

Implementation of Electronic Medical Record Interventions to Maximize Opioid Disposal after Surgery in Routine Clinical Practice

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- BACKGROUND:** Despite guideline-directed opioid prescribing after operation, many patients retain excess opioids. Leftover pills increase the risk for misuse, diversion, and dependency. It is unclear whether interventions applied in routine clinical practice can increase excess opioid disposal rate.
- STUDY DESIGN:** All adult patients at our institution with postoperative opioid prescriptions were identified in general surgery, otolaryngology, plastic surgery, neurosurgery, urology, and transplant surgery. Disposal rates for 453 preintervention patients (operation between March 1, 2023, and June 30, 2023) were compared with 545 intervention patients (operation between October 1, 2023, and January 31, 2024). Pre- and postintervention patients were called 1 to 3 months after operation and asked about excess opioids. Interventions include (1) opioid disposal information sheets provided after operation; (2) opioid disposal reminder delivered via patient portal in electronic medical record (EMR); and (3) best practice alert triggered in EMR at postoperative visit reminded providers to discuss opioid disposal.
- RESULTS:** Opioid disposal outcomes were obtained from 70% (699 of 998) of patients. Fifty-four percent (375 of 699) had excess opioids. The percentage of patients disposing of their excess opioids increased from 30% (39 of 130) preintervention to 83% (204 of 245) postintervention ($p < 0.00001$). Forty-seven percent (247 of 545) of postintervention patients had discussions with their providers after a best practice alert fired at their postoperative visits. Patients who had a provider discussion were more likely to dispose of excess opioids than those who only received an information sheet and patient portal reminder (92% vs 70%, $p < 0.00001$).
- CONCLUSIONS:** Interventions easily incorporated into the EMR as part of routine clinical practice can markedly increase excess opioid disposal rates after operation. When information on opioid disposal and patient portal reminders are combined with disposal discussions with providers at the postoperative visit, opioid disposal rate of >90% can be achieved. (J Am Coll Surg 2025;240:898–906. © 2024 by the American College of Surgeons. Published by Wolters Kluwer Health, Inc. All rights reserved.)
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Opioid use disorder involves the misuse or diversion of prescribed opioids or the use of illicit synthetic opioids. Over the past 2 decades, this disorder has reached epidemic

proportions in the US. In 2022, there were 90,000 drug overdose deaths and 70% of these involved opioids.¹ Many patients begin using opioids through legitimate

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prescriptions after surgical procedures. Six to 10% of opioid-naïve patients prescribed opioids after operation will become persistent users.^{2,3} Several studies have documented that persistent opioid use is strongly associated with opioid dependence and overdose.⁴⁻⁶ Approximately 2 of every 1,000 opioid-naïve patients undergoing operation will develop opioid dependence or overdose.^{4,6}

Extensive efforts to address this problem have focused on matching opioid prescriptions with consumption using prescription guidelines. Although this approach has clearly decreased the number of opioids prescribed,⁷ even after guideline-directed prescribing, a high proportion (>50%) of patients are left with excess pills.⁸⁻¹⁰ These excess opioids pose a hazard to the patient and fuel the opioid epidemic via the mechanism of diversion—the transfer of prescription medication to those who have not been prescribed them. Studies indicate that as many as 25% of surgical patients who are prescribed opioids divert them to others,¹¹ and that patients whose family members have opioid prescriptions are nearly 3 times more likely to overdose.¹² However, prescribing too few opioids risks subjecting patients to excessive pain. It is challenging to prescribe exactly the right amount of opioids, without either over prescribing or under prescribing.¹³ To resolve this dilemma, minimize the danger of excess opioids, and eliminate the diversion problem, physicians should ensure that all patients with excess opioids dispose of their leftover pills.

At baseline, systematic reviews have found that without intervention, patients dispose of their excess pills at rates from 5% to 30%.^{14,15} Patient education has been used to increase the disposal rate. One study recorded a 22% increase in disposal after patients were informed of a pharmacy-based takeback program.¹⁶ Another educational intervention used patient brochures to encourage disposal of excess pills and found that 22% of patients with the brochure disposed of their excess pills compared with 11% of the comparator arm.¹⁷ However, 1 review reported that only 3 of 7 studies that used some form of patient education as the only intervention were able to demonstrate significant increase in opioid disposal.¹⁵ In contrast, a prospective study that combined patient education with a reminder telephone call and an easy method for disposal achieved a disposal rate of 83%.⁹

Our aim was to integrate several interventions into the context of routine patient care in an attempt to maximize excess opioid disposal. We combined (1) a patient information sheet (which recommended disposal of excess opioids, described the hazards of excess retention and methods of proper disposal) with (2) a patient portal reminder to dispose and (3) a best practice alert (BPA) which reminded

the provider that their patient was prescribed opioids and encouraged discussing disposal at the postoperative visit. We hypothesized that implementation of these interventions into routine postoperative care would result in a significantly higher rate of excess opioid disposal.

METHODS

This study was evaluated by the Dartmouth-Hitchcock IRB and was determined to be exempt. All adult patients prescribed opioid pain medication after operation were identified in the sections of general surgery, neurosurgery, otolaryngology, plastic surgery, urology, and transplant surgery.

Baseline, preintervention group

During this time period, surgeons were not aware that interventions designed to increase opioid disposal were planned. A total of 453 patients who had undergone operation between March 1, 2023, and June 30, 2023, were identified and called by study investigators starting 30 days after their operation. Patients were asked about their opioid usage and disposal per predetermined telephone call script. Responses were categorized as:

1. Chronic opioid user;
2. Still using, agrees to dispose excess;
3. Still using, refuses dispose excess;
4. Used all prescribed opioids;
5. Disposed excess before appointment;
6. Disposed excess during appointment;
7. Disposed excess after appointment;
8. Not using, refuses to dispose of excess.

Responses were recorded for 279 of these patients for an effective response rate of 61.6%.

Intervention group

The interventions were discussed with and endorsed by the Department of Surgery chairman, the institution quality improvement team, and the section chiefs, surgeons, and associate providers of participating sections. All providers (staff surgeons, residents, nurse practitioners, and physician assistants) in participating sections were informed of the details of this quality improvement initiative in emails and in-person meetings. The interventions were deployed starting in October 2023. Five hundred forty-five patients who had undergone operation between October 1, 2023, and January 31, 2024, formed the postintervention group. Three interventions were deployed.

1. Patients were provided with an information sheet describing the potential hazards of excess opioid pills, FDA-compliant opioid disposal methods, and a recommendation that patients should dispose of excess opioids in their after-visit summary (**Supplemental Digital Content 1**, <http://links.lww.com/JACS/A429>).
2. Patients received a reminder on their EMR patient portals before their postoperative appointment with the following message: "Please dispose of unused excess opioids before your appointment or bring them with you to the appointment and we will help you dispose of them correctly."
3. During postoperative health check appointments (coded as "HCK"), a BPA fired when a surgical provider opened the chart of all patients prescribed opioids after operation. The BPA prompted the provider to discuss opioid use and disposal with these patients and record the response.

BPA response categories were as follows:

1. Chronic opioid user;
2. Still using, agrees to dispose excess;
3. Still using, refuses dispose excess;
4. Used all prescribed opioids;
5. Disposed excess before appointment;
6. Disposed excess during appointment;
7. Will dispose excess after appointment;
8. Not using, refuses to dispose of excess.

Two additional response options were available: "not discussed" if the provider did not discuss opioid use or disposal with the patient and "not now" if the provider wished to dismiss the alert.

Analysis

The primary outcome was the proportion of patients with excess opioids who disposed of their extra pills before, during, or after their postoperation appointment. This outcome was assessed by telephone call in the preintervention group and either in-person provider discussion or telephone call in the postintervention group. Some patients had providers dismiss BPAs (response categories "not now" or "not discussed") at multiple encounters before a provider ultimately selected a definitive (categories 1 to 8) response. In these cases, the patient was categorized into that ultimate response. Some patients had BPAs dismissed (response categories "not now" or "not discussed") with no ultimate definitive (categories 1 to 8) response. These patients were called starting 30 days after their

postoperative appointments using the same telephone script as the preintervention group to obtain definitive responses. Additionally, patients in the postintervention group whose BPA response indicated that they agreed to dispose of excess opioids (BPA categories 2 and 7) were called starting 30 days after their postoperative appointments to determine whether they had actually disposed of their excess opioids. The response category recorded at the time of the BPA was used as the final response category for the rest of the postintervention patients.

For the postintervention group, definitive responses (defined as either a BPA response in categories 1 to 8 during the postoperative visit or telephone call) were recorded for 420 of these 545 patients for an effective response rate of 77%.

All clinics in the participating surgical services were provided with Deterra bags (Verde Environmental Technologies, Inc, Minneapolis, MN) to facilitate disposal of excess opioids either during or after the postoperative appointment.

Proportions of patients were compared using the chi-square test.

RESULTS

Patients were considered to have excess opioids if they were marked as category 5 (disposed excess before appointment), 6 (disposed excess during appointment), 7 (disposed excess after appointment), or 8 (refused to dispose excess). Overall, more than half of the patients (54%) had excess opioids. The proportion of patients with excess opioid pills was comparable in the pre- and postintervention groups ([Fig. 1](#)). The remainder of patients either used all of their prescribed opioids at the time of assessment (33%) were still using opioids at the time of assessment (5%) or were categorized as chronic opioid users (8%).

There were no significant differences in the composition, by surgical specialty, of the pre- vs postintervention groups: general surgery 49% vs 55%, neurosurgery 14% vs 12%, otolaryngology 17% vs 14%, plastic surgery 15% vs 15%, urology 4% vs 3%, and transplant surgery 1% vs 1%. Because only 3 months separated the pre- vs postintervention time periods, there was no substantial difference in the providers involved with the pre- and postintervention groups. During the 11-month duration of the study, there was no hospital-, department-, or section-level change that might have affected opioid disposal. For example, during this study, a drop box was available at a pharmacy 1 mile from the hospital, but no drop box was available in the hospital itself.

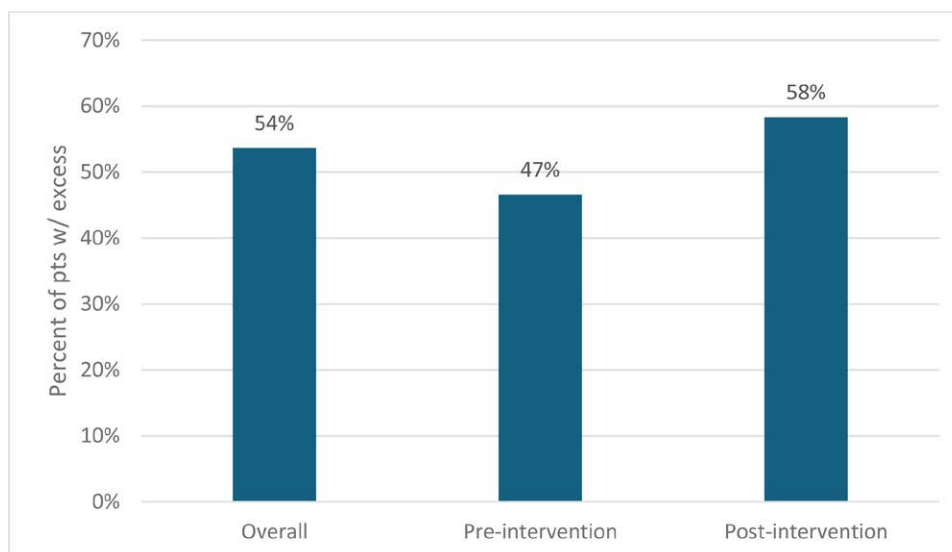


Figure 1. Percentage of patients with excess opioid pills.

Excess opioid disposal rates

Patients were considered to dispose excess pills if they disposed their excess opioids before, during, or after their postoperative appointment (BPA categories 5, 6, or 7). The percentage of patients disposing excess opioids was significantly greater in postintervention compared with preintervention patients (83% vs 30%, $p < 0.00001$; Fig. 2). There was a significant increase in excess opioid disposal noted in all surgical specialties ($p < 0.01$ for each specialty; Fig. 3).

In the preintervention patient group, 5% of patients with excess opioids disposed their excess opioids before their postoperative appointment, 0% during the appointment, and 25% after the appointment. In the postintervention group, 28% of those with excess disposed before their postoperative appointment, 4% during the appointment, and 51% after the appointment. A significantly greater proportion of patients in the postintervention group disposed excess opioids before (28% vs 5%, $p < 0.00001$) and after (51% vs 25%, $p < 0.00001$) the postoperative appointment (Fig. 4). There was no significant change in the percentage of patients who disposed excess opioids during the postoperative appointment (4% vs 0%).

To highlight the timing of opioid disposal in relation to the postoperative visit, we analyzed just the subset of patients who disposed excess opioids. When considering just the subset of patients who disposed their excess opioids, the relative proportion of patients in the preintervention group who disposed excess opioids before, during, and after their postoperative visit

was 15%, 0%, and 85%. In the subset of patients who disposed excess opioids in the postintervention group, 34%, 5%, and 61% of patients disposed opioids before, during, or after their postoperative visit, respectively. The relative proportion of patients who disposed their excess opioids before their appointment was significantly higher in the postintervention patients (34% vs 15%, $p = 0.02$).

Importance of provider engagement on excess opioid disposal

The effect of provider engagement with the patient during the postoperative visit on disposal of excess opioids was specifically evaluated. Opioid use was discussed with a provider during at least 1 postoperative visit (as indicated by a BPA response in categories 1 to 8) in 47% (257 of 545) of patients. There was no discussion about postoperative opioid use with a provider at any postoperative visits (as indicated by a BPA response of “not discussed” or “not now”) in 53% (288 of 545) of patients. Patients who had discussions about opioid use during a postoperative appointment had significantly higher disposal rate compared with patients whose providers did not discuss opioid use at the postoperative visit (92% vs 70%, $p < 0.00001$; Fig. 5).

Therefore, interventions 1 (discharge summary information sheet on potential hazards of excess opioid pills, FDA compliant opioid disposal methods, and a recommendation that patients should dispose of excess opioids) and 2 (reminder to dispose of excess opioids in patient portal)

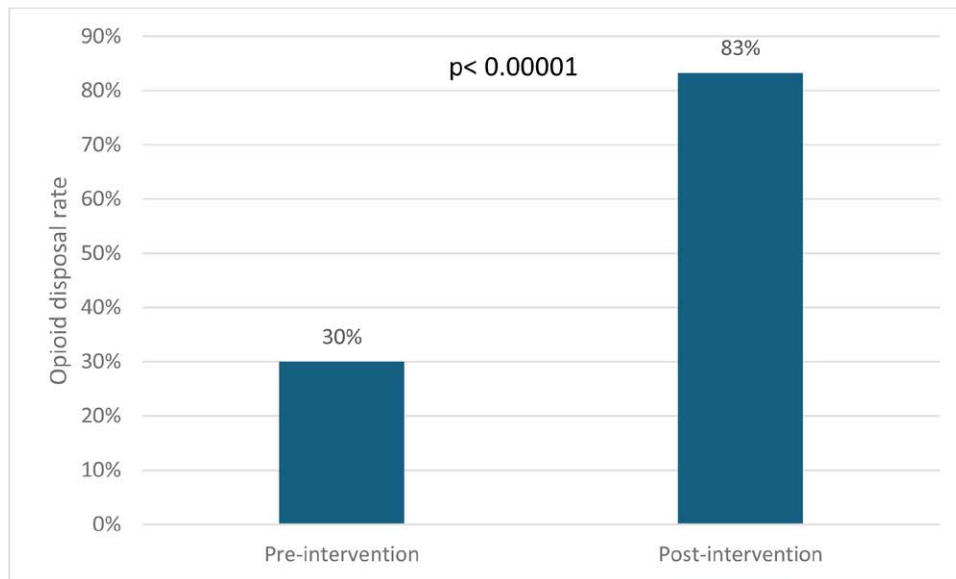


Figure 2. Percentage of patients who disposed of excess opioid pills.

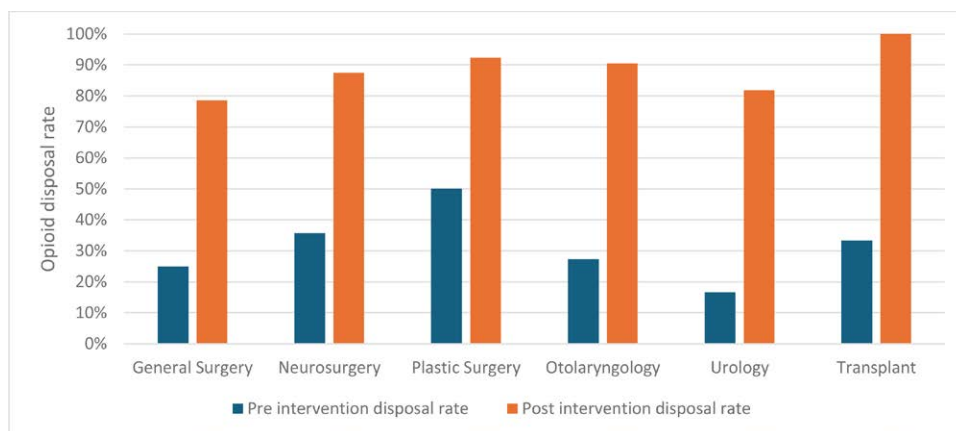


Figure 3. Excess opioid disposal rate in specific surgical specialties. $p < 0.01$ for all specialties.

resulted in 70% of patients disposing excess opioids. When interventions 1 and 2 were combined with a provider discussion of excess disposal, the disposal rate was 92%.

Sixty-three providers had postoperative visits with at least 1 patient in the study. For each provider, we determined the percentage of times they engaged with their patients in a discussion about excess opioids. This engagement percentage was calculated by dividing the number of BPA responses 1 to 8 by the number of BPA responses 1 to 8 plus responses of “not discussed” or “not now” (BPA categories 9 and 10). Engagement percentages varied from 0% to 100%. For all providers, the mean and median engagement percentages were 52% and 55%. For the

subset of 30 providers with at least 5 patient encounters, the mean and median engagement percentages were 42% and 40%, respectively.

Seventy percent of providers were surgical attendings, 2% were residents, and 27% were associate providers (nurse practitioner and physician assistant). There was no significant difference in the mean engagement percentage of surgical attending providers compared with associate providers (51% vs 44%, $p = 0.1$). Additionally, there was no significant difference in the excess disposal rate between patients undergoing postoperative visits by surgical attending providers vs associate providers (81% vs 84%, $p = 0.55$).

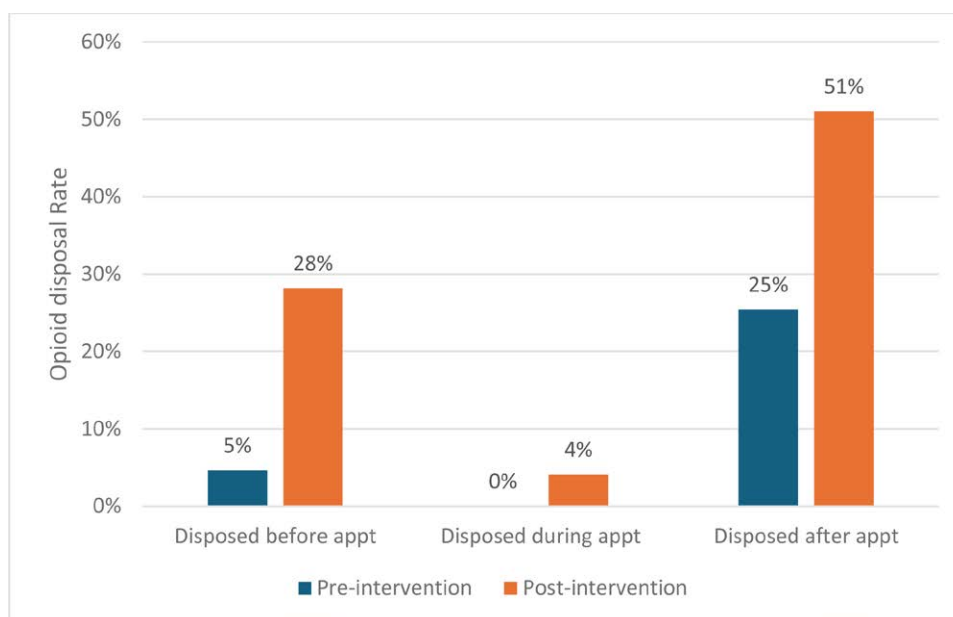


Figure 4. Percentage of patients who disposed of excess opioid before, during, or after their postoperative appointment. A significantly greater proportion of patients in the postintervention group disposed excess opioids both before and after ($p < 0.00001$) the postoperative appointment.

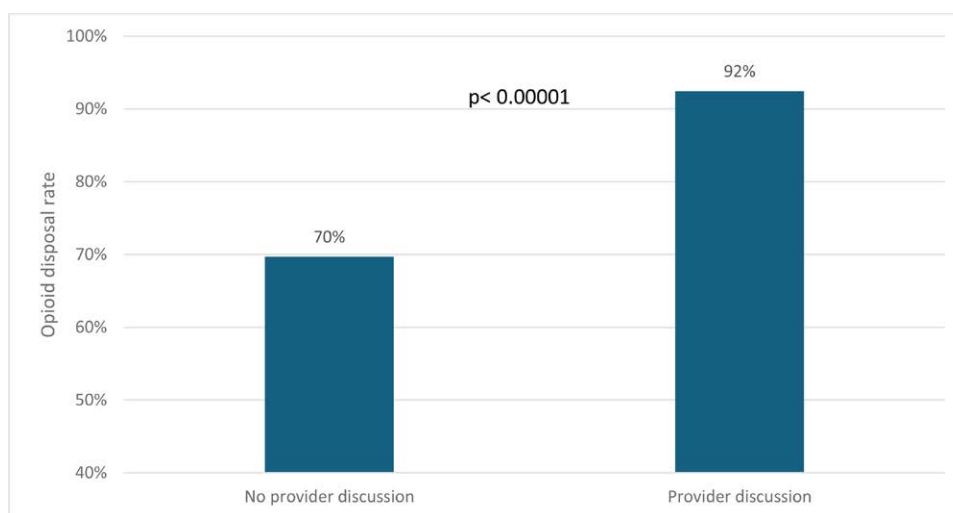


Figure 5. Effect of provider discussion on excess opioid disposal rate.

DISCUSSION

Our intervention, which combined an information sheet, a patient portal reminder, and a BPA, resulted in a highly significant increase in excess opioid disposal from 30% to 83%. When all 3 interventions were applied, and providers had discussions with patients about opioid disposal during the postoperative visit, the excess opioid disposal rate was 92%. These data demonstrate that implementation of EMR-integrated interventions in routine clinical

practice can lead to an opioid disposal rate comparable to that attained in the context of clinical trials.⁹ Inclusion of a wide range of surgical disciplines (general surgery, neurosurgery, otolaryngology, plastic surgery, urology, and transplant surgery) and a large number (63) of both attending and associate providers demonstrates that these results should be generalizable to a wide array of surgical practices. If these interventions were widely implemented, such that 92% of all surgical patients disposed their excess opioids,

we would expect that this would substantially reduce the incidence of overdose, the development of dependence in patients prescribed postoperative opioids, and diversion of opioids to others.

Examining when opioids were disposed (before, during, or after the postoperative appointment) can provide insight into the effectiveness of each intervention. The percentage of patients disposing their excess opioids before the postoperative appointment significantly increased (from 5% to 28%) after the intervention. Therefore, the information sheet and the EMR portal message, both of which recommended excess disposal before the appointment, did significantly affect the disposal percentage. Disposal of opioids during the postoperative appointment was uncommon; no preintervention patients disposed during the postoperative visit and only 4% of postintervention patients disposed during the postoperative visit. Disposal of excess pills after the postoperative visit was also significantly more likely in the postintervention patients (51% vs 25%). Because the information sheet and patient portal message recommended disposal before or during the appointment, it is likely that the interaction with the provider most influenced the markedly greater percentage of patients in the postintervention group who disposed opioids after the appointment.

When one considers on a relative basis when it is most likely for patients to dispose excess opioids, the highest percentage of patients both preintervention and postintervention disposed excess opioids after the postoperative visit. This again emphasizes the importance of the provider interaction during the postoperative visit on the successful disposal of excess opioids.

The most convincing evidence of the importance of a provider discussion about excess disposal comes from the comparison of patients who had this discussion vs those who did not: 92% vs 70% disposed of excess opioids (Fig. 5). However, the information sheet and portal reminder themselves were effective interventions, because 70% of postintervention patients who did not have a provider discussion disposed their excess opioids, much higher than the 30% of preintervention patients who disposed.

We are not aware of previous studies that have used BPAs to affect excess opioid disposal. Previous studies have shown that BPAs integrated into the EMR can influence provider behavior. One study found that BPA reminders reduced duplicate laboratory orders by 18%.¹⁸ Another study used BPAs to prompt co-prescription of naloxone when patients either (1) had opioids prescribed without concomitant naloxone, (2) had a previous history of opioid overdose, or (3) had a history of opioid use disorder. Naloxone prescriptions increased from 2%

at preintervention to 58% postintervention.¹⁹ However, when applied specifically to opioid interventions, the results have been mixed. A study of 21,689 surgical patients at 4 intervention sites used BPAs to attempt to reduce overall opioid prescriptions, but this did not lead to any difference in postintervention opioid prescription rates.²⁰ Another study triggered BPAs when providers prescribed more than 15 pills after hysterectomy, but this intervention resulted in a reduction in prescription volume in only 12% of cases.²¹

Our BPA intervention was designed in line with the 5 principles of successful clinical decision support: (1) right information (2) to the right people (3) through the right channels (4) in the right information format (5) at the right time.²² The interventions were discussed with the department chairman, section chiefs, and providers in each involved surgical service before implementation. Most importantly, our providers (both surgeons and associate providers) generally understood the importance of disposal of excess opioids before beginning the intervention phase. Alignment with the purpose of the BPA has been noted²³ to reduce clinician alert fatigue. Providers realize that responsible opioid prescribing is the right thing to do for their patients. If one prescribes an opioid to their patient, one also has a responsibility to minimize the potential harms associated with that prescription.

BPAs may not be successful if providers ignore or dismiss them. This was an issue in our study: 53% of our patients did not have a discussion (documented by recording a definitive response in the BPA) with a provider regarding excess opioid disposal. In some cases, patients were seen by 1 provider several times or by multiple providers and no discussion was documented. This dismissal rate is similar to that found in other studies investigating BPAs to modify provider behavior. In Jankulov's study using BPAs to alert physicians to opioid overprescribing after hysterectomy, 45% of the alerts were dismissed.²¹ A large study collecting data on 85,322 patients triggered BPAs to fire when patients' Early Warning scores (a composite predictor for in-hospital death or cardiac arrest) passed threshold: 86% of these alerts were dismissed.²⁴ In another study of 7,569 patients, BPAs alerted providers of "triple low events" (physiological changes associated with inpatient mortality) but were ignored about 50% of the time.²⁵ Subsequent to our study, to potentially remedy this problem, we have adjusted the BPA to refire at the time the provider signs their note. A provider can then dismiss the BPA which initially appears when they open the patient chart by clicking "not now," do work in the chart, discuss opioid disposal with the patient, and then record

the patient's disposal response at the end of the visit when the BPA reappears at the time of note signing.

Limitations

BPAs can be powerful tools to influence provider behavior, but they may also distract providers, impede workflow, and worsen burnout. To mitigate these harms, alert performance can be evaluated by measuring impact on patient outcomes, override rate, disruption to workflow, and provider perception. When considering these domains of alert performance, it is important to note that our intervention did not just change provider behavior (eg by modifying a prescription) but actually improved patient outcomes by significantly increasing the rate of excess opioid disposal. We actively sought feedback from providers regarding the effect of our BPA on workflow in clinic and on whether this intervention felt unduly burdensome and did not receive any negative comments.

We did not strictly record the percentage of patients who obtained Deterra bags at the time of their postoperative appointment and used them to dispose of excess opioids.

These data were obtained from a single academic institution in a rural setting, which might not be as directly applicable to surgical services in different settings.

CONCLUSIONS

Interventions easily incorporated into the EMR as part of routine clinical practice can markedly increase excess opioid disposal after operation. Discussions with trusted providers are a powerful tool to ensure disposal of excess opioids, and providers can be prompted to initiate discussion via EMR reminders. When information on opioid disposal is combined with provider discussion during the postoperative visit, a disposal rate of >90% can be achieved.

Author Contributions

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 Formal analysis: Deshmukh, Barth
 Investigation: Deshmukh, Amezcua, Barth, Cotter
 Writing – original draft: Deshmukh
 Writing – review & editing: Amezcua, Barth, Cotter
 Conceptualization: Cotter, Barth
 Methodology: Cotter, Barth
 Project administration: Cotter, Barth
 Resources: Cotter, Barth
 Supervision: Barth

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Invited Commentary

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Many surgeons have developed guidelines to prescribe the “right” amount of opioid medications to relieve postoperative pain. The idea is to suit analgesic needs without leaving a surplus of pills that might harm the patient (with chronic dependence or overdose) or loved ones (through diversion). Of course, patients vary in their narcotic needs, and so it can be difficult to predict how many tablets to dispense, even with a formulaic, operation-specific approach. In fact, more than half of patients will ultimately possess excess opioid pills and relatively few will get rid of them.

The team at Dartmouth has produced yet another important contribution regarding responsible management of postoperative opioid prescriptions.¹ This study differs from right-sizing the number of pills prescribed by embedding a system in the electronic medical record (EMR) that encourages patients to discard the redundant

supply after operations in various specialties. The investigators implemented a series of interventions that rely on EMR-based prompts of both patients (via the patient portal) and clinicians (through best practice alerts during postoperative visits), along with traditional printed instructions about the hazards of opioids and disposal methods.

The authors’ interventions boosted the documented disposal of excess opioids from 30% of patients who exclusively received educational materials, before implementation, to 83% in the cohort who also benefited from the novel measures. On further analysis, when clinicians responded to best practice alerts and personally engaged patients in discussions about opioids, the disposal rate rose to 92%, as opposed to 70% among patients who received written instructions and portal reminders but did not hear personal appeals from clinicians.

During our department’s quality improvement efforts, we have focused on problems with the greatest opportunities and advocated standardization, automation, durability, education, risk assessment and risk-stratified care, broad applicability, and simplicity whenever possible. Protocols integrated in the EMR can be configured to offer these features and improve outcomes.² Conversely, we have observed projects in which reliance on the human element compromised sustainability.³ These experiences capture the thrill of victory and the agony of defeat within the quality domain. In the current series, Deshmukh and colleagues¹ reported a clever application of the EMR, and they demonstrated the additive value of both automation and personal interactions with the surgery team.

Although this article demonstrates a creative and practical approach to eliminating excess opioid pills, opportunities persist. For example, despite presumably widespread institutional awareness of the authors’ passion for limiting the supply of prescribed narcotics that circulate beyond their intended interval as well as their attentiveness to the dangers of opioids prescribed after operations, about half of the clinicians still did not discuss disposal with their patients regardless of EMR recommendations to do so. It will be interesting to learn whether the investigators can modify behavior among their colleagues and ultimately strengthen compliance with EMR prompts. Interaction between clinicians and patients is essential on so many levels and will likely remain necessary to reach the goal of all patients discarding leftover opioids.

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