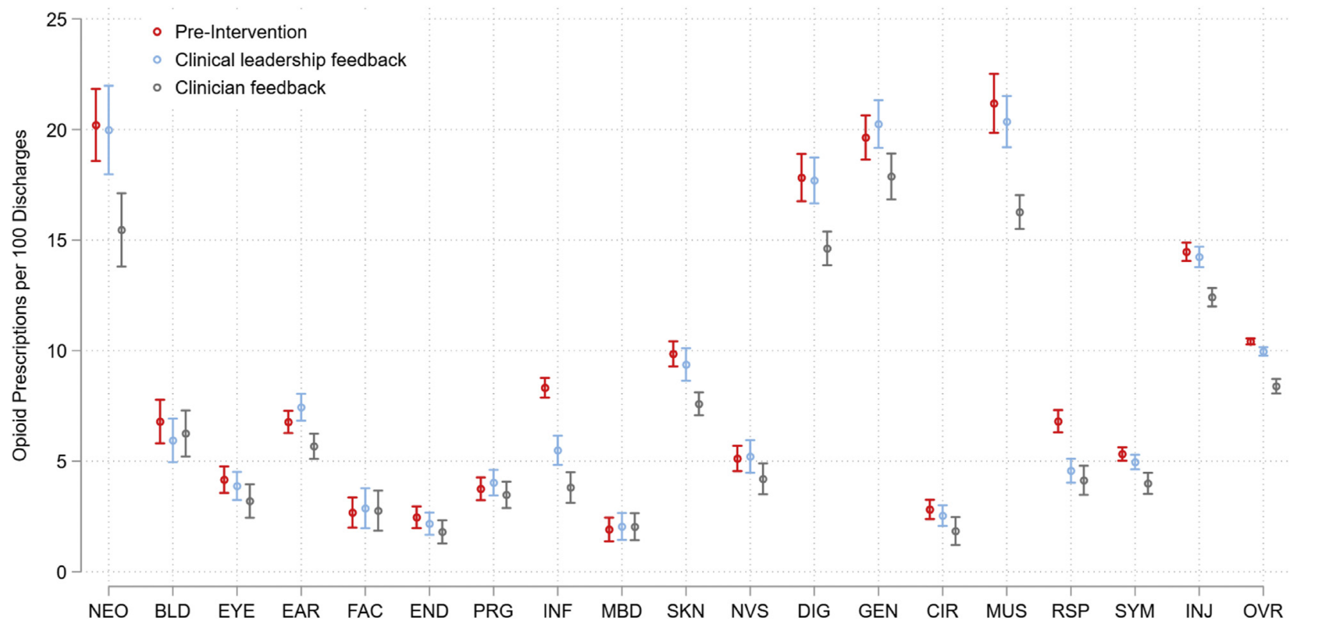

Figure 3. Predicted means in opioid prescription rates by primary diagnosis. Opioid prescription rates are adjusted for patient and clinical characteristics and include a facility-level fixed effect. Primary diagnosis is classified using CCSR v2021.2. CCSR categories with fewer than 1,000 visits in any time period are not shown. Preintervention: January 1, 2019, to June 15, 2020; clinical leadership feedback: June 26, 2020, to November 30, 2020; clinician feedback: December 1, 2020, to July 31, 2021. *OVR*, Overall opioid prescription rates; *INJ*, injury, poisoning and certain other consequences of external causes; *SYM*, symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified; *RSP*, diseases of the respiratory system; *MUS*, diseases of the musculoskeletal system and connective tissue; *CIR*, diseases of the circulatory system; *GEN*, diseases of the genitourinary system; *DIG*, diseases of the digestive system; *NVS*, diseases of the nervous system; *SKN*, diseases of the skin and subcutaneous tissue; *MBD*, mental, behavioral, and neurodevelopmental disorders; *PRG*, pregnancy, childbirth, and the puerperium; *END*, endocrine, nutritional, and metabolic diseases; *EAR*, diseases of the ear and mastoid process; *INF*, certain infectious and parasitic diseases; *FAC*, factors influencing health status and contact with health services; *EYE*, diseases of the eye and adnexa; *BLD*, diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism; *NEO*, neoplasms.

LIMITATIONS

Several limitations should be considered. Regression to the mean may have contributed to the change in opioid prescription rates for visits treated by clinicians with high rates during the preintervention period. Without a control group, it is not possible to directly estimate what the reduction may have been in the absence of the intervention or to compare the trends seen in this study with that of clinicians not in this national emergency clinician group who did not receive the intervention. However, the effect seen in this study is large and declined steadily for 7 months after the second phase of the intervention was implemented. Also, pill quantity and milligram morphine equivalents were not available in the data set.

Another concern is that the intervention overlapped with the COVID-19 pandemic. Prior literature has shown declines in ED volume and changes in case mix during this time.[32-36] Although our models included a large set of covariates, including case mix, ESI triage level, and daily visit volumes, we cannot rule out the fact that there may be unobserved effects of the pandemic on the opioid prescribing behavior of clinicians. We also observed an increase in opioid prescription rates in the 3 months prior to the initial intervention (April to June 2020), which coincides with the early months of the COVID-19 pandemic. Other investigators found a stable number of total opioid prescriptions filled at retail pharmacies but a smaller number of prescriptions for opioid-naive patients from March 18, 2020, to May 19, 2020.[37] From May 20, 2020, to September 1, 2020, opioid prescribing for new patients returned to 100% of projected. We do not have an explanation as to why opioid prescription rates increased during this time in our study; however, opioid prescription rates during the second phase of the intervention were significantly lower than the entire preintervention period.

There was also a change in the triage level over time. During the intervention, there were more ESI levels 2 and 3 and fewer levels 4 and 5, indicating a shift toward higher acuity. The model used in this study does incorporate ESI; however, other unobserved changes in patient acuity that our model does not fully capture may have occurred. In addition, a change in diagnostic prevalence occurred during the study period. Compared with the preintervention period, the

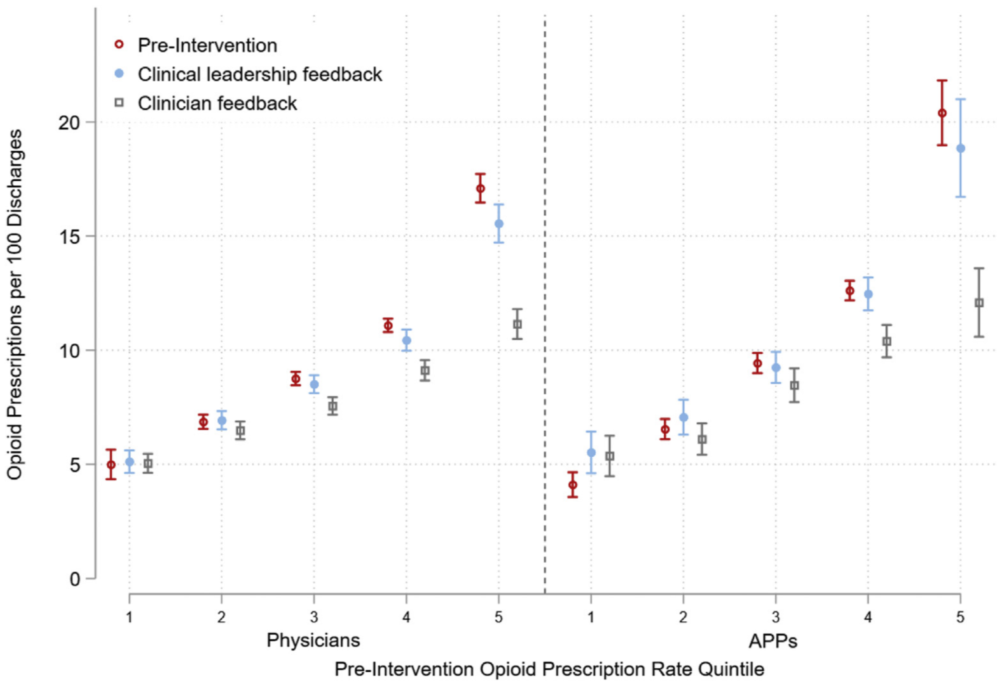

Figure 4. Predicted means in opioid prescription rates by preintervention prescribing rate quintiles. Opioid prescription rates are adjusted for patient and clinical characteristics and include a facility-level fixed effect. Preintervention: January 1, 2019, to June 15, 2020; clinical leadership feedback: June 26, 2020, to November 30, 2020; clinician feedback: December 1, 2020, to July 31, 2021. *APP*, advanced practice provider.

intervention period saw larger proportions of infectious and parasitic diseases and mental/behavioral/neurodevelopmental disorders and smaller proportions of respiratory system diseases. Finally, the emails and telephonic conversations between national leadership and clinicians were not standardized or scripted. Although this allowed for flexibility, it likely created variability in the information and recommendations provided to the outlier clinicians.

DISCUSSION

In this largest study to date of an ED opioid prescribing intervention, personalized feedback along with making opioid prescription rates visible to all clinicians and leaders through a dashboard led to immediate large reductions in opioid prescription rates, with the greatest decline among the highest quintile of prescribing. Several smaller studies have evaluated feedback programs at single institutions or in single systems.[17,21-24] This study builds on prior literature by expanding a similar intervention to a wide breadth of practice settings, hospital systems, and geographic regions.

The initial intervention in this study that provided feedback on clinician performance to site-level physician directors was ineffective at reducing opioid prescribing. This is perhaps because specific guidance on how to deliver the feedback to individual clinicians was not offered. Site directors may have had other understandably competing, higher priorities (eg, COVID-19 waves and other prioritized activity, such as sepsis care, or local priorities), and some may not have delivered the feedback to their clinicians on opioid prescribing. However, when feedback was delivered directly from the group's national leadership to high-outlier clinicians and all clinicians were able to see their own prescribing and how they compared with others, locally and nationally, an immediate and significant decrease resulted. Although fewer than 1 in 10 clinicians were identified as outliers and engaged in one-on-one conversations with national leadership, it demonstrates the power of personalized feedback to individuals and providing individualized education on how to improve practice. It is also possible that there may have been spillover effects to other clinicians as the message became clear that this was a priority as clinicians communicated among themselves about the program. In addition, it allowed individuals to directly examine their own prescribing with local and national benchmarks, which also may have played a role in the behavior change of high prescribers who may have not previously realized that they were practicing differently from peers. The greatest reduction in prescribing was also seen in the state with the highest preintervention prescribing (North Carolina). This may have been because North Carolina had a disproportionate number of outliers and larger number clinicians who received prescribing feedback conversations. In addition, clinicians from higher-prescribing states and

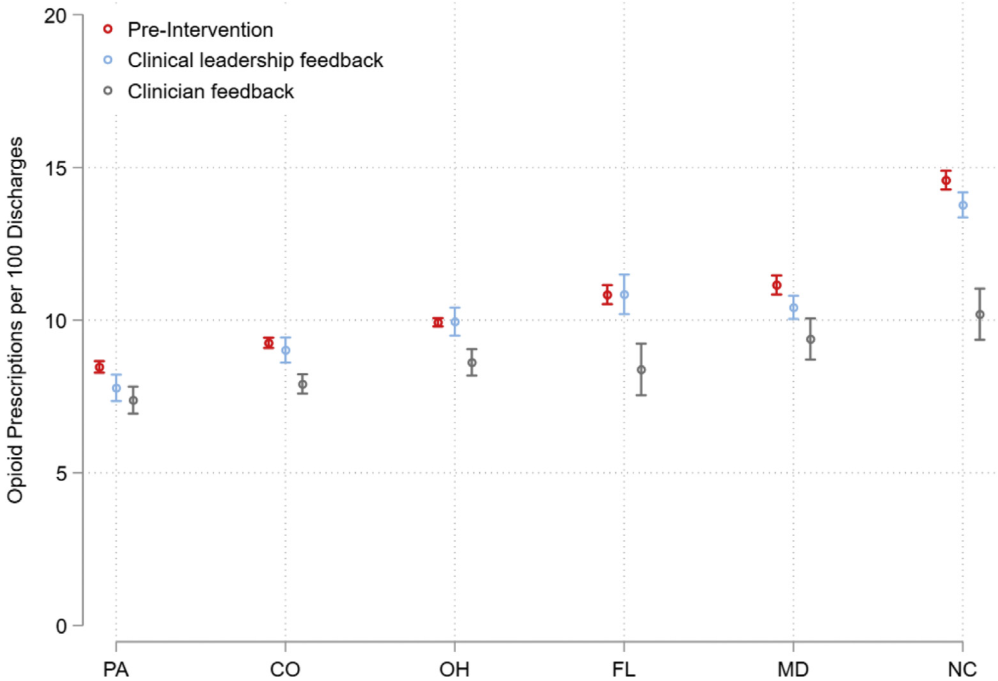

Figure 5. Predicted means in opioid prescription rates by state. Opioid prescription rates modeled separately for each state are adjusted for patient and clinical characteristics and include a facility-level fixed-effect. States shown include 85 facilities and 4.47 million visits (84% of the total visit sample). States sorted left-to-right by unadjusted preintervention prescribing rates. Preintervention: January 1, 2019, to June 15, 2020; clinical leadership feedback: June 26, 2020, to November 30, 2020; clinician feedback: December 1, 2020, to July 31, 2021. *CO*, Colorado; *FL*, Florida; *MD*, Maryland; *NC*, North Carolina; *OH*, Ohio; *PA*, Pennsylvania.

regions were able to observe data from other areas that had considerably lower prescribing rates and may have reconsidered their prescribing practices.

Prior research involving direct feedback and peer comparison on opioid prescribing rates to emergency clinicians has shown a significant, immediate, and lasting effect but in only single institutions or a small number of mostly academic sites.[17,21-24] This study includes a wider diversity of practice settings, including community EDs, than prior studies. Including a diverse set of sites is of particular importance given that the vast majority of ED patients are treated outside of academic settings. In prior studies, when compared with merely providing feedback to individual clinicians on their own prescribing practices, feedback plus peer comparison has been shown to have greater reductions in opioid prescribing.[24] In our study, opioid prescribing rates also demonstrated a sustained reduction over 7 months and appear to be continuing to decline. These sustained declines may be a result of a general change in the culture of prescribing, with a greater focus on opioid alternatives and communication with patients. We believe that this reduction in opioid prescribing has improved the quality, efficiency, effectiveness, and safety of ED care at our sites.[25]

Meaningful declines were seen for several conditions, with particularly large reductions in prescribing for injuries (eg, ankle sprains) and musculoskeletal conditions (eg, back pain). In addition, prescribing declined for infections. For example, the use of opioids was avoided as cough suppressants or for infectious conditions that cause acute pain, such as pharyngitis and cellulitis. Surprisingly, opioid prescriptions for neoplasms also decreased, which was not necessarily a desired outcome. Clinician group resources support opioid prescribing under appropriate circumstances, and future interventions may need to include language supporting opioid prescriptions for patients with cancer.

Given the reported association of acute care opioid prescriptions with an increased risk of opioid addiction, the effectiveness of this intervention can serve as a model of how to accomplish these outcomes in community practice settings and among physicians and advanced practice providers.[1,7] Smaller institutions or systems may not easily have access to regional and national peer comparison data. But such data could potentially be integrated into other national and regional efforts, such as prescription drug monitoring programs, to allow a similar type of feedback for clinicians. Further steps would be to evaluate the long-term durability of the feedback program's effect on prescribing behavior to determine how often feedback should be given.

In conclusion, this large multisite study demonstrated the effectiveness of a feedback and peer comparison program to reduce opioid prescribing in a variety of ED settings across the United States and among a substantial number of emergency clinicians in a national ED practice organization over a 7-month period. This intervention may serve as a model for reducing high-outlier opioid prescription rates in a variety of US health care settings.

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Author contributions: All authors conceived the study and designed the trial. MSZ provided statistical advice on the study design and analyzed the data. JJO drafted the manuscript, and all authors contributed substantially to its revision. JJO takes responsibility for the paper as a whole.

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