Changing the default option in electronic medical records reduced postoperative opioid prescriptions after cardiac surgery

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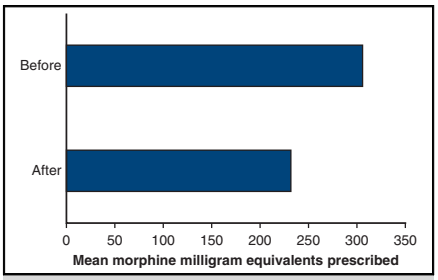
ABSTRACT

Objective: Overprescribing of opioids has contributed to the opioid epidemic. Electronic medical records systems can auto-populate a default number of opioid pills that are prescribed at time of discharge. The aim of this study was to examine the association between lowered default pill counts with changed prescribing practices after cardiac surgery.

Methods: On May 18, 2017, the default number of pills prescribers see in electronic medical records in the Yale New Haven Health System was lowered from 30 to 12. Patients undergoing coronary artery grafts, valve surgeries, and thoracic aortic aneurysm surgeries were included in this study. Data were gathered and stratified into 2 groups: 1 year before and 1 year following the default change. The amount of opioid prescribed was compared between the 2 groups.

Results: A total of 1741 patient charts were reviewed, 832 before the change and 909 after the change. Significant changes were seen in prescribing practices, where the average amount of opioid prescribed was about 25% lower after the change. This amounted to about 15 fewer pills of 5 mg morphine for each patient. A linear regression model adjusting for other factors determined a prescribing difference of 75.2 morphine milligram equivalents per prescription ($P < .01$). In addition, a significant decrease in opioids prescribed was found for each type of procedure.

Conclusions: Lowering the default opioid pill count in electronic medical record systems is a simple intervention that may modify prescribing behavior to promote judicious prescribing of opioids after cardiac surgery. (JTCVS Open 2021;8:467-74)



Mean monthly opioid dose prescribed after cardiac surgery, before and after default change.

CENTRAL MESSAGE

Lowering the default pill counts displayed in electronic medical record systems may lower the amount of opioids prescribed after cardiac surgery.

PERSPECTIVE

Overprescribing of opioids is a serious issue related to the opioid addiction epidemic. We demonstrated that a simple change in the EMR to display lower opioid pill count by default was associated with significantly lower opioid prescriptions in cardiac surgery. This is important, especially in minimizing the risk of prosthetic valve infective endocarditis.

See Commentaries on pages 475 and 477.

The extensive overuse of opioid drugs is referred to as the opioid epidemic and is a major public health challenge. In 2017, around 130 people died on average each day in the United States because of an opioid overdose.[1] Overprescribing of opioids for analgesia has contributed to the epidemic.[2,3] New persistent opioid use among opioid-naïve patients (defined as filling an opioid prescription between 90 and 180 days postoperatively) is common after cardiac surgery. Recent studies report that about 5.5% to 11.4% of valve surgery patients,[4,5] and 8.1% to 12.5% of patients undergoing coronary artery bypass grafts[6] develop new persistent opioid use. Larger initial opioid doses are associated with a higher risk of long-term use of opioids after cardiac surgery,[4-6] highlighting the importance of appropriate prescribing of opioids.

Prior strategies to change prescribing practices, including educating providers on opioid prescribing,[7] guidelines to prescribing,[8] and prescription drug monitoring programs,[9] had minimal success. A potential way to improve prescribing behaviors is through the use of computerized provider

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Received for publication April 12, 2021; accepted for publication April 12, 2021; available ahead of print May 11, 2021.

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2666-2736

https://doi.org/10.1016/j.xjon.2021.04.005

Abbreviations and Acronyms
EMR = electronic medical records
MME = morphine milligram equivalent
YNHH = Yale New Haven Hospital

order entry systems within electronic medical record (EMR) systems.[10] When opioids are prescribed through an EMR, the system can auto-populate a default number of pills to prescribe. Changing the default number may affect prescription behaviors by altering prescriber beliefs of the amount of opioid needed, and studies have shown that prescribers are influenced by the default number.[11]

Lowering the default pill count may result in a lower quantity of opioids prescribed in an outpatient setting.[10] Examining this in cardiac surgery is important, because whether the findings in an outpatient setting applies to more invasive inpatient operations remains unknown. The aim of this study was to analyze the association of lowering default opioid pill counts seen by prescribers in an EMR with postoperative opioid prescribing after cardiac surgery.

METHODS

Study Group and Design

This study was a single-center, retrospective chart review of patients undergoing cardiac surgery in the Yale New Haven Health System from May 18, 2016, to May 18, 2018. This time period corresponds to a year before, and a year after the default change. Patients were subdivided into 2 groups, depending on whether they had surgery during the time period before or after the default change. Prescribing patterns and morphine equivalent doses prescribed were compared between the 2 groups. The procedures selected for review were coronary artery bypass grafts, thoracic aortic aneurysm repairs and valve surgeries because they comprise the majority of open heart surgeries performed. The Epic EMR system (Hyperspace 2015 IU2; Epic Systems Corporation, Verona, Wis) was used throughout the health system.

Data on patient demographic characteristics (eg, age, sex, race, and body mass index), with information on the type of surgery, performing surgeon, and hospital was collected. Information on patient history of substance abuse and chronic pain was also gathered from diagnostic codes. Different drug formulations and types of opioids were standardized by conversion to morphine milligram equivalents (MMEs). This was based on conversion factors published by the Centers for Disease Control and Prevention.[8]

A total of 1946 of the selected procedures were performed during the study period in the Yale New Haven Health System. One hundred seventy-nine patients were omitted from the data because it was unknown in which hospital they underwent operation. Twenty-six patients with large MME values were removed as outliers, so the final number of patients used in the analysis was 1741. A value was considered to be an outlier if the value was >3 standard deviations away from the mean.

Intervention

On May 18, 2017, the multihospital Yale New Haven Health System in Connecticut, which includes 5 hospitals and multiple outpatient care centers, changed the default number of opioid pills prescribers see in EMRs from 30 to 12 pills. This applied to all medication containing codeine, hydrocodone, hydromorphone hydrochloride, morphine sulfate, oxycodone, or tramadol hydrochloride. This amount of pills was believed to provide sufficient analgesia, based on evidence suggesting that about 10 to 15 pills are satisfactory after most surgical operations.[12,13] This default only served as a guideline, and prescibers could change the amount prescribed. Surgeons were given an educational session on the default change as well as the opioid epidemic and ways to reduce overprescribing of opioids.

Statistical Analysis

For comparison of categorical variables, the χ^2 test was used, and Welch t test or Wilcoxon rank-sum test were used for comparison of continuous variables, based on normality. For evaluation of the change in MME prescribed before and after the default change, a multiple linear regression model was used. Changes in MME after the default change stratified by type of surgery were evaluated with Wilcoxon rank-sum test. All statistical analyses and calculations were performed using the statistical software R (version 3.6.2, R Foundation for Statistical Computing, Vienna, Austria). Yale Institutional Review Board approved this study and individual consent was waived.

RESULTS

Study Group Demographic Characteristics

A total of 1741 patient charts were reviewed. Of those, 832 were operated in the first period (from May 18, 2016, to May 17, 2017), and 909 in the second period (from May 18, 2017, to May 17, 2018). The operations were performed in 2 hospitals; namely, Bridgeport Hospital and Yale New Haven Hospital (YNHH). Thirteen different surgeons performed the operations before the default change, whereas 10 of them operated after the change. Table 1 displays the basic demographic features of the 2 groups. Mean age was about 67 years, and the majority of patients were White (82%) and men (70%). The groups were similar with regard to age, sex, body mass index, race, types of procedures, and history of substance abuse. However, having a history of chronic pain was significantly more prevalent for patients in the second group (30.9% vs 21.6%; $P < .01$).

Prescribing Changes

A significant decrease in the mean MME prescribed after the selected cardiac surgeries was detected after the default change. Figure 1 displays the monthly average MME prescribed from May 2016 to May 2018. The average MME prescribed for the first group was 307.2 (Table 1) but for the second group the average MME prescribed dropped to 233.3, a difference of 73.9 MME (24.1%). This is equal to about 15 fewer pills of 5 mg morphine per patient. The median MME prescribed also dropped from 240 to 225, a difference of 15 MME (6.25%). For all operations, about 43,500 more MME was prescribed before versus after the change. A multivariable linear regression model was constructed to control for other factors (Table 2), which showed that the mean prescriptions decreased by 75.2 MME (95% confidence interval, –95.0 to –55.4) after the default change.

Significant changes in prescribing practices were also seen for each type of procedure (Table 3). A linear

TABLE 1. Comparison of demographic features between the 2 groups before and after the electronic medical records (EMR) default change

Variable	Before (n = 832)	After (n = 909)	*P* value
Female sex	239 (28.7)	262 (28.8)	.99
Age (y)	66.4 ± 13.8	66.8 ± 12.2	.80
BMI	30.1 ± 6.0	30.1 ± 6.2	.65
Race			.15
Asian	16 (1.9)	17 (1.9)	
Black	65 (7.8)	59 (6.5)	
Hispanic	50 (6.0)	72 (7.9)	
Unknown	7 (0.8)	17 (1.9)	
White	694 (83.4)	744 (81.8)	
Hospital			.11
Bridgeport Hospital	141 (16.9)	182 (20.0)	
YNHH	691 (83.1)	727 (80.0)	
History of chronic pain	180 (21.6)	275 (30.3)	<.01
History of substance abuse	60 (7.2)	66 (7.3)	1.0
Type of procedure			.68
Coronary artery grafts	412 (49.5)	441 (48.5)	
Thoracic aortic aneurysms	122 (14.7)	125 (13.8)	
Valve surgery	298 (35.8)	343 (37.7)	
MME	307.2 ± 221.9	233.3 ± 203.9	<.01
MME	240 (150-450)	225 (90-300)	

Values are presented as n (%), mean ± standard deviation, or median (interquartile range). *BMI*, Body mass index; *YNHH*, Yale New Haven Hospital; *MME*, morphine milligram equivalents.

regression model was built for each (Tables E1-E3), which demonstrated a significant change for all types of surgeries when controlling for other factors. Because patients with a history of chronic pain may differ from other patients in terms of analgesic needs, a subgroup analysis was performed (n = 455) in patients with a history of chronic pain. Significantly less MME was prescribed for the postintervention group within this subgroup.

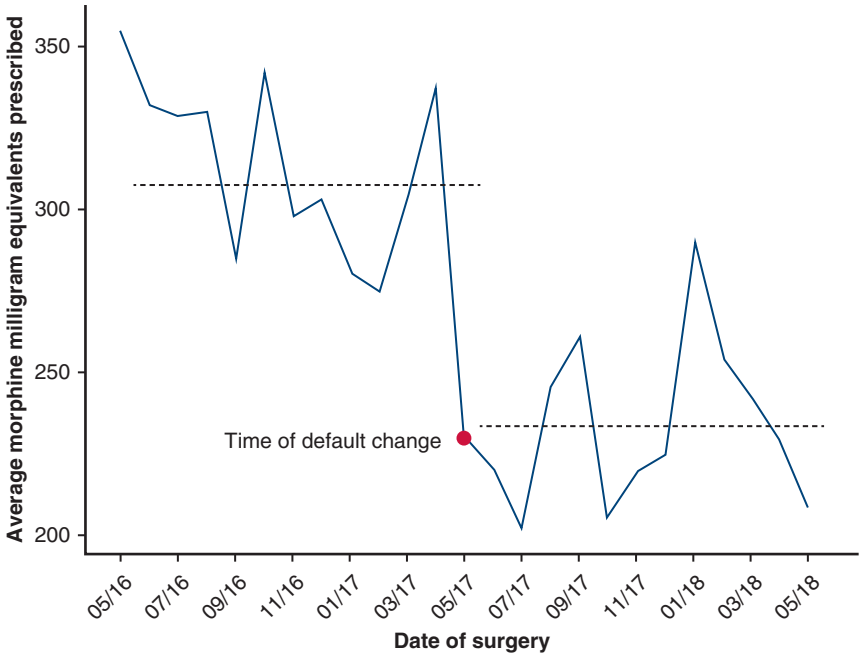

FIGURE 1. Line graph displaying the average monthly opioid prescribing after cardiac surgery at Yale New Haven Hospital, May 2016 to May 2018. *Dashed lines* represent the mean morphine milligram equivalents (MME) prescribed across the 2 time periods, before and after the change.

TABLE 2. Linear regression analysis estimating the change in morphine milligram equivalents (MMEs) prescribed

Variable	Estimate (95% confidence interval)	*P* value
Study period		
Before default change	1 [Reference]	
After default change	–75.2 (–95 to –55.4)	<.01
Sex		
Female	1 [Reference]	
Male	9.49 (–12.8 to 31.8)	.404
Age	–1.45 (–2.25 to –0.65)	<.01
Race		
White	1 [Reference]	
Asian	–35.2 (–107 to 37.1)	.340
Black	–28.4 (–67.7 to 11.0)	.157
Hispanic	16.3 (–23.3 to 55.8)	.420
Unkown	–6.69 (–91.1 to 77.8)	.876
History of substance abuse	75.2 (36.2 to 114.0)	<.01
History of chronic pain	35.2 (12.3 to 58.1)	<.01
Procedure type		
Coronary artery grafts	1 [Reference]	
Valve surgery	–33.1 (–55.3 to –10.9)	<.01
Thoracic aortic aneurysm	–58.70 (–89.6 to –27.9)	<.01
Hospital		
YNHH	1 [Reference]	
Bridgeport Hospital	–51.3 (–77.2 to –25.5)	<.01

YNHH, Yale New Haven Hospital.

DISCUSSION

Prescribing Changes

In this study, we found that lowering the default number of pills prescribers see in an EMR system substantially reduced the amount of opioids prescribed after the most common types of cardiac surgeries. The change in prescribing behaviors occurred shortly after the default change and remained relatively steady over the 12 months time. Additionally, a significant decrease in the mean MME prescribed was found for all 3 types of cardiac surgeries included (Table 3). These changes were relatively cheap and easy to implement. Mean opioid prescriptions were significantly lower in Bridgeport Hospital compared with YNHH. As different centers, practices may be different, but the reason for variation is unknown.

These results are comparable with similar research. Chiu and colleagues[10] studied the effect of this change in a different patient population in the same medical system. They studied outpatients, and established that these changes were associated with a decline in the amount of opioids prescribed. The population in this study underwent a more invasive procedure and received a higher amount of analgesics, but the relative change was similar compared with outpatient prescribing. Lower default settings have also been associated with lower prescriptions in an emergency department setting.[14] Our results suggest that prescibers were influenced by the default pill count, and add to literature on the use of EMR tools to influence prescriber behavior. This study further supports the idea of using lower defaults in attempt to lower prescriptions, with the ultimate goal of reducing addiction rates. In addition, this is a relatively simple intervention that could be implemented across the system.

Applications

Lowering the amount of opioids prescribed after cardiac surgery is an important issue. A recent study found that about 10% of opioid-naïve cardiac surgery patients who received opioids continued to use them 90 days after surgery. Also, the risk of persistent use increased with greater prescriptions.[15] Many surgeons are unaware of these high rates according to a recent survey among Canadian cardiac surgeons and trainees.[16] In addition, that study found that variability in opioid prescribing patterns among cardiac surgeons is significant, indicating a lack of guidelines and interventions to coordinate opioid prescribing.

Lowering defaults may have an influence where other measures have not proven to be successful, for instance where prescribing limits have been set. Statewide limits in opioid prescribing for opioid-naïve patients have been set

TABLE 3. Prescribing changes stratified for type of surgery

Prescribing changes	Coronary artery grafts (n = 853)	Valve surgery (n = 641)	Thoracic aortic aneurysm (n = 247)
Mean MME before	324.3	299.1	268.9
Mean MME after	251.4	215.2	219.0
Change in mean MME	–72.9	–83.9	–49.9
P value	<.01	<.01	<.01
Median MME before	300	225	225
Interquartile range	207.5-450	150-400	200-300
Median MME after	225	180	225
Interquartile range	120-360	90-240	90-300
Change in median MME	–75	–45	0

MME, Morphine milligram equivalents.

in many states. Most are relatively new, from 2016 or later, and set the limits to 7-day supply of opioids.[17] However, early results are disappointing, indicating an association with only minor changes in prescribing patterns. Suggested reasons for this include that the limits are not restrictive enough, that most limits only apply to days of supply without specifying a maximum daily dose, and possible noncompliance of providers.[18] Lowering the EMR defaults can encourage use for far fewer than 7 days, applies to the total opioid dose, not only day supply, and forces providers to actively increase the dose if they choose to prescribe a greater amount.

Limitations

Limitations are the following. The findings are from a single health care system and the applicability to other health systems is unknown. However, YNHH is a tertiary medical center, whereas Bridgeport Hospital is more community based, which gives this study a more diverse study population.

Opioid-naïve patients were not separated from non-naïve patients. Having filled out a prescription recently may affect prescribing, and is perhaps more informative than a history of substance abuse or chronic pain.

Outcomes relating to patient pain control and satisfaction were not investigated, so it is not known whether or not this intervention led to inferior pain control. From these results only, it is not clear if this strategy is advisable because it may lead to insufficient analgesia. However, when this intervention was applied in the same medical system for outpatients, no difference in refill rates was found.[10] A recent study with more than 26,000 opioid-naïve patients receiving opioids after surgery found that a smaller initial prescription was not associated with a higher probability of a refill, even for major surgeries like bariatric surgery or a hysterectomy.[19] Another recent study found that patients receiving more pills were likelier to use more, but those who received less were not more likely to take all of the pills prescribed or get a refill.[20]

This is a pre–post study and the exact causal relationship could not be defined. Opioid prescribing in the United States has been slowly declining for the past several years[21] and a slight downward trend may be seen during the 12 months before the change. However, the decrease in prescribing was seen immediately after the change, indicating that it is likely associated with the default change. Laws limiting the prescribing of opioids for first-time outpatient use became effective in Connecticut on July 1, 2016. They limited prescribing to a 7-day supply, with a 5-day limit for minors added during July 2017.[17] This may have affected prescribers to some extent, but limiting laws have not proven to be effective.[18] A limit of 7 days is not very restrictive, and is more than most people get prescribed for acute pain. Prescribers also took part in an education session during general surgery grand rounds at the time the new default took effect, which may have influenced prescribing rates.

Education and increased awareness of opioid overuse probably played a part in decreasing opioid prescriptions, indicating that the decrease is associated with the intervention. However, estimating the effects the education had is difficult. When this intervention was applied to outpatient prescribing, departments that received no formal education observed a substantial decrease, suggesting an independent association with the EMR default change.[10]

CONCLUSIONS

Lowering the default opioid pill count seen in EMRs, a relatively simple and cheap intervention, may be an effective way to promote judicious opioid prescribing after the most common types of cardiac surgeries. The effects this intervention has on the adequacy of pain management, and whether such changes are durable long after the change requires further investigation.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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Key Words: opioid, prescription, electronic medical record, cardiac surgery

TABLE E1. Linear regression estimating morphine milligram equivalents for patients undergoing coronary artery bypass graft procedure

Variable	Estimate (95% confidence interval)	*P* value
Study period		
Before	1 [Reference]	
After	74.50 (–103.0 to –45.9)	<.01
Sex		
Female	1 [Reference]	
Male	15.70 (–19.7 to 51.1)	.384
Age	–2.78 (–4.22 to –1.34)	<.01
Race		
White	1 [Reference]	
Asian	–45.50 (–142.0 to 51.6)	.358
Black	–26.80 (–86.7 to 33.0)	.379
Hispanic	13.30 (–38.6 to 65.2)	.615
Unknown	25.10 (–80.1 to 130.0)	.640
History of substance abuse	68.80 (8.82 to 129.0)	.025
History of chronic pain	32.60 (–2.01 to 63.2)	.037
Hospital		
YNHH	1 [Reference]	
Bridgeport Hospital	–52.80 (–86.6 to –19.0)	<.01

YNHH, Yale New Haven Hospital.

TABLE E2. Linear regression estimating morphine milligram equivalents for patients undergoing valve surgery

Variable	Estimate (95% confidence interval)	*P* value
Study period		
Before	1 [Reference]	
After	–87.10 (–122.0 to –52.4)	<.01
Sex		
Female	1 [Reference]	
Male	–6.950 (–42.1 to 28.2)	.698
Age	–0.588 (–1.77 to 0.59)	.328
Race		
White	1 [Reference]	
Asian	–14.90 (–141.0 to 112.0)	.817
Black	–21.80 (–88.0 to 44.4)	.518
Hispanic	29.60 (–41.6 to 101.0)	.415
Unknown	–93.70 (–270.0 to 83.0)	.298
History of substance abuse	98.90 (35.7 to 162.0)	<.01
History of chronic pain	42.60 (–0.942 to 86.2)	.055
Hospital		
YNHH	1 [Reference]	
Bridgeport Hospital	–64.70 (–110.0 to –19.5)	<.01

YNHH, Yale New Haven Hospital.

TABLE E3. Linear regression estimating morphine milligram equivalents for patients undergoing thoracic aortic aneurysm surgery

Variable	Estimate (95% confidence interval)	*P* value
Study period		
Before	1 [Reference]	
After	–46.90 (–90.1 to –3.65)	.033
Sex		
Female	1 [Reference]	
Male	46.10 (–3.07 to 95.2)	.066
Age	–1.06 (–2.71 to 0.587)	.206
Race		
White	1 [Reference]	
Asian	–109.0 (–345.0 to 128.0)	.366
Black	–44.70 (–124.0 to 34.2)	.265
Hispanic	–62.70 (–204.0 to 78.2)	.381
Unknown	19.20 (–218.0 to 256.0)	.873
History of substance abuse	–6.13 (–93.9 to 81.6)	.891
History of chronic pain	30.40 (–25.8 to 86.5)	.288
Hospital		
YNHH	1 [Reference]	
Bridgeport Hospital	142.00 (20.6 to 264.0)	.022

YNHH, Yale New Haven Hospital.