



Results of the Opioid Knowledge Assessment from the PA Hospital Engagement Network Adverse Drug Event Collaboration

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ABSTRACT

There are many published studies and reported events that demonstrate potential gaps in the knowledge regarding the use of opioids. As a part of the Pennsylvania Hospital Engagement Network adverse drug event collaboration sponsored by the Centers for Medicare and Medicaid Services, an 11-question opioid knowledge assessment tool for participating hospitals was developed to assess their practitioners' current knowledge about the use of opioids. The questions covered a variety of issues associated with the use of opioids, including differences between opioid-naïve and opioid-tolerant patients, indications for long-acting opioids, and patient-specific conditions that require a lower starting dose of opioids. More than 1,700 individual practitioners completed the assessment. The lowest-scoring questions encompassed topics identifying the predictors of respiratory depression in patients receiving intravenous 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. Strategies that organizations may consider include assessing the organization's need for training based on the analysis of reported adverse events, near misses, outcome measures, staff observations, and knowledge assessments. This type of analysis may be helpful in identifying knowledge gaps and in developing improvement strategies to reduce medication errors associated with opioid use. (*Pa Patient Saf Advis* 2013 Mar; 10[1]:19-26.)



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INTRODUCTION

There are several published studies that have looked into errors related to knowledge deficiencies regarding the use of opioids. For example, analyzed data from the MEDMARX national medication error reporting database revealed 644 harmful opioid errors from 222 facilities.¹ Of these, 21% were opioid prescribing errors. Another study looked at opioid errors specifically in cancer pain patients.² The authors found that 70% of those with cancer pain had at least one incorrect opioid prescription—and in some cases, there were up to seven errors per patient. One of the common errors was the use of incorrect dosing intervals.

To describe the epidemiology of medication prescribing errors averted by pharmacists, the clinical staff pharmacists in a 700-bed academic medical center saved all orders that contained a prescribing error for a week in early 2002.³ Anti-infective agents, cardiovascular agents, and opioid analgesics accounted for 57% of the clinically significant prescribing errors.

In a pilot study to evaluate the hypotheses that there are differences in pediatric pain management knowledge across resident specialties and that questions in the form of multiple-choice items could detect such differences, fewer than 50% of respondents were able to correctly convert from one opioid to another (defined as opioid equianalgesia).⁴ In addition, 46% of residents who correctly converted from one opioid to another were anesthesiology residents. The authors concluded that this revealed a real knowledge deficit among pediatric and orthopedic residents in opioid equianalgesia.

Based on these findings, and as a part of the Centers for Medicare and Medicaid Services (CMS) Partnership for Patients, the Pennsylvania Hospital Engagement Network's (HEN) adverse drug event collaboration focuses on problems with the use of opioids. As part of the opioid collaboration, the analysts decided to develop an opioid knowledge assessment tool for participating hospitals to assess their practitioners' current baseline knowledge on problematic issues with the use of opioids.

Medication Errors

Opioid drugs are a necessary component of pain management for many patients. When used inappropriately, or in error, they present serious risks that can lead to patient harm. An opioid, morphine, was one of six medications or medication classes on the first Institute for Safe Medication Practices (ISMP) list of high-alert medications published in 1989.⁵ High-alert medications are defined as drugs that bear a heightened risk of causing significant patient harm when they are used in error.⁶ The current ISMP's *List of High-Alert Medications* for acute care hospitals includes opioids as one of 22 high-alert drugs or drug classes.

Errors with opioids have led to serious adverse events, ranging from allergic reactions, failure to control pain, oversedation, respiratory depression, seizures, and death. According to data from the United States Pharmacopeia MEDMARX program, opioids, particularly morphine and HYDROMORPHONE, are still among the most frequent high-alert medications to cause patient harm.⁷ In 2004, among medication error events reported to the Pennsylvania Patient Safety Authority's Pennsylvania Patient Safety Reporting System (PA-PSRS), approximately one out of four reports involved high-alert medications. Of those reports, 44% involved opioids, including morphine, HYDROMORPHONE (Dilaudid®), meperidine (Demerol®), and fentaNYL.⁸



Additional analysis of medication error and adverse drug reaction events involving HYDROMORPHONE reported to the Authority also revealed the following:⁹

- The most common medication error event types associated with HYDROMORPHONE were wrong dose/overdosage (16.9%) and wrong drug (10.9%).
- A majority of the HYDROMORPHONE overdoses that occurred during the prescribing node involved orders for a wrong dose (79.6%), followed by an incorrect frequency (18.5%).
- Of the reported central nervous system (CNS) and respiratory adverse drug reaction reports, 65% appear to have been preventable adverse drug events (ADEs) (i.e., medication errors) in which patients received a dose in excess of what would be needed to resolve pain symptoms (e.g., greater than a 1 mg dose for an opioid-naïve adult patient) or in which HYDROMORPHONE was prescribed and administered with other medications that would lead to additive sedative effects (e.g., orders for both morphine and HYDROMORPHONE).

Additional examples of factors associated with medication errors involving opioids that have been published by ISMP or learned from root-cause analyses of actual errors include the following:¹⁰

- Dosing errors in opioid-naïve patients:
 - Prescribing initial doses too high for opioid-naïve patients, especially with HYDROMORPHONE and fentaNYL transdermal systems
 - Unfamiliarity with proper oral (PO)-to-intravenous (IV) dose conversions for some opioids
 - Prescribing short-acting opioids without knowledge that long-acting morphine (DepoDur®) had been administered

- Prescribing opioids without knowledge that an epidural opioid had been administered
- Prescribing doses of opioids too high for patients with a history of respiratory conditions (e.g., sleep apnea), for patients on concomitant medications with sedative properties, or for elderly patients
- Patient monitoring problems:
 - Failure to notice respiratory depression due to insufficient, improper, or untimely monitoring of patients receiving opiates

Proposed Intervention

On December 14, 2011, CMS announced the award of \$218 million to 26 state, regional, and national hospital system organizations to serve as HENs. The Department of Health and Human Services sponsored the contract, which is part of the public-private Partnership for Patients. This initiative was started to help keep patients from being harmed while in the hospital and heal without complications once they are discharged.¹¹

The Hospital and Healthsystem Association of Pennsylvania (HAP) is the only Pennsylvania-based organization that serves as a HEN as part of the Partnership for Patients initiative.¹² According to HAP, it will be under a two-year contract with its partners (the Authority, the Health Care Improvement Foundation, Quality Insights of Pennsylvania, and the Pennsylvania Health Care Quality Alliance) to implement strategies to support Pennsylvania hospitals in achieving Partnership for Patients' goals of reducing preventable hospital-acquired conditions, readmissions, and complications during hospitalization. There are 10 core areas of focus that are a part of the overall project, including ADEs. In Pennsylvania, the ADE collaboration specifically addresses the safe use of opioids.

The purpose of the ADE opioid collaboration is to explore the current trends of opioid therapy within organizations, barriers to optimal therapy and safety, common types of errors that occur with opioids, and contributing factors that lead to patient harm from opioid use. This collaboration includes all care and procedural areas, as well as practitioners who prescribe, dispense, administer, or monitor patients on opioids. The goal of the collaboration is to decrease the number of harmful events with opioids for participating hospitals (compared with the participating hospitals' baseline using historical controls).

Hospitals that signed up to participate in this collaboration were asked to be involved in

- developing a multidisciplinary task force team;
- asking staff to complete baseline and follow-up opioid knowledge assessments;
- completing baseline and follow-up opioid organizational assessments;
- collecting outcome measures, specifically naloxone use for patients on opioids and rapid response team calls primarily due to opioids;
- gathering and reviewing documents related to established process measures with the use of opioids;
- submitting program feedback; and
- participating in webinars and conference calls.

METHODS

As a part of the collaboration, the Authority partnered with the Pennsylvania Medical Society to develop a clinician knowledge assessment tool for opioids for prescribers, pharmacists, and nurses. 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 HYDROMORPHONE
- 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. A paper version was also used by organizations to capture responses from practitioners who were unable to respond by e-mail. This tool was released on June 5, 2012, and the last day of data submission was August 26, 2012. (The tool will be available for use at <http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/Pages/home.aspx>.)

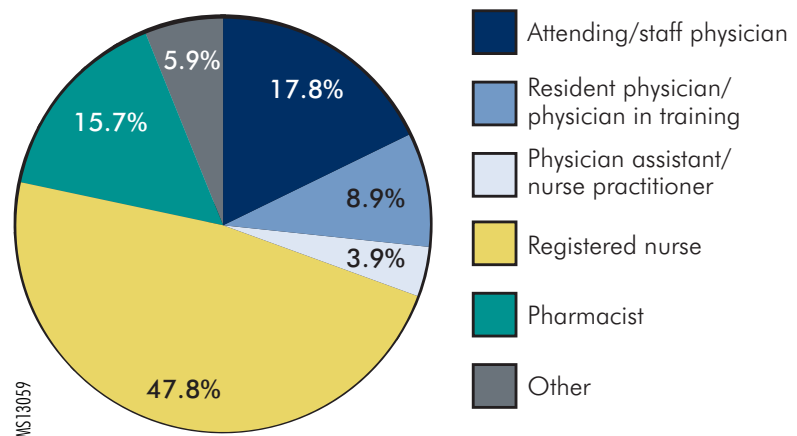
RESULTS

Practitioner Characteristics

Practitioners from 24 of the 29 (83%) hospitals that signed up for the collaboration participated in the assessment. More than 2,000 practitioners started the assessment, of which 1,758 individuals (79%) completed the assessment (see Figure).

Overall, more registered nurses (47.8%, n = 840) completed the opioid knowledge assessment than any other type of practitioner. Other practitioners included (in decreasing order of participation): attending/staff physicians (17.8%, n = 313); phar-

Figure. Percentage of Completed Knowledge Assessments by Type of Practitioner (N = 1,758)



macists (15.7%, n = 276); resident physicians/physicians in training (8.9%, n = 157); practitioners who selected “other” (5.9%, n = 104); and physician assistants/nurse practitioners (3.9%, n = 68). Practitioners who selected “other” were predominantly certified registered nurse anesthetists (46.1%, n = 48).

The lowest-scoring questions in the assessment included topics addressing the following:

- 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 HYDROMORPHONE on ventilation

Predictor of Opioid-Induced Respiratory Depression

Sedation is a common and expected adverse effect of opioids, particularly at the start of therapy and generally during the first 24 hours of opioid therapy, as well as with increases in opioid dose.¹³ Although respiratory depression is less common than sedation, it is frequently the most serious of the opioid-induced adverse effects.

Opioid-induced respiratory depression can be defined as a decrease in the effectiveness of an individual’s ventilatory function after opioid administration.¹⁴ Sedation generally precedes significant respiratory depression.^{15,16} Opioid-induced sedation occurs on a continuum ranging from full consciousness to complete loss of consciousness and respiratory arrest. Unintended advancing sedation occurs at increasingly higher levels along the continuum of sedation, impairing both arousal mechanisms and content processing.

Acute pain appears to stimulate respiration and antagonize the respiratory depressant effects of opioids.¹⁷ While pain can antagonize opioid-induced respiratory depression, sleep can intensify the depressant effects of opioids. In addition, as carbon dioxide levels increase due to respiratory depression, patients exhibit a reduction in overall level of consciousness that is additive to the direct sedative effects of opioids. Critical incidents from opioid-induced respiratory depression appear to be more common in the hours from midnight to 6 a.m.¹⁷ Depression of level of consciousness is an extremely useful guide to observing clinical effect

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Table. Results of the Opioid Knowledge Assessment by Individual Question and Practitioner Type

QUESTION	OVERALL NO. OF RESPONSES	ANSWER	OVERALL (%)	ATTENDING/STAFF PHYSICIAN (%)	RESIDENT PHYSICIAN/PHYSICIAN IN TRAINING (%)	PHYSICIAN ASSISTANT/NURSE PRACTITIONER (%)	REGISTERED NURSE (%)	PHARMACIST (%)	OTHER (%)
Patients who are considered opioid tolerant are those who have been:	2,024	Taking acetaminophen 300 mg with codeine 30 mg, up to 5 doses a week	6.4	6.3	6.3	3.9	7.5	3.7	5.8
		Taking oxyCODONE 10 mg with acetaminophen 325 mg 4 times daily for 5 days	1.4	1.4	3.4	0.0	1.1	1.7	1.7
		Taking oxyCODONE 10 mg with acetaminophen 325 mg 4 times daily for 14 days	29.1	34.2	24.0	32.5	25.5	40.5	20.7
		Taking extended-release morphine 15 mg twice daily for 1 week	10.2	8.8	11.4	14.3	8.5	16.3	9.1
		All of the above	52.9	49.3	54.9	49.4	57.4	37.8	62.8
The most important predictor of respiratory depression in patients receiving intravenous (IV) opioid analgesics in the hospital setting is:	2,023	Respiratory rate	49.1	36.8	45.7	50.6	49.0	62.9	56.2
		Patient-reported pain intensity	0.6	1.1	0.6	1.3	0.3	0.7	0.8
		Sedation level	22.4	33.0	30.9	19.5	20.1	16.0	15.7
		Blood pressure	0.3	0.0	0.0	1.3	0.2	1.0	0.0
		All of the above	27.6	29.1	22.9	27.3	30.4	19.4	27.3
Which of the following statements about long-acting opioids is true?	2,024	They are intended for use for pain on an as-needed basis.	6.6	4.0	4.0	3.9	10.1	0.0	6.6
		They are indicated for pain in the immediate postoperative period (12 to 24 hours following surgery).	10.3	4.5	17.1	7.8	11.3	6.5	20.5
		They are indicated for pain during the postoperative period, if the pain is not expected to persist for an extended period of time.	13.5	11.6	10.3	13.0	14.5	12.6	18.0
		They are only indicated if the patient is opioid tolerant and has already been receiving the drug prior to surgery.	56.5	71.6	58.3	71.4	46.4	78.6	31.1
		All of the above	13.0	8.2	10.3	3.9	17.7	2.4	23.8
Which of the following best represents the equianalgesic dose of IV HYDROmorphine to IV morphine 2 mg?	1,898	0.4 mg	67.2	70.1	80.6	73.2	55.8	92.6	66.7
		0.8 mg	8.6	12.7	6.7	9.9	9.1	2.8	9.0
		1 mg	19.2	14.2	10.3	14.1	28.0	3.5	17.1
		2 mg	5.0	3.0	2.4	2.8	7.2	1.1	7.2

Table. Results of the Opioid Knowledge Assessment by Individual Question and Practitioner Type (continued)

QUESTION	OVERALL NO. OF RESPONSES	ANSWER	OVERALL (%)	ATTENDING/STAFF PHYSICIAN (%)	RESIDENT PHYSICIAN/PHYSICIAN IN TRAINING (%)	PHYSICIAN ASSISTANT/NURSE PRACTITIONER (%)	REGISTERED NURSE (%)	PHARMACIST (%)	OTHER (%)
Which patient-specific parameters might cause you to consider reducing the initial dose of HYDROmorphone?	1,899	Hypertension	0.2	0.3	0.0	0.0	0.0	0.0	1.8
		Sedation following administration of morphine	6.6	7.3	10.9	5.6	5.7	7.7	4.5
		A history of obstructive sleep apnea	10.4	4.5	6.1	2.8	11.2	19.0	9.9
		Hypertension and a history of obstructive sleep apnea	1.9	3.0	1.8	1.4	1.4	2.1	3.6
		Sedation following administration of morphine and a history of obstructive sleep apnea	65.9	71.9	70.9	66.2	66.8	54.9	61.3
		Hypertension, sedation following administration of morphine, and a history of obstructive sleep apnea	15.0	13.0	10.3	23.9	14.9	16.2	18.9
The best choice to manage this patient's pain and restlessness is to:	1,832	Ask the nurse to provide reassurance to the patient and continue to monitor him for signs of increased sedation and respiratory depression	63.0	71.7	64.4	58.0	63.0	49.1	73.6
		Administer diphenhydramine 25 mg proper oral (PO)	29.4	20.2	28.8	34.8	29.7	42.3	19.1
		Administer diazepam 10 mg PO	4.1	3.4	4.4	4.3	4.8	2.2	4.5
		Administer midazolam 2 mg IV	3.5	4.7	2.5	2.9	2.5	6.5	2.7
Which of the following patient-specific parameters is/are the most important to monitor in patients receiving IV HYDROmorphone?	1,831	Patient-reported pain intensity	0.5	0.9	0.6	0.0	0.2	0.7	1.8
		Level of sedation	2.6	5.0	3.8	1.4	2.5	0.4	1.8
		Adequacy of ventilation	2.7	3.1	3.8	2.9	2.5	0.4	7.3
		Respiratory rate	6.2	4.3	5.6	1.4	7.9	4.7	6.4
		Patient-reported pain intensity and respiratory rate	11.7	9.3	11.3	4.3	10.7	19.0	13.6
		Patient-reported pain intensity, level of sedation, and adequacy of ventilation	76.2	77.3	75.0	89.9	76.3	74.9	69.1



Table. Results of the Opioid Knowledge Assessment by Individual Question and Practitioner Type (continued)

QUESTION	OVERALL NO. OF RESPONSES	ANSWER	OVERALL (%)	ATTENDING/STAFF PHYSICIAN (%)	RESIDENT PHYSICIAN/PHYSICIAN IN TRAINING (%)	PHYSICIAN ASSISTANT/NURSE PRACTITIONER (%)	REGISTERED NURSE (%)	PHARMACIST (%)	OTHER (%)
Which of the following statements is correct in regard to the HYDROmorphine 1 mg order?	1,789	The dose is appropriate since the patient has an insignificant past medical history.	11.6	7.3	9.4	7.2	15.2	7.6	11.3
		The dose is too high because the patient is opioid naïve and over 80 years old.	77.4	85.2	79.9	85.5	70.5	87.8	74.5
		The dose is too low because the patient’s chronic medications will lead to rapid metabolism of HYDROmorphine.	4.7	4.4	5.0	2.9	5.8	1.4	5.7
		The dose is too low based on her elevated body mass index.	6.3	3.2	5.7	4.3	8.5	3.2	8.5
Which of the following agent(s) can potentiate the effects of HYDROmorphine on ventilation?	1,788	Atorvastatin	0.9	0.3	0.6	1.4	1.0	0.7	1.9
		FLUoxetine	2.6	2.5	3.8	1.4	2.7	2.9	0.9
		ALPRAZolam	51.5	47.6	54.1	58.0	49.9	59.6	45.8
		Atorvastatin and ALPRAZolam	5.2	6.0	6.9	2.9	5.1	1.8	11.2
		FLUoxetine and ALPRAZolam	39.8	43.5	34.6	36.2	41.2	35.0	40.2
What would be the best option to control this patient’s pain?	1,759	Order a second dose of IV HYDROmorphine 1 mg	3.5	3.2	5.1	7.4	3.7	1.8	2.9
		Assess sedation level, then continue titration of IV HYDROmorphine 0.2 mg to 0.4 mg every 10 minutes	60.4	72.2	61.8	60.3	54.0	68.8	52.9
		Order a nonopioid pain reliever until the initial dose HYDROmorphine starts to have an effect	34.8	24.3	31.8	32.4	41.0	28.3	40.4
		Order a dose of meperidine 25 mg IV	1.2	0.3	1.3	0.0	1.3	1.1	3.8
Which patient-specific parameter(s) might cause you to consider reducing the subsequent dose of opioid?	1,758	Hypertension	0.6	0.0	1.3	0.0	0.6	1.1	1.0
		Patient’s age	10.1	7.3	8.3	7.4	8.9	17.4	13.5
		Coronary artery disease	0.8	0.3	0.0	0.0	1.1	0.7	1.9
		Sedation following the initial dose of HYDROmorphine	70.6	78.9	79.6	72.1	70.7	60.5	56.7
		Patient’s age and coronary artery disease	17.9	13.4	10.8	20.6	18.7	20.3	26.9

Note: Percentages for individual questions are added vertically and reflect each practitioner type’s responses for each answer choice; correct answer choices are shaded gray. Case examples were included for some questions in the original assessment but are not provided in this table.

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in patients receiving opioids. Respiratory depression is almost always preceded by sedation or clouded sensorium.¹⁸

The second question posed on the assessment (see Table) asked practitioners to select the most important predictor of respiratory depression in patients receiving IV opioids. Participants could select respiratory rate, patient-reported pain intensity, sedation level, blood pressure, or all of the above. Overall, 22.4% of all respondents answered the question correctly; 33.0% of physicians, 20.1% of nurses, and 16.0% of pharmacists answered correctly.

Opioid Tolerance

Although opioids are often titrated to the effective dose to avoid dose-dependent adverse effects, the appropriate starting doses or the use of potent and/or long-acting dosage forms for chronic pain depend on whether patients are opioid tolerant or opioid naïve.¹⁹

“Opioid naïve” implies patients are not chronically receiving opioids on a routine basis. “Opioid tolerant” implies patients are chronically receiving opioids on a daily basis. Opioid-tolerant patients, as defined in the fentaNYL transdermal patch official labeling, are those who have been taking, for a week or longer, at least 60 mg of oral morphine daily, at least 30 mg of oral oxyCODONE daily, at least 8 mg of oral HYDROMORPHONE daily, or an equianalgesic dose of another opioid.²⁰ This is the lowest daily dose of opioid taken over a week that a patient must be receiving in order to be prescribed the lowest dose of fentaNYL transdermal systems. Therefore, fentaNYL transdermal systems should only be used in patients who are already receiving opioid therapy and who have demonstrated tolerance.¹⁹

Giving potent, long-acting opioids like a fentaNYL transdermal system to opioid-naïve patients has resulted in deaths.²¹ Thus, most long-acting opioids such as fentaNYL transdermal system should not be used for acute pain.

This definition of opioid tolerance that is endorsed by the Food and Drug Administration (FDA) is also found in many of the new Risk Evaluation and Mitigation Strategy documents and FDA-approved Medication Guides for new opioids.²²

The first question posed on the assessment (see Table) asked practitioners to identify the order(s) that would make a patient tolerant to opioids. Only one of the four proposed orders was correct. Overall, 29.1% of all respondents answered the question correctly; 34.2% of physicians, 25.5% of nurses, and 40.5% of pharmacists answered correctly. In addition, almost 53% of all respondents answered “all of the above”; 49.3% of physicians, 57.4% of nurses, and 37.8% of pharmacists thought that all of the listed orders would render a patient to be opioid tolerant.

Medications That Potentiate the Effects of Opioids on Ventilation

Various patients are at higher risk for adverse events from opioid use, including patients with sleep apnea, patients who are morbidly obese, and patients who concurrently receive other drugs that are CNS and respiratory depressants. This includes patients receiving other sedating drugs, such as benzodiazepines, antihistamines, diphenhydramine, sedatives, or other CNS depressants.²³ One study found that most ADEs were due to drug-drug interactions, most commonly involving opioids, benzodiazepines, or cardiac medications.²⁴

The ninth question posed on the assessment (see Table) asked practitioners to identify which medications could potentiate the effects of HYDROMORPHONE on ventilation. Overall, only 51.5% of all respondents answered the question correctly; 47.6% of physicians, 49.9% of nurses, and 59.6% of pharmacists answered correctly.

NEXT STEPS

Facility representatives from participating organizations were provided with facility-specific assessment results on the Authority’s password-protected Patient

Safety Knowledge Exchange (PassKey) site. In addition, the results of the knowledge self-assessment tool have helped identify statewide knowledge gaps that need to be addressed through education or other technical assistance. The Authority will work with the Pennsylvania Medical Society to develop tools on opioids to address these gaps. Collaboration will also continue with the Pennsylvania Society of Anesthesiologists to continue to enhance the role of the anesthesia department in pain management overall in participating facilities.

The Authority intends to repeat this opioid knowledge assessment to determine if improvements have been made within organizations in regard to use of opioids.

CONCLUSION

The results of the knowledge assessment supported the Authority’s perception that Pennsylvania hospitals may have underestimated or were unaware of the degree of opioid knowledge deficit among practitioners. The knowledge assessment has identified basic knowledge gaps by practitioners, which will hopefully spur organizations to address these gaps and possibly assess staff knowledge about other high-alert medications. Based on the results of the opioid knowledge assessment, organizations should consider both educating and assessing the understanding of staff that care for patients receiving opioids about the following:^{14,24}

- Potential effect of opioid therapy on sedation and respiratory depression
- Differences between opioid-naïve and opioid-tolerant patients, and what constitutes or makes a patient opioid tolerant
- Indications for long-acting opioids (who and/or when should they be prescribed)
- Equianalgesic dosing between opioids, IV to PO as well as between two different opioids
- Patient-specific conditions that require a lower starting dose of opioids



- The impact of concomitant medications in combination with opioids
- Technological and clinical monitoring

Staff training can emphasize how to assess patients for adverse drug reactions,

how to recognize advancing sedation, and the importance of making timely adjustments to the plan of care based on the patient’s risk.

In addition, it is important to assess the organization’s need for training based on

the analysis of reported adverse events, near misses, outcome measures, staff observations, and knowledge assessments. This analysis may be helpful in identifying knowledge gaps and in developing improvement strategies to reduce recurrences.

NOTES

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