ORIGINAL ARTICLE

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Associations Between Management Pathway and Opioid Prescriptions for Patients Entering the Emergency Department With Neck and Back Pain

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Abstract

Objective: To determine associations between post-emergency department (ED) management pathways and downstream opioid prescriptions in patients seeking care for incident neck and/or back pain.

Patients and Methods: We identified patients seeking first-time ED care for neck and/or back pain from January 1, 2013, through November 6, 2017. We reported demographic characteristics and opioid prescriptions across management pathways using descriptive statistics and assessed the relative risk of any opioid prescription 12 months post-ED visit among 5 different post-ED management pathways using Poisson regression adjusted for patient demographic characteristics.

Results: Within 12 months after the index ED visit, 58.0% (n=10,949) were prescribed an opioid, with most patients prescribed an opioid within the first week (average daily morphine milligram equivalents of 6.8 mg (SD 9.6 mg). The morphine milligram equivalents decreased to 0.7 mg (SD 8.2 mg) by week 4 and remained consistently less than 1 mg between week 4 and 12 months. Compared with the ED to primary care provider pathway, the relative risk of opioid prescription between 7 days and 12 months after the index ED visit was similar for the ED to physical therapy pathway, higher for both the ED to hospital admission or repeat ED visit pathway (30% increase; relative risk (RR), 1.3; 95% CI, 1.17-1.44) and the ED to specialist pathway (19% increase; RR, 1.19; 95% CI, 1.07-1.33), and lower in the ED with no follow-up visits pathway (41% decrease; RR, 0.59; 95% CI, 0.54-0.65).

Conclusion: In general, more conservative care was associated with lower opioid prescription rates, and escalated care was associated with higher opioid prescription rates.

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Neck and back pain have been associated with a dramatic rise in opioid prescribing rates over the past 3 decades, despite evidence that opioids have only modest effectiveness, no benefit over nonopioid medications, and safety risks including sedation, gastrointestinal adverse effects, addiction, and overdose deaths.[1-7] The top reason for opioid prescriptions in the United States is back pain, and the highest prescription rates, up to 60% of patients, occur in the emergency department (ED).[6-8] As 15%-17% of all health care visits for neck and back pain, numbering over 3 million visits per year, occur in EDs, the number of opioid exposures is large and has been associated with an increased risk of long-term opioid use.[8-12] Furthermore, those with limited access to primary care and other vulnerable populations frequently use the ED as their primary entry point into the health care system. Thus, spine pain care pathways established during an ED visit have a potentially large effect on a large number of people.

Nonopioid medications and nonpharmacologic interventions have been recommended as first-line treatments over opioids for musculoskeletal neck and back pain by national medical organizations for at least the past decade.[13-16] However, the paucity of data on the nature of

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current ED management of musculoskeletal spine pain and subsequent care pathways after discharge currently limits the ability to rigorously assess and apply these guidelines in the ED setting. The existing data indicates heterogeneity in testing, treatment, discharge disposition, and follow-up care pathways for ED patients with nonserious back pain.[17-19] Furthermore, marked practitioner variability in opioid prescribing and a low rate of nonpharmacologic treatment referrals in the ED suggest important areas for improvement in ED spine pain care.[3,8,20-23] Short-term ED prescribing of high-dose opioids has been associated with dramatic increases in both 30-day return ED visits and rates of prolonged opioid use.[11,12,24] By contrast, early physical therapy (PT) for neck and back pain is associated with decreased opioid and health care utilization and improved pain and functional outcomes.[23,25-28] However, few studies have examined the prevalence and characteristics of individuals with neck and back pain who enter various post-ED care pathways or the relationship between the different management pathways and patient outcomes, such as downstream opioid prescribing.

Therefore, the purposes of this retrospective cohort study were to (1) characterize a population of patients with incident neck and/or back pain initially managed in the ED and (2) determine the extent to which a particular post-ED care pathway (ie, follow-up with a primary care provider [PCP], specialist, PT, repeat ED visit or hospitalization, or no follow-up) was associated with downstream opioid prescriptions in this population.

PATIENTS AND METHODS

Setting and Study Design

We queried the electronic health record of a large academic health system in North Carolina from January 1, 2013, to November 6, 2017, to identify eligible adult ED patients for this retrospective cohort study. The index ED visit was identified as the patient's first ED visit within this timeframe.

Inclusion and Exclusion Criteria

We included adult patients seeking care for neck and/or back pain in the ED who were aged 18 years or older at the time of the index ED visit and had a primary or secondary diagnosis of musculoskeletal neck and/or back pain for the ED encounter on the basis of International Classification of Disease-9 and Internationa-10 codes (Supplemental Table 1, available online at http://www.mcpiqojournal.org). Patients were excluded if they had a documented neck and/or back pain-related ED visit or opioid prescription in the 3 months before the index ED visit. This 3-month washout period was on the basis of the definition of chronic pain to identify new episodes of neck and/or back pain. We excluded patients with chronic neck or back pain, cancer-related pain, and patients on methadone or buprenorphine at any time within the 12 month pre-index ED visit period. Patients for whom these inclusion or exclusion criteria could not be accurately assessed were also excluded. Patients with a discharge status of death, discharge to hospice, or a preplanned hospital admission at the index ED visit (eg, sent by their provider to the ED to be admitted) were also excluded. The distribution of diagnoses by care pathways can be found in Supplemental Table 2, available online at http://www.mcpiqojournal.org.

Defining Management Pathways

Patients were classified into 5 post-ED management pathways on the basis of the type of provider seen for follow-up visits associated with a diagnosis of neck and/or back pain recorded within 28 days after the index ED visit: (1) ED to hospital admission or repeat ED visit; (2) ED to PCP (including family medicine, internal medicine, geriatric medicine, and urgent care); (3) ED to PT (physical therapy, occupational therapy, and chiropractic medicine); (4) ED to a specialist (including surgery, anesthesia pain specialists, orthopedics, neurosurgery, sports medicine, or pain management); and (5) ED with no return visits. Patients were assigned to the ED for hospital admission or repeat ED visit pathway if they were ever admitted to the hospital or had another ED visit within 28 days. Patients were assigned to the ED to PCP pathway if they saw a PCP but did not see a PT or a specialist within 28 days; otherwise, they were assigned to the ED to PT or ED to specialist pathway, respectively. If patients saw both a PT and a specialist, patients were assigned to the pathway corresponding to

the first visit after the index ED visit. The management pathway was determined based only on visits associated with a neck and/or back pain-related diagnosis (ie, unrelated visits were not used to assign the pathway). If no additional visits associated with neck and/or back pain diagnoses were identified within the 28-day post-ED visit period, the patient was assigned to the ED with no return pathway.

Identifying Opioid Prescriptions

We extracted prescription data from the electronic health record and identified opioid prescriptions using medication names (ie, propoxyphene, codeine, hydrocodone, tramadol, dihydrocodeine, pentazocine, morphine, oxycodone, hydromorphone, meperidine hydrochloride, oxymorphone, levorphanol, methadone, fentanyl, buprenorphine, opium, and tapentadol). To quantify the opioid prescriptions for each patient in the statistical analysis, we identified the total number of days of opioid prescriptions and the timing of each opioid prescription relative to the index ED visit. The number of days of supplied opioids was calculated by summing the days supplied for all opioid prescriptions, then removing overlapping days. We calculated each of these opioid metrics within 4 weeks, 6 months, and 12 months of the index ED visit as measures of short-term and long-term opioid prescriptions. These were not mutually exclusive groups.

To quantify the strength of the opioid prescriptions, the average daily morphine milligram equivalents (MME), using the 2016 opioid oral MME conversion factor table.[29,30] We calculated the average daily MME for the first 4 weeks after the index date and the weekly cumulative MME within weeks 1-4.

Functional Comorbidity Index

The functional comorbidity index (FCI) was developed as a measure of the degree of comorbidities effecting functional status, making it a unique measure more relevant to opioid prescriptions than other comorbidity measures, such as Charlson or Elixhauser, which focus on morbidity and mortality as the outcomes.[31,32] The FCI is scored using a binary scale for each item: 1 point is given for the presence of each of the conditions, or 0 for the absence of the condition (Supplemental Table 3, available online at http://www.mcpiqojournal.org). The FCI score is the total number of points and ranges from 0-18, with a higher score correlating with lower physical functioning.[33]

Primary Outcomes

Our primary outcome was the binary outcome of any opioid prescription between 7 days and 12 months after the index ED visit for incident neck and/or back pain. We chose this timeframe as a measure of post-ED opioid prescribing and excluded prescriptions from the ED (which typically cover the first week). Secondary outcomes included average daily MME for the first 4 weeks post-ED visit, monthly average daily MME up to 12 months, long-term opioid usage (having opioid prescriptions for 90 days or more within 6 months), and number of days on opioids up to 12 months.

Statistical Analyses

We examined the associations of post-ED management pathways (follow-up with a PCP, specialist, PT, repeat ED visit or hospitalization, or no follow-up) with each of the primary and secondary outcomes. Descriptive statistics were used to compare patient characteristics and downstream opioid prescriptions between management pathways. Multivariable modified Poisson regression models were fit to assess the association of management pathways with any opioid prescription after 7 days post-index ED visit. The relative risk (RR) of having an opioid prescription after 7 days post-index ED visit was reported using ED to PCP as the reference group and controlling a family-wise error rate of 0.05 for multiple testing using Dunnett's method. Similar models were used to assess secondary outcomes by management pathway. All regression models used the management pathway as the primary explanatory variable and adjusted for the following variables: age, sex, race, primary payer, and FCI. All statistical analyses were conducted using SAS 9.4 (SAS Institute). The level of statistical significance was set at $P<.05$, and all tests were 2-sided.

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RESULTS

We identified 23,790 patients who had a neck or back pain-related ED visit. After the inclusion and exclusion criteria were met, 18,875 patients remained for the analyses (Figure). Over 87% (n=16,501) of the patients did not receive further neck or back pain-related care (ED with no return pathway). Patient demographic characteristics can be found in Table 1.

Across the entire sample, 58.0% (n=10,949) had an opioid prescription within 12 months after the index ED visit with a mean of 5.8 (SD 16.7) days of opioids prescribed. When examining opioid prescriptions by post-ED management pathway, patients in the ED to specialist and ED to hospital admission or repeat ED visit pathways had the highest rates of opioid prescriptions of 79.2% (n = 571) and 79.8% (n = 600), respectively, prescribed an opioid within 12 months. The total number of days of opioids prescribed in these groups was 12.2 (SD 27.1) days for ED to hospital admission or repeat ED visit and 17.9 (SD 35.9) days for ED to specialist (Table 2).

Next, we examined the strength of the opioid prescriptions in the first 4 weeks. The average daily MME in week 1 was 6.8 mg (SD 9.6 mg), which decreased to 1.1 mg (SD 6.1 mg) in week 2, 0.8 mg (SD 6.9 mg) in week 3, and 0.7 mg (SD 8.2 mg) in week 4. After the first 4 weeks, the average daily MMEs remained less than 1 mg from months 2-12 for the full cohort. Patients in the ED to specialist pathway received the highest MMEs throughout the first 4-week post-ED visit period, followed by patients in the ED to hospital admission or repeat ED visit, ED to PCP, ED to PT, and ED with no return pathways. (Table 3 and Supplemental Figure, available online at http://www.mcpiqojournal.org).

Finally, we assessed the association of the post-ED management pathway with any opioid prescription after 7 days post-index ED visit. After adjusting for covariates, compared with the ED to PCP pathway, the ED to hospital admission or repeat ED visit pathway was associated with a 30% increase in RR of any opioid prescription after 7 days post-index ED visit (RR, 1.3; 95% CI, 1.17-1.44; adjusted $P<.001$); ED to the specialist pathway with a 19% increase (RR, 1.19; 95% CI, 1.07-1.33; adjusted $P=.005$); and ED with no return pathway with a 41% decrease in RR (RR, 0.59; 95% CI, 0.54-0.65; adjusted $P<.001$). There was no significant difference in the RR of an opioid prescription after 7 days post-index ED visit between the ED to PCP and ED to PT pathways (RR, 0.86; 95% CI, 0.7-1.06; adjusted $P=.4$). Covariate factors, including woman, Medicaid, Medicare, and higher FCI, were also associated with an increased risk of any opioid prescription after 7 days post-index ED visit (Table 4).

DISCUSSION

The Center for Disease Control and Prevention (CDC) Clinical Practice Guideline for Prescribing Opioids for Pain was initially released in 2016 to address the use of opioids for primary care management of chronic pain and more recently, was updated to include all prescribers and acute and subacute pain.[34] These Guidelines recommend that prescribers limit the use, duration, and potency of prescribed

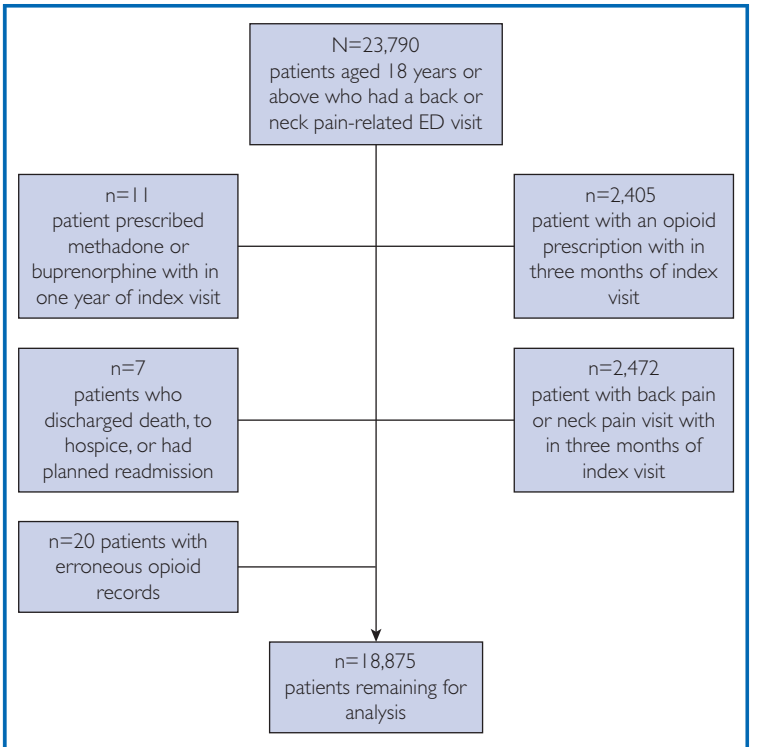

FIGURE. The cohort inclusion and exclusion applied to derive the final analytical cohort.

TABLE 1. Patient Characteristics by Management Pathway

Characteristic	ED-PCP (n=738)	ED-PT (n=163)	ED-Admission/ED (n=752)	ED-Specialist (n=721)	ED-No Return (n=16,501)	Total (N=18,875)
Age at index ED						
Mean ± SD	48.4±17.7	46.3±16.2	43.7±17.1	50.9±17.8	42.6±16.8	43.3±17.0
Sex						
Woman	494 (66.9%)	110 (67.5%)	379 (50.4%)	389 (54.0%)	9327 (56.5%)	10,699 (56.7%)
Man	244 (33.1%)	53 (32.5%)	373 (49.6%)	332 (46.0%)	7174 (43.5%)	8176 (43.3%)
Race						
White	243 (32.9%)	46 (28.2%)	228 (30.3%)	394 (54.6%)	4628 (28.0%)	5539 (29.3%)
Black	446 (60.4%)	102 (62.6%)	464 (61.7%)	256 (35.5%)	9972 (60.4%)	11,240 (59.5%)
Other/Unknown	49 (6.6%)	15 (9.2%)	60 (8.0%)	71 (9.8%)	1901 (11.5%)	2096 (11.1%)
Discharge disposition						
Cancer center/children's hospital	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.0%)	2 (0.0%)
Federal hospital	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.0%)	2 (0.0%)
Home health service	4 (0.5%)	0 (0.0%)	4 (0.5%)	2 (0.3%)	50 (0.3%)	60 (0.3%)
Home or self-care	734 (99.5%)	163 (100.0%)	739 (98.3%)	715 (99.2%)	16,335 (99.0%)	18,686 (99.0%)
Intermediate care facility	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.0%)	4 (0.0%)
Left against medical advice	0 (0.0%)	0 (0.0%)	4 (0.5%)	1 (0.1%)	35 (0.2%)	40 (0.2%)
Long-term acute care	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.0%)	4 (0.0%)
Other	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.0%)	4 (0.0%)
Other acute hospital	0 (0.0%)	0 (0.0%)	4 (0.5%)	1 (0.1%)	29 (0.2%)	34 (0.2%)
Other health care institution	0 (0.0%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	5 (0.0%)	6 (0.0%)
Psychiatric facility	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (0.0%)	4 (0.0%)
Rehabilitation facility	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.0%)	2 (0.0%)
Skilled nursing facility	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.3%)	25 (0.2%)	27 (0.1%)
ED length of stay (h)						
Mean ± SD	3.7±2.8	4.1±3.5	3.5±3.0	5.1±3.7	3.6±3.2	3.6±3.2
Primary payor						
Medicare	184 (24.9%)	32 (19.6%)	144 (19.1%)	202 (28.0%)	2458 (14.9%)	3020 (16.0%)
Medicaid	88 (11.9%)	17 (10.4%)	112 (14.9%)	53(7.4%)	2169 (13.1%)	2439 (12.9%)
Private insurance	350 (47.4%)	87 (53.4%)	141 (18.8%)	343 (47.6%)	4460 (27.0%)	5381 (28.5%)
Other or unknown	116 (15.7%)	27 (16.6%)	355 (47.2%)	123 (17.1%)	7414 (44.9%)	8035 (42.6%)
History of spine operation						
Yes	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.3%)	2 (0.0%)	4 (0.0%)
Functional comorbidity index						
Mean ± SD	0.8±1.3	0.7±1.1	0.3±0.8	0.5±1.0	0.3±0.8	0.3±0.8
Median	0	0	0	0	0	0
Q1, Q3	0.0, 1.0	0.0, 1.0	0.0, 0.0	0.0, 0.0	0.0, 0.0	0.0, 0.0
Range	(0.0-10.0)	(0.0-6.0)	(0.0-5.0)	(0.0-7.0)	(0.0-9.0)	(0.0-10.0)

ED, emergency department; PCP, primary care provider; PT, physical therapy, occupational therapy, and chiropractic medicine; Q1, 1st quartile; Q3, 3rd quartile;

opioids for outpatient management of pain.[34] These updates were driven by newer data showing high opioid prescribing rates for patients with acute pain discharged from ED, postsurgical, and other acute care settings.[35] Thus, recent efforts across the country have focused on decreasing ED opioid prescribing.[36] The findings of our study provide an important contribution to this effort, as it adds to the limited literature on the existing relationship between downstream management of neck and back pain after an ED visit and opioid prescribing rates. We focused on opioid prescribing before the implementation of current deprescribing efforts to better isolate the effect of care pathways on post-

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TABLE 2. Total Number of Days of Opioid Prescription

	ED-PCP (n=738)	ED-PT (n=163)	ED-Admission/ED (n=752)	ED-Specialist (n=721)	ED-No Return (n=16,501)	Total (N=18,875)
Opioid prescription within 4 wks of ED index visit						
Prescribed any opioid in this time period? (%)						
No	293 (39.7)	68 (41.7)	184 (24.5)	202 (28.0)	8753 (53.0)	9500 (50.3)
Yes	445 (60.3)	95 (58.3)	568 (75.5)	519 (72.0)	7748 (47.0)	9375 (49.7)
Days of prescribed opioids						
Mean ± SD	4.7±6.7	3.9±5.7	5.6±7.0	6.8±9.0	2.1±3.2	2.5±4.2
Opioid prescription within 6 mo of ED index visit						
Prescribed any opioid in this time period?						
No	258 (35.0%)	57 (35.0%)	168 (22.3%)	167 (23.2%)	7982 (48.4%)	8632 (45.7%)
Yes	480 (65.0%)	106 (65.0%)	584 (77.7%)	554 (76.8%)	8519 (51.6%)	10,243 (54.3%)
Days of prescribed opioids						
Mean ± SD	9.0±18.7	7.6±15.1	9.6±17.7	13.4±21.7	3.2±7.3	4.1±9.9
Opioid prescription within 12 mo of ED index visit						
Prescribed any opioid in this time period?						
No	224 (30.4%)	53 (32.5%)	152 (20.2%)	150 (20.8%)	7347 (44.5%)	7926 (42.0%)
Yes	514 (69.6%)	110 (67.5%)	600 (79.8%)	571 (79.2%)	9154 (55.5%)	10,949 (58.0%)
Days of prescribed opioids						
Mean ± SD	12.3±29.8	11.0±28.9	12.2±27.1	17.9±35.9	4.6±13.0	5.8±16.7

ED, emergency department; PCP, primary care provider; PT, physical therapy, occupational therapy, and chiropractic medicine.

ED opioid prescribing. We found that almost half of all patients with incident neck and/or back pain received an opioid prescription within the first 4 weeks after the index ED visit and that across the 5 post-ED care pathways, the highest rates and strengths (in MMEs) of opioid prescriptions were found in the ED to admission or repeat ED visits and ED to specialist pathways compared with the ED to PCP and ED to PT pathways. In addition, those patients who returned to the ED and were admitted to the hospital or received specialist care had considerably higher rates of short-term and long-term opioid prescriptions compared with other more conservative management pathways; however, the MMEs were small across groups, limiting the ability to ascertain a clinically meaningful difference between the pathways. These findings are consistent with literature in other settings suggesting a relationship between escalated care and increased opioid prescribing.[35,37] Of note, only a small percentage (13%) of patients in our study received follow-up care for their

TABLE 3. Average Daily MME Within the First 4 Weeks After ED Visit

	ED-PCP (n=738)	ED-PT (n=163)	ED-Admission/ED (n=752)	ED-Specialist (n=721)	ED-No Return (n=16,501)	Total (N=18,875)
Average daily MME in wk 1 post-index						
Mean ± SD	8.6±11.0	7.0±9.1	11.5±13.6	14.4±16.0	6.2±8.7	6.8±9.6
Average daily MME in wk 2 post-index						
Mean ± SD	3.3±8.7	2.3±6.4	4.9±13.1	5.9±16.8	0.6±4.1	1.1±6.1
Average daily MME in wk 3 post-index						
Mean ± SD	2.1±7.9	1.7±5.7	3.8±16.2	5.1±18.1	0.4±5.0	0.8±6.9
Average daily MME in wk 4 post-index						
Mean ± SD	1.6±6.9	1.5±6.7	3.1±19.6	5.0±20.7	0.4±6.0	0.7±8.2

ED, emergency department; MME, morphine milligram equivalent; PCP, primary care provider; PT, physical therapy, occupational therapy, and chiropractic medicine.

TABLE 4. Association of Management Pathway With Any Opioid Use After 7 Days of the Index ED[a]

Effect	Relative Risk (95% CI)
Management pathway	
ED-PT	0.86 (0.7-1.06)
ED-admission/ED	1.3 (1.17-1.44)
ED-specialist	1.19 (1.07-1.33)
ED-no return	0.59 (0.54-0.65)
ED-PCP	REF
Age (per 10-y increase)[b]	1.02 (1-1.03)
Sex	
Woman	1.09 (1.04-1.14)
Man	REF
Race	
Black	1.05 (1-1.1)
Other/Unknown	0.68 (0.61-0.75)
White	REF
Insurance type	
Medicaid	1.33 (1.23-1.43)
Medicare	1.13 (1.04-1.22)
Other or unknown	1.05 (0.99-1.11)
Private insurance	REF
FCI (per 1-point increase)	1.14 (1.12-1.16)

[a]ED, emergency department; FCI, functional comorbidity index; PCP, primary care provider; PT, physical therapy, occupational therapy, and chiropractic medicine.

[b]A modified Poisson regression model with robust standard errors was fit to assess the association of management pathway with back pain diagnosis within 28 days with any opioid use after 7 days of the index ED visits while adjusting for other variables. One patient listed as age 141 years old from the main study cohort was excluded (as this represents an unidentified patient) and the sample size was 18874.

neck or back pain after their index ED visit. Most patients did not go on to seek additional care and had the lowest rates of opioid prescriptions. These findings likely reflect the natural resolution of acute neck and back pain during the first few weeks after onset, the challenges faced by many ED patients preventing attendance at follow-up visits, and the expected lack of prescriptions among people not seeing a health care provider.[38]

Our data suggest a few high-priority questions to facilitate future studies. First, ED opioid prescription rates since 2010 have continued to fall,[39] but recent data from both the CDC and the Congressional Budget Office note the continued variability in prescriptive care.[34,40] Furthermore, Harwood et al[37] point out that early opioid prescriptions are still the lowest for conservative care (eg, chiropractor or acupuncturist) and the highest for ED care. Thus, a goal of future work will be to investigate the extent to which embedding conservative approaches for neck and back pain in the ED reduces short-term and long-term opioid prescriptions.[41] Second, because work in this area is frequently the product of claims data, it is crucial that future studies operate at a more granular, individual level to deduce modifiable influences on pain and pain management. For example, pain severity is a well-known factor for both provider referral and downstream opioid prescription,[42] but little is known about how modifiable mediators of severity, such as psychological distress, influence downstream care. Available pathway guidelines for spine pain emphasize multidisciplinary, stratified approaches to address individual differences and dictate management.[43,44]

Our study has some notable strengths. First, ours is one of the first studies to describe associations between combined ED and post-ED care pathways and both short-term and long-term opioid prescribing. Although it is difficult to fully attribute long-term prescribing to specific care pathways, our findings suggest an important avenue for future exploration and intervention. Second, our population is a uniquely large and diverse cohort of ED patients who are opioid-naive and experiencing a new onset of neck or back pain. Our data are before opioid-reduction initiatives, making our findings of opioid prescribing more reflective of that episode of ED and post-ED care. Finally, our study provides longitudinal comparisons of opioid prescriptions among 5 different management pathways that have not been previously compared in previous literature.

Our study has some limitations to consider. First, although our sample was large, our data came from 1 health system, and we were limited in our ability to identify care outside of our health system. Second, our data regarding opioids was limited to the prescribing information. We cannot make any assumptions regarding following through on filling the prescriptions or actual opioid use, as some studies have indicated that there is variability in fill rate among this population

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and limited actual use.[35] Finally, our study examines the rate of opioid prescribing before the release and implementation of CDC guidelines for opioid prescribing.[29] Indeed, the effect of care pathways on opioid prescribing may be different in the newer era of opioid deprescribing. However, given the literature showing high variability in changes in opioid prescribing for neck and/or back pain after the introduction of opioid guidelines, ranging from as high as a 71% decrease down to a 7%-16% decrease to no change in prescribing patterns, our findings still suggest an important novel strategy for potentially further reducing opioid prescribing by optimizing care pathways.[39,45-47]

CONCLUSION

Downstream opioid prescription rates after ED visits for incident neck and back pain varied by post-ED care pathway. In general, more conservative care was associated with lower opioid prescription rates, and escalated care was associated with higher opioid prescription rates. Future research is needed to further elucidate the factors that contribute to the heterogeneity of opioid prescribing across care pathways.

POTENTIAL COMPETING INTERESTS

The authors report no competing interests.

SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://www.mcpiqojournal.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: **CDC**, Center for Disease Control and Prevention; **ED**, emergency department; **FCI**, functional comorbidity index; **MME**, morphine milligram equivalent; **PCP**, primary care provider; **PT**, physical therapy, occupational therapy, and chiropractic medicine

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