Impact of a pharmacy-led nursing education on discharge opioid prescribing after kidney transplant

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Abstract
A major contributor to the opioid epidemic is prescribing in the postoperative setting. There remains the need for opioid stewardship both postoperatively and upon discharge in kidney transplant recipients. In October 2017, pharmacist-led education was given to all transplant nursing staff at a single center with the goal of optimizing postoperative pain control through education and empowerment of nurses. Furthermore, the education focus was to advance nursing knowledge, enhance patient assessment, and reform patient education. Clinical pharmacists continued to work with the transplant team to base a patient's discharge analgesia on inpatient analgesia use. This study assessed the impact of the nursing education on discharge analgesic prescribing patterns after kidney transplant admission. Opioid prescribing on transplant discharge was significantly lower after the education (pre 68.3% vs post 11.1%, \(P < .001\)). Transplant admission was shortened by 1 day (6 vs 5 days, \(P = .03\)). Over time, a significant downtrend in opioid prescribing was observed on discharge from 86.1% in 2015 to 49.6% in 2017 and 8.5% in 2018 (\(P < .001\)). If opioid therapy was required on discharge in the posteducation group, tramadol was predominantly prescribed (7/13 opioid prescriptions, 53.9%). Thus, opioid minimization and pain management using nonopioid analgesic prescribing on discharge are feasible in an adult kidney transplant population with proper nursing collaboration and education.

KEYWORDS
interprofessional education, nursing education, opioid analgesics, opioid epidemic, pharmacists, prescriptions, transplants

1 | INTRODUCTION

The opioid epidemic in the United States has triggered a national public health crisis. Opioid prescribing in the postoperative setting is a major gateway into opioid addiction and has been a large contributor to the opioid epidemic.1,2 As the opioid epidemic has grown, various opioid minimization strategies were implemented in the setting of postsurgical analgesia.3-5 Initiatives to limit opioid prescriptions have incorporated multimodal approaches including altering perioperative pain management, incorporating pain expectation education to patients, and systematic changes in opioid prescribing practices on an institutional level. These approaches began to be implemented and described within the...
realm of both liver and kidney transplantation, resulting in reduced opioid utilization in both the peri-operative and postoperative settings.5,7

In recent years, the opioid epidemic and its impact on outcomes of kidney transplant recipients has garnered significant interest in the transplant community. Various studies reported deleterious outcomes of opioid use pretransplantation.8-14 Barrantes and colleagues demonstrated that 10.2% of their patients evaluated for transplantation were considered chronic opioid users (COUs) and reported regular, daily use of opioids for at least 3 months before receiving a kidney transplant.8 While these patients experienced similar allograft outcomes to the non-COU cohort, they experienced worsened cumulative mortality at 1, 3, 5, and 7 years after transplant.8 In another analysis, Lentine and colleagues found that 29% of their patients filled an opioid prescription in the year before transplantation. Those identified as high opioid users (exceeding 1000 morphine mEq per year) experienced an increased risk of death and all-cause graft failure.13 Moreover, Wilson and colleagues and Patel and colleagues reported higher readmission rates and total readmission costs at 30-, 90-, and 365-days after transplantation in opioid experienced patients at the time of transplantation.1,10,11 Continued use of opioids after transplantation has also been linked to poor outcomes. Kulshresta and colleagues reported increased hospitalization rates for patients that filled an opioid prescription in 3 or more of the 11 months in the year after transplantation.12 Abbott and colleagues demonstrated increased mortality and graft loss with long-term opioid use; moreover, these outcomes worsened sequentially with daily doses of opioids exceeding 90 morphine milligram equivalents (MMEs).14 Similarly, Lentine and colleagues linked high opioid use within the first year after kidney transplant with a higher risk of death and graft loss within the first 5 years after kidney transplantation.13 Consequently, kidney transplant programs around the U.S. have implemented opioid minimization strategies. After implementing a multidisciplinary, multimodal, opioid minimization initiative, Rohan and colleagues described a multidisciplinary approach that resulted in a reduction in opioid use during hospitalization but had little impact on opioid prescribing patterns on discharge (~25% of patients discharged with opioid prescriptions).15 In the context of this study, their interventions included removal of the automatic postoperative patient-controlled analgesia pump and implementation of an opioid-sparing multimodal pain regimen, which included scheduled acetaminophen, lidocaine patch, and gabapentin. In 2014, a ketorolac-based pain management protocol was implemented for peri-operative analgesia after donor nephrectomy at our center. Compared with a retrospective cohort, kidney donors who followed this opioid minimization protocol had a shorter length of stay (LOS), used less opioids, and had similar renal function outcomes.16-18 While opioids were being minimized in kidney donors, kidney transplant recipients remained mostly discharged with opioids. Our pain management approach in kidney transplant recipients included rapid de-escalation from opioid to nonopioid analgesia to ensure an adequate pain regimen by discharge (Table 1). In reviewing progress toward this goal, we observed that pain medications selected by the nurse and administered to patients frequently did not correlate with patient-reported pain scores documented within the electronic medical record (EMR). Consequently, a pharmacist-driven nursing education campaign was composed for transplant nursing staff. The purpose of this study was to assess the impact of a pharmacist-led nursing education on discharge analgesic prescribing patterns in adult kidney transplant recipients.

2 MATERIALS AND METHODS

2.1 Study design

This was a retrospective study assessing adult kidney transplant recipients from January 1, 2015 to October 30, 2018. The study took place at a single academic medical center; a 462-bed hospital performing

| TABLE 1 | Recommended inpatient analgesic regimen |
| --- | --- | --- |
| **Pain severity** | **Pain score (numeric rating scale)** | **Preminimization protocol** | **Opioid minimization protocol** |
| Mild | 1-3 | Acetaminophen-hydrocodone 325 mg-10 mg PO q6h PRN | Acetaminophen 500 mg PO q6h PRN |
| Moderate | 4-6 | Acetaminophen-hydrocodone 325 mg-10 mg PO q6h PRN OR Morphine 2 mg IVP q2h PRN | Acetaminophen-hydrocodone 325 mg-5 mg PO q6h PRN* |
| Severe | 7-10 | Morphine 2 mg IVP q2h PRN | Morphine 2 mg IVP q2h PRN (interval of administration increased daily)** |
| Discharge | N/A | Acetaminophen-hydrocodone 325 mg-10 mg PO q6h PRN | Acetaminophen 500 mg PO q6h PRN or Tramadol 50 mg PO q6h PRN |

Note: PO denotes by mouth, PRN as needed, and IVP intravenous push.

*Subsequent year transitioned tramadol 50 mg PO q6h PRN.

**Subsequent year transitioned to acetaminophen-hydrocodone 325 mg-5 mg PO q6h PRN.
71 to 155 kidney transplants per year during the study time period. Patients were excluded if they expired during the transplant index admission or were less than 18 years of age. The pre-education group encompassed kidney transplant recipients from January 1, 2015 to October 15, 2017 (when the education roll-out was completed). The post-education group consisted of kidney transplant recipients after the education (October 16, 2017 until October 30, 2018). The primary outcome was to compare the percentage of patients who had opioids prescribed at discharge from the kidney transplant index admission between those in the pre- and post-education cohorts. Secondary outcomes included transplant index admission LOS and type of opioid prescribed upon discharge from the transplant index admission. All data was manually extracted from the EMR. Patient demographic information, transplant information, and discharge opioid information was collected and audited by investigators. This study was approved by the University of Illinois at Chicago Institutional Review Board.

2.2 | Interventions

In October 2017, an education campaign focusing on opioid minimization was implemented to all bedside nurses within the solid organ transplant intensive care unit and the stepdown unit. The elements of the campaign included the importance of postoperative pain control, a review of opioid pharmacotherapy, pain assessment tools, clinical pearls in analgesic selection, and setting pain expectation goals with patients (Figure 1). The key point of this training was to convey the need for accurate pain assessment and appropriate pain management while effectively stewarding opioids. First, the importance of pain control on the road to recovery and rehabilitation was reviewed as inadequate pain control has been shown to lead to reduced mobility, cardiac instability, and other negative effects on patient status. Second, opioid mechanisms, equianalgesic doses, and adverse effects were reviewed. Third, this training discussed how nursing staff could set early and realistic patient expectations regarding pain management throughout the duration of the transplant index hospitalization. Within the context of this education, patients were informed that the analgesic goal would be to alleviate pain to a manageable level, but that pain may not be completely absent. Furthermore, pain assessment tools such as the numeric pain rating scale (1-10) and the critical care pain observation tool (CPOT) were discussed. Appropriate use of as needed (PRN) pain medications for mild, moderate, or severe pain was discussed to minimize inappropriate selection of pain medications as described in Table 1. Nurses were educated to use nonopioid analgesia when pain medications were needed for a pain score under 4, to use oral acetaminophen-hydrocodone when pain scores were 4 to 6, and to

FIGURE 1  Components of opioid minimization education
reserve intravenous opioids for pain scores indicating severe pain such as 7 to 10. As previously noted, prior to this education, oral, and intravenous opioids were being administered for all levels of pain and this education sought to implement a more systematic approach.

The transplant clinical pharmacist team developed content including handouts for the educational sessions. All nurses of the transplant ICU and stepdown units received education at one of these small-group, in-person, interactive sessions. Each session included valuable question and answer dialogue between the educator and the nurses, which allowed the educator to gauge understanding of the session’s content.

Transplant clinical pharmacists, practicing under protocol, continued to enter all prescriptions including the discharge analgesic regimen based on the patient’s pain medication requirements on the days prior to discharge. If patients were still utilizing opioids regularly on the day prior to discharge, the clinical pharmacist would be more likely to arrange for an opioid prescription to be filled for discharge. Therefore, the objectives of the nursing education were for better nursing assessment of pain and for more appropriate pain medication selection. Optimization of opioid usage during the inpatient stay would then allow for better opioid stewardship in discharge analgesic prescribing.

Medication education materials were revised to help the patient anticipate being discharged on nonopioid pain medications. After kidney transplant at our center, transplant clinical pharmacists provide an initial discharge medication education for the patient as early as postoperative day 1. Medication education materials include a chart with anticipated discharge medications such as immunsuppression, infection prophylaxis, previous home medications, and postoperative analgesic medications. As outlined in Table 1, the goal under this opioid minimization strategy was to utilize nonopioids, such as acetaminophen, on discharge. Therefore, medication education charts were revised to include acetaminophen rather than acetaminophen-hydrocodone to help patients anticipate, as early as postoperative day 1, that the goal will be to utilize acetaminophen for analgesia upon discharge.

At discharge, all new prescriptions including analgesic medications, whether opioid or nonopioid, are filled and present for a final bedside patient education. Acetaminophen was the baseline analgesic that all patients were prescribed. Depending on the utilization of opioids during the hospital stay and patient exam, a decision was made alongside the advanced nurse practitioner and/or transplant surgeon to provide additional analgesic medications on discharge, including opioids.

### 2.3 Statistical analysis

Data was assessed for normality. Nominal data was described with percentages and compared with the $\chi^2$ test or Fischer's exact test. Continuous data were described with mean (standard deviation [SD]) or median (interquartile range [IQR] or range) and compared using the Student’s t test or Mann Whitney U test. Statistical analysis was performed on STATA Version 14 (StatCorp, LLC).

### 3 RESULTS

#### 3.1 Patient demographics

Overall, 376 adult kidney transplant recipients were assessed and included in the analysis. The study population was on average 50.8 years old, 63% male, with an average body mass index (BMI) of 32.2 (SD ± 8.6) kg/m² (Table 2). No significant differences were noted in major baseline characteristics between the pre- and post-education groups including surgery type (open vs robotic-assisted) and transplant type (living vs deceased donor). A significant difference was observed in the racial composition of the groups, which was driven by more Hispanic (pre 26.3% vs post 36.8%, $P = .038$) and more Asian...

| Variable | Overall (n = 376) | aPre- (n = 259) | bPost- (n = 117) | P-value |
|----------|------------------|----------------|----------------|---------|
| Age, years (SD) | 50.8 (13.5) | 50.1 (13.6) | 52.3 (13.3) | .143 |
| Male gender, n (%) | 237 (63.0) | 165 (63.7) | 72 (61.5) | .690 |
| BMI, kg/m² (SD) | 32.2 (8.6) | 32.6 (8.8) | 31.3 (8.1) | .198 |
| Race, n (%) | | | | |
| Caucasian | 73 (19.4) | 52 (20.1) | 21 (17.9) | .629 |
| African-American | 173 (46.0) | 127 (49.0) | 46 (39.3) | .080 |
| Asian | 9 (2.4) | 3 (1.2) | 6 (5.1) | .049 |
| Hispanic | 111 (29.5) | 68 (26.3) | 43 (36.8) | .038 |
| Other | 10 (2.7) | 9 (3.5) | 1 (0.9) | .144 |
| Transplant surgery type—robotic, n (%) | 149 (39.7) | 101 (39.0) | 48 (41.4) | .663 |
| Donor type—deceased, n (%) | 201 (53.5) | 135 (52.1) | 66 (56.4) | .44 |

$^a$Pre-education: January 1, 2015 to October 15, 2017.
$^b$Post-education: October 16, 2017 to October 30, 2018.

Abbreviations: BMI, body mass index; SD, standard deviation.
(pre 1.2% vs post 5.1%, \( P = .049 \)) patients present in the post-education group. Table 2 details the demographic information of the cohort.

### 3.2 Opioid prescribing at discharge and LOS

There was a significant reduction in the percentage of patients discharged with an opioid prescription after the education initiative (pre 68.3% vs post 11.1%, \( P < .001 \)). Figure 2 illustrates the overall changes in the percent of patients discharged with an opioid prescription pre- and post-educational efforts. Figure 3 displays the percentage of patients with opioid prescriptions upon discharge from kidney transplant admission by calendar year during the study period. The percentage of patients being discharged with an opioid prescription significantly decreased each year (2015 86.1% vs 2016 62.7% vs 2017 49.6% vs 2018 8.5%, \( P < .001 \)). The year-over-year percent reduction in opioid prescribing was 27% in 2016 and 21% in 2017, with the most drastic reduction being 83% in 2018, the year after the structured education. In the calendar year after the education, 13 of 117 (8.5%) patients were discharged with an opioid prescription after kidney transplant.

When patients did require an opioid prescription at discharge, acetaminophen (APAP)/hydrocodone (89.8%) was most observed pre-education, whereas tramadol (53.9%) was most prescribed post-education. Overall, the type of opioid prescribed on discharge differed significantly between the pre- and post-education groups (\( P < 0.001 \)). This was driven by the reduction in the incidence of patients being discharged with APAP/hydrocodone (pre 89.8% vs post 46.2%, \( P < .000001 \)). In addition, the posteducation group had a significantly

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**FIGURE 2** Percentage of kidney transplant recipients discharged with opioid prescription before and after opioid stewardship education

**FIGURE 3** Percentage of kidney transplant recipients discharged with opioid prescription by calendar year
Results

Abbreviation: APAP, acetaminophen.

to 3-day supplies, inpatient opioids could not be ordered PRN for mild
treatment settings. Default quantities for opioid prescriptions were reduced
by 83% year-over-year reduction in this study, after kidney
transplant is feasible with the proper staff collaboration and education
and death. Efforts to reduce opioid exposure in this population have
been described by Rohan and colleagues and Schwab and colleagues
with varying interventions described and varying degrees of success
reported when it comes to discharge prescribing patterns.6,15

Our study demonstrates that a dramatic reduction in opioid pre-
scribing, an 83% year-over-year reduction in this study, after kidney
transplant is feasible with the proper staff collaboration and education
alongside an opioid minimization protocol with nonopioid alternatives.

Because of intravenous acetaminophen or other multimodal analgesia, it is
important to consider that these strategies have the potential to
shorten LOS which could reduce costs of hospitalization.

While other opioid minimization studies have included multi-
disciplinary patient education as an intervention, our study is unique as
it is the only study that directly describes the impact pharmacist-led
nursing education has on a reduction in opioid prescribing.6 This study
illustrates successful multidisciplinary collaboration between transplant
pharmacy and nursing and the direct impact it can have on improving
patient care and outcomes. To date, this is the largest experience
describing opioid prescription reduction in the post-transplant setting.

However, there are limitations that exist within the context of
this analysis. This study is a retrospective cohort study that assessed
trends in opioid prescribing; in this way, it is difficult to isolate the
true impact of nursing education on the practice changes observed at
our institution in the setting of other system-wide initiatives. How-
ever, this was the only means to assess this intervention within the

| Variable                                              | Overall (n = 376) | Pre (n = 259) | Post (n = 117) | P-value |
|-------------------------------------------------------|------------------|--------------|---------------|---------|
| Opioid prescription on discharge, n (%)               | 190 (50.5)       | 177 (68.3)   | 13 (11.1)     | <.001   |
| Type of opioid on discharge, n (%)                    |                  |              |               |         |
| Hydrocodone/APAP                                      | 165 (86.8)       | 159 (89.8)   | 6 (46.2)      | <.000001|
| Hydromorphone                                         | 1 (0.5)          | 1 (0.6)      | 0 (0)         | –       |
| Oxycodeone ± APAP                                     | 2 (1.1)          | 2 (1.1)      | 0 (0)         | –       |
| Tramadol                                              | 20 (10.5)        | 13 (7.3)     | 7 (53.8)      | .699    |
| Codeine/APAP                                          | 1 (0.5)          | 1 (0.6)      | 0 (0)         | –       |
| Other                                                  | 1 (0.5)          | 1 (0.6)      | 0 (0)         | –       |
| Length of stay, days (IQR)                            | 5 (4–8)          | 6 (5–8)      | 5 (4–7)       | .033    |

*Pre-education: January 1, 2015 to October 15, 2017.
*Post-education: October 16, 2017 to October 30, 2018.

Abbreviation: APAP, acetaminophen.

4 | DISCUSSION

In the kidney transplant population, chronic opioid use before and
after transplantation has been linked with worse outcomes.8,12,14
These outcomes include increased readmission rates, higher hospitali-
azation costs, delayed graft function, and increased risk of graft loss
and death. Efforts to reduce opioid exposure in this population have
been described by Rohan and colleagues and Schwab and colleagues
with varying interventions described and varying degrees of success
reported when it comes to discharge prescribing patterns.6,15

Our study demonstrates that a dramatic reduction in opioid pre-
scribing, an 83% year-over-year reduction in this study, after kidney
transplant is feasible with the proper staff collaboration and education
alongside an opioid minimization protocol with nonopioid alternatives.

Before and during the study period, there were aforementioned opi-
oid minimization efforts taking place within the kidney donor popula-
tion. Moreover, hospital-wide changes affecting inpatient and
outpatient opioid prescribing within the electronic ordering system
were also underway. For example, the medication safety department
made changes within the electronic medication order entry system to
courage appropriate opioid prescribing in the inpatient and outpa-
tient settings. Default quantities for opioid prescriptions were reduced
to 3-day supplies, inpatient opioids could not be ordered PRN for mild
pain but only for moderate or severe pain, and inpatient opioid default
doses and frequencies were decreased for more appropriate prescribing.

These combined efforts had definite impact as indicated by the sig-
nificant reduction in opioid prescribing from 2015 to 2017 within our
transplant population. However, when breaking down the study period
on an annual basis, we see that while these efforts did yield some benefit
in reducing opioid prescribing on discharge, it was not until the multi-
disciplinary engagement that the true benefit was realized, with the most
notable difference occurring from 2017 to 2018 after the nursing educa-
tion initiative. At that time, the percent of patients being discharged with
an opioid after kidney transplant decreased from 49.6% to 8.5%.

Similar to results after opioid minimization within our kidney
donor population, the posteducation group in this study had a signifi-
cantly shorter LOS compared with the pre-education group.16-18

TABLE 3 Results

| Variable                                      | Overall (n = 376) | Pre (n = 259) | Post (n = 117) | P-value |
|-----------------------------------------------|------------------|--------------|---------------|---------|
| Opioid prescription on discharge, n (%)       | 190 (50.5)       | 177 (68.3)   | 13 (11.1)     | <.001   |
| Type of opioid on discharge, n (%)            |                  |              |               |         |
| Hydrocodone/APAP                              | 165 (86.8)       | 159 (89.8)   | 6 (46.2)      | <.000001|
| Hydromorphone                                 | 1 (0.5)          | 1 (0.6)      | 0 (0)         | –       |
| Oxycodeone ± APAP                             | 2 (1.1)          | 2 (1.1)      | 0 (0)         | –       |
| Tramadol                                      | 20 (10.5)        | 13 (7.3)     | 7 (53.8)      | .699    |
| Codeine/APAP                                  | 1 (0.5)          | 1 (0.6)      | 0 (0)         | –       |
| Other                                         | 1 (0.5)          | 1 (0.6)      | 0 (0)         | –       |
| Length of stay, days (IQR)                    | 5 (4–8)          | 6 (5–8)      | 5 (4–7)       | .033    |

*Pre-education: January 1, 2015 to October 15, 2017.
*Post-education: October 16, 2017 to October 30, 2018.

Abbreviation: APAP, acetaminophen.
program. The retrospective nature of this study also has the potential for human error during data collection. This study did not analyze preoperative opioid use. While preoperative opioid use data is not available to analyze, there were no changes at our center during this period regarding the pretransplant evaluation and listing process for patients on chronic opioids. Chronic pain conditions, inpatient opioid use, opioid prescriptions filled during outpatient follow-up, or re-admissions due to uncontrolled pain were not analyzed. These items, along with renal function, patient survival, and graft survival, are currently being assessed in the context of the evolving pain protocol within our institution, and plan to be described in future analyses.

In conclusion, multidisciplinary efforts to successfully reduce opioid prescribing on discharge are feasible and necessary for successful implementation of opioid minimization in the kidney transplant population. Nursing education and empowerment are vital components of this multidisciplinary effort and should be maximized within a given institution; clinical pharmacists are well-suited to lead these education efforts. Future studies are warranted to assess the impact of nursing staff education on perioperative pain medication utilization and patient perceptions of their postoperative pain control.

CONFLICT OF INTEREST
The authors have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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