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Nurses' Ability to Recognize and Prevent Opioid-Induced Respiratory Depression

An Evidenced-Based Practice Project

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Opioids are the primary therapy for acute postoperative pain, despite being associated with opioid-induced respiratory depression (OIRD). The purpose of this study was to improve nurses' knowledge, confidence, and ability to recognize, prevent, and treat OIRD in postoperative inpatients and evaluate the feasibility of using the Pasero Opioid-Induced Sedation Scale (POSS). Registered nurses completed three tools: (1) an Opioid Knowledge Self-Assessment, which was administered pre- and post-education; (2) a Confidence Scale, which was administered pre- and post-education; and (3) a POSS Perceptions and Usability Scale that was administered post-education. Nurses were educated on the POSS and then immediately following the training practiced by undertaking a patient assessment using the instrument. They then completed the POSS Perceptions and Usability Scale to rate their perception of the feasibility of using the POSS. Between preeducation and posteducation, participant knowledge increased in the following areas: recognizing opioid-induced side effects, dose selection, risk factors for oversedation, and information to make clinical decisions. However, there was a drop in scores when asked about knowledge of who is at risk for opioid-related side effects. These findings support our conclusion that OIRD education improves nursing confidence and knowledge. There was significant agreement between the nurse and subject matter experts POSS scores, indicating that this tool is easy to use.

Background

In 2012, The Joint Commission issued a Sentinel Event Alert warning hospitals that opioid analgesics are associated with adverse events, including respiratory depression (The Joint Commission, 2012). During the postoperative period, pain management is vital, as it is directly related to functional mobility, length of stay, and patient satisfaction (Dunwoody & Jungquist, 2018). Opioids have often been regarded as the primary therapy for acute postoperative pain, despite being associated with such adverse events as opioid-induced respiratory depression (OIRD) (Ramchandran et al., 2011). OIRD is the decrease in ventilation effectiveness after the administration of an opioid (Jarzyna et al., 2011). Orthopaedic patients are at risk of opioid-related adverse events, including OIRD, as the intensity and duration of pain commonly experienced from orthopaedic surgery often require postoperative pain management with opioids. OIRD is detrimental to patients and can increase cost, increase length of stay, and can cause permanent morbidity or mortality (Gupta et al., 2018; Jungquist et al., 2014). It is estimated that between

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0.003% and 4.2% of all hospitalized patients will experience an opioid-associated event (Dunwoody et al., 2018). These events can increase hospital length of stay by 55%, healthcare costs by 47%, 30-day readmission rates by 36%, and risk of inpatient mortality by 3.4 times the normal rate (Jungquist et al., 2017). However, opioid-associated adverse events, such as respiratory depression, are preventable (Durham et al., 2017). It has been demonstrated that sedation occurs along a continuum and is preceded by respiratory depression (Nisbet & Mooney-Cotter, 2009; Smith et al., 2014).

Assessment of OIRD

Evidence supports the importance of respiratory assessment and sedation assessment to prevent OIRD (Jungquist et al., 2017; Pasero, 2009); however, the frequency of the assessment should be individualized based upon the patient's risk for OIRD and the specific medications they are receiving (Jungquist et al., 2017). Linear sedation scales can aid in monitoring sedation but may not capture the full clinical spectrum of sedation and result in failure to recognize small changes in cognition (Dunwoody & Jungquist, 2018). Preventing OIRD requires a nuanced assessment that balances the need for pain management with the potential for oversedation (Dunwoody et al., 2018), confirming that a systematic assessment is necessary.

Factors Associated With OIRD

Specific patient populations are at an elevated risk of experiencing an opioid-associated adverse event such as OIRD. Patients with a history of cardiac disease, sleep apnea (Gupta et al., 2018; Ramchandran et al., 2011), respiratory disease (Gupta et al., 2018), and renal disease (Brant et al., 2018; Ramchandran et al., 2011) or sensitivity to the effects of opioids (Ramchandran et al., 2011) are at an elevated risk for experiencing OIRD. Patients who receive long-acting opioids and patients who receive opioids and benzodiazepines administered concurrently are more likely to experience oversedation (Brant et al., 2018; Gupta et al., 2018).

Sedation Assessment

Although the Richmond Agitation Sedation Scale (RASS) is an accurate assessment tool for sedation, it is not the appropriate tool for assessment of a patient who has been taking opioids. The RASS was developed for use in the intensive care unit during purposeful sedation (Durham et al., 2017). Whereas, the Pasero Opioid-Induced Sedation Scale (POSS) was designed specifically for monitoring sedation during opioid administration (Nisbet & Mooney Cotter, 2009). Currently, the POSS is the most commonly utilized scale for monitoring sedation during opioid administration (Dunwoody et al., 2018).

Various sedation scales have been evaluated in comparison to the POSS, including the RASS; as a result, the POSS has been recommended for monitoring sedation during opioid administration (Hall & Stanley, 2018; Nisbet & Mooney-Cotter, 2009). Both the RASS and the POSS displayed sufficient reliability and validity; however, the POSS scored higher in ease of use, nursing confidence, and information provided upon which to make clinical decisions (Nisbet & Mooney-Cotter, 2009). As such, the POSS has been recommended for use, as it is effective in assessing sedation and increases nurse confidence in administering opioid medication to meet pain needs while avoiding oversedation. (Hall & Stanley, 2018).

At our facility, a 660-bed teaching hospital in an upper Midwest metro area, the absence of a standardized policy or protocol for monitoring sedation during opioid administration was a significant practice gap. The RASS is intended for sedation assessment and this assessment is the default documentation tool on the pain assessment flowsheet in the electronic medical record (EMR). Although nurses are not required to document a RASS score during opioid medication administration, the EMR automatically prompts the nurse to record a value. However, nurses often record the RASS scores inconsistently and inaccurately.

Educational Interventions

Although variation exists in the literature as to how staff educational interventions are implemented, educational interventions have been demonstrated to be effective at increasing nurses' knowledge of OIRD. Educational methods documented in the literature include didactic sessions conducted at staff meetings or with online modules, use of informational flyers and pocket cards, and bedside practice demonstration (Ramoo et al., 2015, 2016; Smith et al., 2014). Each of these education interventions achieved positive outcomes. Following interventions delivered through multiple formats, nurses were better able to identify patients at risk for opioid-related oversedation and had a better understanding of the instrument the facility was using to assess for opioid-associated oversedation (Smith et al., 2014). The results from one study indicated a combined approach of didactic education followed by practice was effective at increasing confidence levels despite low accuracy in sedation scoring. However, median scores for overall accurate sedation scoring and sedation management were significantly higher at 9 months (compared to 3 months) post-intervention (Ramoo et al., 2015).

Purpose

This evidence-based project used a before-and-after design to determine whether nurses' knowledge and confidence improved in preventing, recognizing, and treating OIRD for patients on an inpatient orthopaedic unit. Two clinical questions were posed. The primary question was: For nurses, who administer opioid medications to postoperative inpatients, how does education on OIRD affect their level of knowledge and self-confidence in determining risk of OIRD compared to their knowledge and self-confidence prior to education? A secondary question was: Do these nurses perceive the POSS instrument as beneficial in recognizing OIRD?

Methods

This project was part of an interprofessional evidence-based clinical scholar program conducted as a collaboration between a practice organization and a university. A team of subject matter experts, including pain management bedside nurses and providers, university faculty, doctor of nursing practice students, and other providers, collaborated on the project. The institutional review board at the practice site and the university determined that the project was not human subject research.

Sample Identification

The sample consisted of registered nurses (RNs) who administer opioid medications to postoperative inpatients on a 30-bed orthopaedic unit in a 660-bed teaching hospital in a metropolitan area in the upper Midwest.

Intervention: Opioid Education Program

Didactic and practice sessions were designed to last approximately 20 minutes. Initially, 20, 1-hour education events were scheduled over a 2-week period in the orthopaedic unit's conference room. It was immediately apparent that it would be challenging to educate a group of nurses together in a structured setting. Nurses were willing to participate during their shifts as time allowed; however they were frequently pulled back into patient care duties during the education period. During the already scheduled periods, by shifting the method from teaching in a group setting to individually approaching and educating nurses using an "at the elbow" model of educating in smaller groups of one to three nurses, we were able to accommodate the nurses' availability. Education sessions began with the administration of the Opioid Knowledge Self-Assessment and the Confidence Scale. Subject matter experts presented the educational content using a didactic approach and case study discussions. Table 1 lists the content included in the education program. Participants then learned about the POSS, followed by application by conducting a patient assessment using the instrument (see Supplemental Digital Content Graphic 1, available at: http://links.lww.com/ONJ/A17). A goal of educating 55 nurses was identified to achieve a statistically significant number of participants. This goal was accomplished within the scheduled 2-week period.

Outcome Measures

Three outcomes were identified for this project: 1) OIRD knowledge, (2) confidence, and (3) POSS perceptions and usability.

OIRD Knowledge

The Opioid Knowledge Self-Assessment, developed as part of a collaboration between the Pennsylvania Patient Safety Authority (2013) and the Pennsylvania Medical

Table 1. Opioid-Induced Respiratory Depression Education Program Content

Age	Older age may lead to decreased metabolism of opioids Younger patients may have less coping skills (related to limited life experience)
Sedation level	Difference between sleepy, drowsy, somnolent *Sleepy*: Respiratory rate is normal. Can awaken without much effort. *Drowsy*: Struggling to stay alert during active conversation or therapy/active teaching. May be intermittent or persistent. Respiratory rate may be satisfactory. *Somnolent*: Minimal or no response to verbal or physical stimulation. May need respiratory support and close monitoring until more alert.
Respiratory status	Chronic obstructive pulmonary disease (COPD), obstructive sleep apnea (OSA), underlying pulmonary condition increases risk of adverse events Opioids produce risk for all patients to have a respiratory event
Functional status	Consider baseline level of function with goal to return to baseline Painful activities may indicate need for increased pain management
Tolerance	The longer patients have been on opioids and the higher the dose, the more likely that they will have diminished analgesic effect from opioids Tolerance does not provide protection from adverse events Think about equianalgesic doses Definition of opioid-naïve and tolerant
Drug–drug interactions	Be mindful of the effects of combining treatments that cause sedation Using more than one medication with the potential for sleepiness increases the risk of oversedation or adverse events
Reaction or response to prior opioid treatment	Ask what has happened with past experiences What happened in the past is likely to happen again
Physical and psychiatric comorbidities	Medical comorbidities may influence drug metabolism Psychiatric comorbidities may influence pain perception Rely on your pharmacist for drug–drug interactions
Gastrointestinal and genitourinary status	Opioids affect bowel function by causing decreased motility Nausea and vomiting can be an opioid-related side effect Opioids can decrease the ability to void
Cardiovascular status	Opioids can contribute to hypotension

Society, was selected to measure OIRD knowledge. This assessment tool contains 11 multiple-choice questions that evaluate knowledge of selection, dosing, and patient monitoring when using opioid products. The questions cover the following topics: identifying differences between "opioid-naïve" and "opioid-tolerant" patients, indications for long-acting opioids, comparative dosing between two different opioids, patient-specific conditions that require a lower starting dose of opioids, impact of concomitant medications in combination with opioids, and monitoring the effects of opioids. Scoring was based on the number of correct responses. The knowledge test was scored based on the number correct over the total number of knowledge questions, which produced a ratio. The Opioid Knowledge Self-Assessment was completed by the nurses prior to education and immediately post-education.

Confidence

The Confidence Scale was used to measure nurses' confidence in assessing levels of sedation; it consisted of a 5-point Likert scale and was developed specifically for this project. Five statements to measure confidence were presented; each represented confidence in regard to a different trait. These traits included recognizing opioid-induced side effects, selection of opioid dose, identifying a patient at risk for oversedation, clinical decision-making, and overall confidence. Nurses were asked to respond by indicating their level of agreement with each statement. The 5 points on the Likert scale were Strongly Agree, Agree, Neutral, Disagree, or Strongly Disagree. Responses were categorized according to reported answers. The confidence scale questions were scored based on the mean of the ordinal responses, which produced interval data. Answers were collected prior to education and immediately post-education.

POSS Perceptions and Usability

Participants recorded a POSS score for the patient they assessed and rated their perception of the feasibility of using the POSS instrument in the clinical setting. To determine the POSS score, each nurse assigned a score to a patient—working side-by-side with a subject matter expert who was also determining the POSS score on the same patient. Score options were S (sleeping), 1–4 (level of sedation); 1 is the least sedated and 4 is the most sedated. Each nurse's score was compared with that of the subject matter expert. Nurses were then asked to assess the POSS instrument. This assessment measured the nurses' perception of the feasibility of using the POSS instrument in the clinical setting; it consisted of a 5-point Likert scale developed specifically for this project. Five statements to measure nurses' perception and usability of the POSS instrument included recognizing appropriate interventions for patients receiving opioids, improving safety, ease of use, benefit to practice, and agreement with recommended intervention of the POSS instrument. Nurses were asked to respond by indicating their level of agreement with each statement. The 5 points on the Likert scale were Strongly Agree, Agree, Neutral, Disagree, or Strongly Disagree. Responses were collected immediately post-assessment and were categorized according to reported answers.

Demographic Data

Demographic data collected included age, years of experience as an RN, and years of experience working with acute postoperative patients. The demographic survey was completed once at the beginning of the education session.

Data Management Process

No identifying data were attached to the data collected. Analysis took place after the education sessions had been completed.

Data Analysis

Descriptive statistics of participating nurses (i.e., age, years of experience as an RN, and years of experience working with acute postoperative patients) were compiled. Data obtained from nursing confidence and OIRD knowledge testing were described using means and standard deviations. Data were explored for outliers, using box plots, and examined for normality.

The analysis of staff nurses' perceptions of the use of the POSS instrument in actual practice included a question-by-question analysis because of the lack of a summary score and involved descriptive analysis, using medians and modes. A Cohen-κ was used to determine whether significant agreement occurred between the staff nurse and the subject matter expert with scoring the POSS instrument.

Results

Demographic Data

Fifty-five nurses completed education packets and questionnaires (see Table 2). The majority of nurses were younger than 30 years and had less than 5 years of RN experience. The next largest group had 5–9 years of RN experience.

Table 2. Demographic Data

Age (year)	Number (n = 55)	Percentage
20–29	24	44%
30–39	10	18%
40–49	13	24%
50–59	6	11%
≥60	2	4%
RN experience (year)		
<5	27	49%
5–9	10	18%
10–14	4	7%
15–19	4	7%
≥20	10	18%
Postoperative RN experience (year)		
<5	31	56%
5–9	10	18%
10–14	3	6%
15–19	3	6%
≥20	8	15%

Table 3. Opioid-Induced Respiratory Depression Knowledge

	Range of Total Correct Responses (0–11)	Mean Score
Pretest	2–11	6.73
Posttest	3–11	8.27

OIRD Knowledge

Opioid Knowledge Self-Assessment pretest scores, used to evaluate OIRD knowledge before education, ranged from 2 to 11 items correctly answered on the 11-item test. Posteducation results ranged from 3 to 11 questions correct (see Table 3); posttest results were not normally distributed (see Figure 1). A statistically significant increase in the nurses' knowledge of OIRD was observed following the education using a Wilcoxon signed rank test when comparing the total cumulative scores on both the pre- and posttests ($z = 4.726$, $p < .005$).

Nursing Confidence

A Wilcoxon signed rank test was utilized to analyze nurse confidence in assessing level of sedation based on their selected level of agreement with each of the five statements. This was used to measure confidence in regard to recognizing opioid-induced side effects, selection of opioid dose, identifying a patient at risk for oversedation, clinical decision-making, and overall confidence. A statistically significant increase in the nurse level of confidence in the areas of recognizing opioid-induced side effects, selecting appropriate doses based on patient condition, ability to identify a patient at risk for oversedation when administering opioids, and having adequate information to make solid clinical decisions occurred between the pretest and posttest (see Table 4). There was not a statistically significant increase in the nurse confidence in relation to feeling they had enough knowledge to understand who is at risk for opioid-related side effects between the pretest and posttest measurements (see Figure 2).

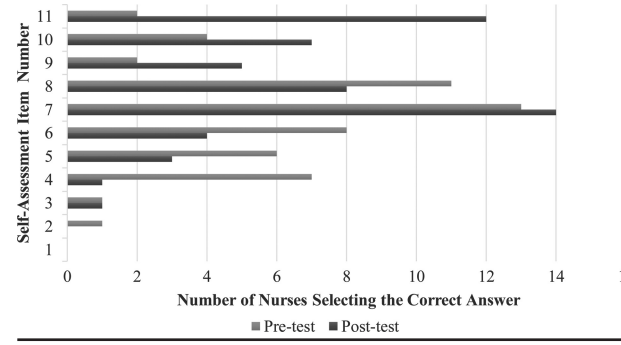

Figure 1. Opioid-induced respiratory depression (OIRD) knowledge testing. The Opioid Knowledge Self-Assessment was selected to measure OIRD knowledge. This assessment tool contains 11 multiple-choice questions that evaluate knowledge of selection, dosing, and patient monitoring when using opioid products. The knowledge test was scored based on the number correct over the total number of knowledge questions, which produced a ratio. For example, Figure 1 shows that two nurses correctly answered item #11 on the pretest and 12 nurses correctly answered item #11 on the posttest. For question 1, there were no correct answers on the pre- or posttest. For question 2, there were no correct answers on the posttest.

POSS Perceptions and Usability

Nurses overwhelmingly rated that they strongly agreed or agreed that the POSS instrument identified appropriate interventions for patients receiving opioids, that the POSS instrument supported safe practice, and the instrument was beneficial and easy to use. Additionally, they strongly agreed or agreed with the interventions as recommended by the POSS instrument (see Table 5).

A Cohen-κ analysis indicated there was significant agreement between the staff nurse POSS scores and the scores of the subject matter expert ($\kappa = 0.909$, $p < .0005$). As can be seen in Figure 3, there was no significant difference between the scores recorded by the nurses and the scores recorded by the subject matter experts.

Table 4. Nursing Confidence

Trait Measured	Preeducation Score	Posteducation Score	*z* Value	*p* Value
Side effects[a]	56	61	2.789	.005
Dose selection[b]	48	63	2.615	.009
Risk identification[c]	48	65	3.545	.005
Clinical decisions[d]	47	62	3.535	.005
Overall confidence[e]	46	33	NA	NA

Note. NA = not available.
[a]I feel confident in recognizing opioid-induced side effects.
[b]I feel confident selecting appropriate doses based on patient condition.
[c]I am able to identify a patient at risk for oversedation when administering opioids.
[d]I have adequate information to make solid clinical decisions.
[e]I do not feel I have enough knowledge to understand who is at risk for opioid-related side effects.

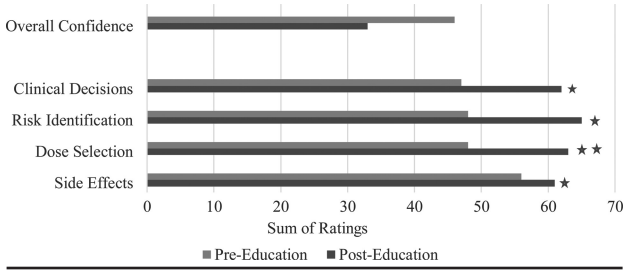

Figure 2. Nurses' confidence in assessing level of sedation. This 5-point Likert scale measured nurses' confidence in assessing levels of sedation. $^{*}p$ value = .005; $^{**}p$ value = .009.

Discussion

This evidence-based project evaluated the effect of education on nurses' knowledge and confidence in preventing, recognizing, and treating OIRD for patients on an inpatient orthopaedic unit. A comparison of the preeducation and posteducation responses indicated that nurse knowledge significantly increased in regard to recognizing opioid-induced side effects, selecting appropriate doses based on patient condition, ability to identify a patient at risk for oversedation when administering opioids, and having adequate information to make solid clinical decisions. However, confidence level in relation to feeling they had enough knowledge to understand who is at risk for opioid-related side effects decreased. This would suggest that although nurses felt confident in their abilities, there may have been an inflated initial perception of confidence. It is also possible that following the education the nurses became increasingly aware of areas where their knowledge had previously been deficient and as a result were feeling less confident in this area. Additional follow-up evaluation of knowledge and confidence was not provided in this project. An area for future research would be the effect different levels of education have on perception of knowledge and confidence; we did not measure the highest level of education that the nurses surveyed had completed and did not ask them to identify whether they were baccalaureate-prepared nurses.

The nurses' perception that the POSS instrument was easily used and supportive of their practice, along with the significant agreement in the nurses' and the subject matter experts' assessment using the POSS Perceptions and Usability Scale, suggests that the instrument is easy to understand and may be utilized after a relatively brief orientation. The benefit of the POSS instrument is the focus on preventing frequent drowsiness, or somnolence in patients to whom opioids are administered to treat pain. If nurses feel that they can safely employ aggressive pain management with opioids, there is a potential for an increase in the advancement of postoperative patient activity and function with a corresponding decrease in OIRD. Further evaluation of the POSS instrument could include analysis of length of stay and reduction in opioid-related adverse events. The POSS instrument could potentially be studied as an instrument to help guide analgesic selection and titration.

In agreement with existing research, we appreciated an increase in nursing confidence in four out of five trait areas after education on OIRD. Ongoing nursing education on OIRD is recommended, as this leads to increased nursing confidence and knowledge. Improvement in a nurse's skill in identifying patients at risk for opioid-related oversedation and the application of validated assessment instruments can result in improved patient care. In our study, the POSS instrument scored well on the POSS Perceptions and Usability Scale, supporting existing research that it is effective for assessing sedation and is recommended to increase nurses' confidence.

As a result of this research project, the process of changing hospital policies and nursing practice related to the assessment of patients receiving opioid medications to incorporate the POSS instrument had begun at a hospital system level. Initial efforts were paused due to limited resources during the COVID pandemic. Based on the initial support and endorsement received from stakeholders in the hospital system when presented with this research, the work to incorporate use of the POSS instrument as standard practice will hopefully continue in the future.

Table 5. Nursing Perception of POSS Instrument

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Intervention Identification[a]	1			25	25
Practice safer[b]			3	29	20
Easy to use[c]			2	26	24
Beneficial[d]			2	24	26
Intervention agreement[e]			1	29	22

Note. POSS = Pasero Opioid-Induced Sedation Scale.
[a]I can use the POSS tool to identify appropriate interventions for patients receiving opioids.
[b]The POSS tool makes my practice safer.
[c]The POSS tool is difficult to use.
[d]The POSS tool is beneficial to patient care.
[e]I *do not* agree with the interventions recommended by the POSS tool.

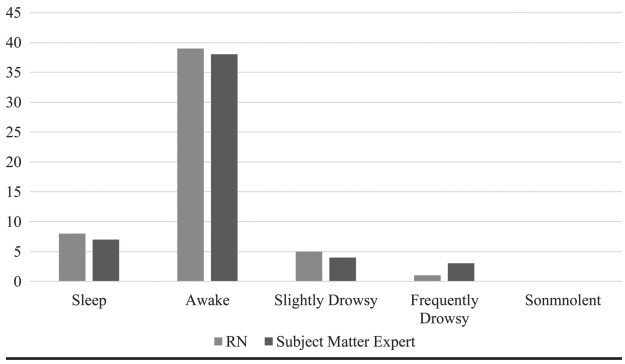

FIGURE 3. RN and subject matter expert Pasero Opioid-Induced Sedation Scale ratings.

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