RESULTS OF THE 2013-2014 OPIOID KNOWLEDGE ASSESSMENT: PROGRESS SEEN, BUT ROOM FOR IMPROVEMENT

INTRODUCTION*

Published studies have examined errors related to knowledge deficiencies regarding the use of opioids.1,2 In 2012, prompted by the literature and as part of the Centers for Medicare and Medicaid Services-sponsored Pennsylvania Hospital Engagement Network (PA-HEN) adverse drug event (ADE) project, the Pennsylvania Patient Safety Authority partnered with the Pennsylvania Medical Society to develop an opioid knowledge assessment tool to assess practitioners’ knowledge about the use of opioids.3 The questions covered issues associated with the use of opioids, including differences between opioid-naive and opioid-tolerant patients, indications for long-acting opioids, and patient-specific conditions that require a lower starting dose of opioids.

The results of the 2012 knowledge assessment identified basic knowledge gaps by practitioners, particularly in the areas of identifying the predictors of respiratory depression in patients receiving intravenous (IV) opioids, defining what constitutes an opioid-tolerant patient, and choosing medications that could potentiate the effects of an opioid with respect to a patient’s ventilation. The Authority published the results of the 2012 assessment in the March 2013 issue of the Pennsylvania Patient Safety Advisory.3

METHODS

In the winter of 2013-2014, the collaboration team distributed the assessment tool developed and used in 2012 for the first round of the opioid knowledge assessment to the 12 hospitals currently participating in the collaboration that also participated in the assessment in 2012. The tool was developed to assess prescribers’, pharmacists’, and nurses’ knowledge about the use of opioids. The assessment consisted of two demographic questions—the practitioner’s position and how long he or she has worked in the facility—followed by 11 multiple-choice assessment questions. The questions covered a variety of problematic issues associated with the use of opioids, including the following:

- Differences between “opioid naïve” and “opioid tolerant,” and what constitutes or makes a patient “opioid tolerant”
- Indications for long-acting opioids (who and/or when they should be prescribed)
- Comparative dosing between two different opioids, particularly morphine and HYDROMORPHINE
- Patient-specific conditions that require a lower starting dose of opioids
- The impact of concomitant medications in combination with opioids
- Monitoring the effects of opioids

The multiple-choice assessment was built and conducted in a web-based survey tool, which was distributed by e-mail. Users were required to enter an organization-specific four-digit code to associate results with specific facilities. No practitioner identifiers were collected in either assessment. A paper version was also used by organizations to capture responses from practitioners who were unable to respond online.

This tool was released on September 27, 2013, and the last day of data submission was March 13, 2014. A listing of the assessment questions can be found in the Opioid Knowledge Self-Assessment, which is available for use at http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/opioids/Pages/home.aspx.

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RESULTS

Participating Hospitals
In 2012, there were 29 hospitals participating in the PA-HEN ADE collaboration. Twenty-four of those hospitals participated in the 2012 opioid knowledge assessment. In 2013-2014, there were 22 hospitals, some of which were new to the collaboration beginning in 2014, participating in the PA-HEN ADE collaboration. In order to compare results between 2012 and 2013-2014, only those organizations (n = 12) that participated in the 2012 assessment were invited to participate in 2013-2014. Ten (83.3%) collaborating hospitals participated in both the 2012 and 2013-2014 opioid knowledge assessments.

Practitioner Characteristics
Practitioners, including physicians, medical residents, physician assistants, nurse practitioners, pharmacists, and nurses, from the 10 hospitals that signed up for the collaboration participated in the 2013-2014 assessment. In 2012, 2,223 practitioners started the survey, but only 1,758 (79%) completed it. In 2013-2014, 1,122 practitioners started the survey, but only 829 (74%) completed it. A chi-square test comparison of these completion rates found that this difference in completion rates, though small, is statistically significant (p < 0.001).

Similar to the results from 2012, more registered nurses (62%) completed the opioid knowledge assessment than any other type of practitioner (see the Table). A chi-square test for independence found statistical significance in the types of practitioners who participated in 2012 versus 2013-2014 (p < 0.001). Respondents in 2012 achieved slightly higher levels of prior education than respondents in 2013-2014. Thus, a comparison of overall opioid knowledge scores could be biased in favor of the 2012 respondents. The length of time a practitioner had worked at his or her current facility was also assessed. Respondents could choose one of the following selections: fewer than 5 years, 5 to 9 years, 10 to 14 years, 15 to 19 years, or 20 or more years. More respondents had worked in their current facility for less than five years than other lengths of time. Overall, there was no statistically significant difference in the duration of time working at the current facility between 2012 and 2013-2014.

Overall Scores
For this analysis, comparisons were made between the overall number of questions answered correctly in 2012 and 2013-2014 (see Figure 1). Only those respondents who answered all 11 questions were included. In 2012, the median correct score was 6 of 11 questions, and the average was 6.5, with a standard deviation of 1.9. In 2013-2014, the median correct score was 7 of 11 questions, and the average was 7.0, with a standard deviation of 2.1. A comparison of these overall scores found that the average score was statistically significantly higher in 2013-2014 than 2012 (p < 0.001). However, the improvement of 0.5 more questions answered correctly in 2013-2014, on average, is small. The percentage of people who answered all 11 questions correctly increased from 1.6% in 2012 to 8.9% in 2013-2014; this difference was statistically reliable using the chi-square test (X^2[2] = 80.0, p < 0.001).

Analysts also compared the overall scores from 2012 with those from 2013-2014 separately for each practitioner type. There was statistically significant improvement for three groups: (1) attending/staff physicians (p < 0.001), (2) physician assistants/nurse practitioners (p = 0.02), and (3) registered nurses (p < 0.001). The other three groups, resident physicians/pharmacists in training, pharmacists, and “other or missing,” showed improvement from 2012 to 2013-2014, but the improvement was not statistically significant.

Individual Questions
The percentage of correct answers for each question from each round of the opioid knowledge assessment can be seen in Figure 2. There was improvement from 2012 to 2013-2014 in 10 of the 11 questions. For questions 1, 2, 4, 5, 6, 7, and 8, the improvement was statistically significant. The largest improvements were seen in questions 1, 2, 7, and 8. The percentage of correct answers for question 10, a case-based question assessing the respondents’ knowledge of adjusting the pain medication regimen based upon patient response, declined in 2013-2014.

Similar to the results from 2012, the three lowest-scoring assessment items in 2013-2014 were identifying the most important predictor of respiratory depression in patients receiving IV opioids, defining what constitutes an opioid-tolerant patient, and choosing which medication could potentiate the effects of HYDROMORPHINE on ventilation.
Predictor of Opioid-Induced Respiratory Depression

Opioid-induced respiratory depression can be defined as a decrease in the effectiveness of an individual’s ventilatory function after opioid administration. Sedation generally precedes significant respiratory depression. Opioid-induced sedation occurs on a continuum ranging from full consciousness to complete loss of consciousness and respiratory arrest. Unintended advancement of sedation occurs at increasingly higher levels along the continuum of sedation, impairing both arousal mechanisms and content processing.

Question 2 of the assessment asked respondents to select the most important predictor of respiratory depression in patients receiving IV opioids. Overall, the percentage of respondents (of those who completed the entire knowledge assessment) answering the question correctly increased from 24% in 2012 to 37% in 2013-2014 (p < 0.001). While an improvement from a quarter to over a third of respondents answering the question correctly is significant, it still means that 63% of the respondents were unable to accurately identify important predictors to increase the safe use of IV opioids.

Opioid Tolerance

The decision to use a potent and/or long-acting opioid and the selection of an appropriate medication is dependent upon an assessment of the patient’s opioid status. This means determining if the patient is either opioid naïve (i.e., the patient has not been chronically receiving opioids on a daily basis) or opioid tolerant (i.e., the patient has been chronically receiving opioids on a daily basis for a specified amount of time) before prescribing, dispensing, or administering an opioid.

Question 1 of the assessment asked respondents to select which treatment regimen would meet the definition of opioid tolerance. Only one of the four treatment regimens was correct. Overall, the percentage of respondents (of those who completed the entire knowledge assessment) answering the question correctly increased from 29% in 2012 to 37% in 2013-2014 (p < 0.001). However, this leaves 63% of respondents who selected regimens that would have indicated the patient was opioid naïve.

Note: A t-test comparison of the overall scores found that the average score was statistically significantly higher in 2013-2014 than 2012 (t [2,585] = 6.8, p < 0.001). A Wilcoxon test found the same thing (p < 0.001).
Medications That Potentiate the Effects of Opioids on Ventilation

Patients with sleep apnea or those who are morbidly obese are at increased risk for experiencing adverse events from the use of opioids. Patients who are concurrently receiving other medications that are central nervous system or respiratory depressants (e.g., benzodiazepines, antihistamines, diphenhydramine, sedatives) are also at higher risk of adverse events.9,10 Question 9 of the knowledge assessment was designed to measure practitioners’ ability to identify which medications (i.e., atorvastatin, FLUoxetine, ALPRAZolam, atorvastatin and ALPRAZolam, or FLUoxetine and ALPRAZolam) could potentiate the effects of HYDROMorphone on ventilation. Overall, the percentage of respondents (of those who completed the entire knowledge assessment) answering the question correctly increased from 51% in 2012 to 55% in 2013-2014. However, the improvement was not statistically significant (p < 0.13).
Adjusting the Treatment Regimen in Response to the Patient’s Pain

Minimizing the risk of adverse effects from the use of opioids is important. However, effectively managing and treating a patient’s pain is also important. Effectively monitoring a patient’s response to opioids and appropriately adjusting therapy contributes to both safe and effective pain management. Question 10 of the knowledge assessment asked practitioners to select the most appropriate treatment plan for a patient who continued to have moderate to severe pain following the administration of IV HYDROmorphine 0.2 mg. Unlike the improvement seen in the percentage of correct answers for all of the other knowledge assessment questions, the percentage of correct answers overall for question 10 declined from 2012 (60% correct) to 2013-2014 (59% correct); however, this decline was not statistically significant.

DISCUSSION

It appears that improvement in current knowledge about the use of opioids did occur from 2012 to 2013-2014. Results of the 2013-2014 opioid knowledge assessment indicate there was improvement in overall scores for all practitioner types, with statistically significant improvements for (1) attending/staff physicians, (2) physician assistants/nurse practitioners, and (3) registered nurses. There were also statistically significant increases in the percentage of correct answers for 7 of the 11 questions. However, the degree of improvement from 2012 to 2013-2014 is small. Significant percentages of practitioners, between 15% and 63% for a given question, continue to have gaps in knowledge about opioids, particularly in the following areas:

- Identifying the most important predictor of respiratory depression in patients receiving IV opioids
- Defining what constitutes an opioid-tolerant patient
- Choosing which medication could potentiate the effects of HYDROMORPHINE on ventilation

The highest percentage of correct answers for any one question in 2013-2014 was 85% for question 8, which asked practitioners if a starting dose of 1 mg of HYDROMORPHINE for an opioid-naive 80-year-old patient was appropriate. This question also had the highest percentage of correct answers (77%) in 2012. In June 2011, the US Food and Drug Administration approved changes in the official prescribing information for HYDROMORPHINE. As a result, drug information compendia and databases were updated to reflect the new dosing information. It is likely that these higher-level systematic changes, beyond any educational efforts, contributed to this statistically significant improvement.

Causess of medication errors include breakdowns due to inadequate staff orientation, ongoing education, supervision, and competency validation.11 Examples of errors in part due to deficiencies in staff education and competency are inappropriate medication doses or errors in patient assessment and monitoring due to lack of knowledge about particular patient populations; medication errors by new or reassigned (“float”) staff who are required to perform unfamiliar tasks or give unfamiliar medications without proper orientation, education, or supervision; and errors with new medications given to patients without full knowledge of the preparation, dose, route, action, or effects to anticipate.11

Organizations often are under the belief that when errors occur, providing staff education is an effective stand-alone strategy in preventing medication errors. However, two meta-analyses of continuing medical education (CME) activities and interventions found that didactic and passive learning interventions appear to have little to no effect in changing physician performance or patient outcomes.12,13 CME activities that are interactive or use a mix of educational methods or interventions appear to effect change in physician knowledge and practice, but due to its nature, the change may wane over time.12,13 While knowledge is necessary in the delivery of safe and effective medical care, it is not sufficient by itself to effect change in practitioner behavior or patient outcomes.12 This is in part why strategies, such as education, that rely on individual performance will likely be ineffective when used alone in attempting to prevent errors.14

The intent of the opioid knowledge assessment was to assist organizations in identifying basic knowledge gaps by practitioners, which would hopefully spur organizations to address these gaps and possibly assess staff knowledge about other high-alert medications. In the course of the collaboration, each facility was responsible for providing education to address identified deficiencies, both collaboratively and facility-specific. Facilities indicated these educational efforts ranged from physician-specific programs to broader efforts for all staff. The ADE project team did not provide educational materials specific to the deficits identified from the assessment results to facilities, so the responsibility of developing and/ or providing any educational efforts or materials was up to each separate facility. This could have led to a nonstandardized approach to the education provided within facilities (e.g., type of material, staff included in educational efforts, method of providing education, monitoring that the education was successful), which may have limited the increases in selecting the correct answers in the 2013-2014 Opioid Knowledge Self-Assessment.

Although staff education alone is an insufficient approach to error reduction, it does play an important role when combined with system-based error reduction strategies.14 It is important that practitioners receive sufficient orientation to medication use and undergo baseline and annual competency evaluation of knowledge and skills related to safe medication practices,
including new medications, nonformulary medications, high-alert medications, and error prevention.12,14 Providing practitioners involved in medication use with ongoing education about medication error prevention and the safe use of drugs that have the greatest potential to cause harm if misused is also important.11 For example, organizations may consider providing staff with ongoing education about medication errors that have occurred within the organization and in other organizations, as well as strategies to prevent these errors. The use of active and interactive modalities in these educational activities, increasing the length of contact time, and continuing contact can contribute to a larger effect of the educational activities.13

In order to see greater improvement in practitioner knowledge of opioids, safe and appropriate use of opioids, and prevention of adverse events from opioids, the expansion (or in some cases the introduction) of extensive opioid and pain management education and training in medical, pharmacy, and nursing education programs and new-practitioner training will be necessary. However, to prevent harm with the use of opioids, a mix of high-leverage strategies (e.g., fail-safes, forcing functions, constraints, standardization), some of which are highlighted below, can be implemented in addition to education.

**Fail-Safes and Forcing Functions**

- Use smart infusion pumps (i.e., infusion pumps with dose error reduction software) with soft and hard stops enabled to alert the user to unsafe doses for continuous opioid infusions and patient-controlled analgesia (PCA) therapy.15
- Use oral syringes for administration of oral liquid products.16 To further reduce the risk of unintended administration of oral medications via the IV route, have pharmacy dispense all oral liquids that are not commercially available as unit dose product in an oral syringe.17,18

**Constraints**

- Limit the variety of opioids, concentrations of each opioid, and formulations of each opioid included on the hospital formulary.19
- Prescribing
  - Consider requiring prescribers to undergo a privileging process to verify proficiency with PCA pain management.19
  - Consider restricting fentaNYL PCA use to anesthesia or pain management team members only.20
  - Implement standard order sets for PCA therapy, with all sections completed, and limit verbal orders to dose changes.19
  - Take into consideration important information about the patient that could affect the prescribing of opioids (e.g., patient’s current medication profile for drugs with additive central nervous system or respiratory depressant side effects, age, renal function, total current opioid therapy).21
- Storage
  - Avoid storing concentrated oral forms of opioids in floor stock and automated dispensing cabinets (ADCs).15
  - Store only the smallest-size package, concentration, and dose of opioids in floor stock and ADCs.16
  - Store each medication in a separate, lock-lidded bin or drawer in the ADC to help prevent drug-selection errors. In the pharmacy, segregate prefilled syringes and vials of these drugs, especially if they contain the same concentration.22

**Standardization**

- Ensure current pain management protocols and guidelines for opioid use are available to guide prescribers, pharmacists, and nurses when opioids are prescribed, dispensed, administered, or monitored.23
- Implement a standardized pain scale(s) appropriate to the patient population to assess a patient’s level of comfort/pain.23
- Use standardized preprinted order forms and computerized prescriber order entry (CPOE) order sets to prescribe oral and parenteral opioids.21
- Standardize concentrations of parenteral opioid infusions for adult patients to a single concentration per drug, and use these in at least 90% of the cases.21
- Standardize concentrations of parenteral opioid infusions for pediatric patients (including neonates) to a single concentration per drug, and use these in at least 90% of the cases.24
- Standardize preprinted order forms and CPOE order sets used for PCA.23
- Establish protocols for reversal agents that can be administered without additional physician orders when warranted.24

**Redundancies**

- Implement an independent double check for all parenteral opioids that are compounded in the pharmacy.15
- At the point of administration, implement an independent double check with each new infusion bag, bottle, or syringe, as well as with changes in the rate of infusion of parenteral opioids.15,16
- At the point of administration, implement an independent double check with each new PCA infusion bag, bottle, or syringe, as well as with changes in the rate of PCA administration of parenteral opioids.15

**CONCLUSION**

The results of the 2013-2014 knowledge assessment illustrate that gaps in practitioners’ knowledge about opioids continue to exist. While education on statewide...
and local levels and in-facility staff training programs are necessary and can produce minor improvements in levels of knowledge, more needs to be done. Better incorporation of education about opioids in medical, pharmacy, and nursing school programs and new-practitioner training is needed. Also, the development of standardized approaches and protocols to pain management and monitoring can help institutionalize best practices regarding the use of opioids.

NOTES


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