continuing education for pharmacists

Volume XXXIV, No. 7

A New Generation of Medical Errors with the Rise of Health Information Technology

Mona T. Thompson, R.Ph., PharmD

Dr. Mona T. Thompson has no relevant financial relationships to disclose.

Goal. The goal of this lesson is to review the impact of e-prescribing and health information technology (IT) on medication errors in the community pharmacy setting. The use of clinical decision support systems (CDSS) and the impact of alert fatigue on overriding potentially clinically significant medication-related alerts will be reviewed. The role of pharmacists in identifying and minimizing medication errors will also be discussed.

Objectives. At the completion of this activity, the participant will be able to:

1. demonstrate an understanding of the rationale for the continued development and implementation of electronic prescribing in community pharmacies and across other health systems;
2. list advantages of utilization of electronic prescribing in community pharmacies;
3. identify drawbacks, common sources of errors, and workflow issues related to electronic prescribing; and
4. recognize solutions for identifying and resolving medication-related errors associated with electronic prescribing and for reducing alert fatigue.

Electronic Prescribing: Background, Rationale and Meaningful Use

On November 29, 1999, the Institute of Medicine (IOM) released a report called *To Err is Human: Building a Better Health System*. The report, which was covered widely in the media, brought medication errors to the forefront with a headline story describing a large number of health care deaths, as many as 98,000 each year, related to medical errors. While many individuals or organizations previously focused on establishing accountability for errors, the committee's report stressed that accountability alone does not make systems safer. The committee's approach was to emphasize that "error" resulting in patient harm was not a property of health care professionals' competence, good intentions, or hard work. Rather, the safety of care (defined as *freedom from accidental injury*) is a property of a system of care. This may be a hospital, primary care clinic, nursing home, retail pharmacy, or home care in which specific attention is given to ensuring that well-designed processes of care prevent, recognize and quickly recover from errors so that patients are not harmed. This current way of thinking about medication errors places the error at the fault of weak medication systems, not individual negligence. These system problems can include procedures, workflow, short-staffing, faulty software, etc.

The IOM committee moved the focus from errors to safety, and called for systemwide changes with key strategies for improvement. One of these strategies called for implementing safety systems in health care organization to ensure safe practices at the delivery level. This required a new field of health care research and new tools for addressing problems. The report called on Congress to create the Center for Patient Safety, within the Agency for Health Care Research and Quality, to develop new tools and patient care systems to make it easier to do things right and harder to do things wrong.

Medication errors are a major category of medical errors that cause over 7000 deaths per year. Not only do medication errors have the potential to induce adverse drug events, they may lead to inappropriate medication use and harm to patients. Consequently, medication errors are associated with increased length of hospitalizations and higher treatment costs. Additionally, prescription errors are a subcategory of medication errors often encountered in community pharmacies. With over 3.5 billion prescriptions received in community pharmacies annually, it is estimated that prescription errors range from as low as 0.23 percent to as high as 11 percent. Adverse drug events account for one in three hospital admissions, adding up to nearly two million hospital stays every year. Electronic pre-

Table 1
Advantages of using electronic prescribing

Patient Safety: CDSS allows providers to be prompted and to avoid potential errors such as drug-drug interactions and drug-allergy interactions. CDSS also prompts the provider for the optimal therapy for the patient disease state.

Cost: E-prescribing has shown to be more cost-effective than with handwritten prescriptions due to e-prescribing systems suggesting low cost generics and avoiding errors.

Access to Patient Records: Increased access to patient records allows for continuum of care with the patient in multiple settings, including: emergency departments, primary care settings, and pharmacies.

Improved Workflow: Patients do not need to present a prescription at the pharmacy and wait for the prescription due to electronic submission. Pharmacists also save time by not having to contact providers when an illegible handwritten prescription is presented.

Malpractice Claims: Utilizing CDSS allows providers to be prompted with potential conflicts in a patient's care; in return, fewer malpractice claims have been projected as a result of e-prescribing.

Forged Prescriptions: A decline in handwritten prescriptions given to patients may lead to fewer forged prescriptions.

Adapted from U.S. Pharmacist, August 20, 2013

scribing, a form of health information technology (health IT), also referred to as *e-prescribing*, has been introduced to community pharmacy in order to reduce prescription errors in this setting. E-prescribing systems enable physicians to electronically generate and transmit prescriptions to community pharmacies. Research has shown that handwritten prescriptions are unsafe and result in errors that can lead to tremendous inefficiency for patients and pharmacists.

In order to improve the safety of and efficiency in health care delivery in the United States, national policies are promoting the adoption and use of health IT. The American Recovery and Reinvestment Act (ARRA), enacted in February 2009, included the "Health Information Technology for Economic and Clinical Health (HITECH) Act." The HITECH Act supports the concept of electronic health records-meaningful use (EHR-MU) and is led by the Centers for Medicare and Medicaid Services (CMS) and Office of the National Coordinator for Health IT (ONC). Meaningful use is defined as the use of certified EHR technology in a meaningful manner. The purpose is to ensure that certified EHR technology is connected in a manner that provides for the electronic exchange of health information to improve the quality of care. Electronic prescribing is an example of meaningful use.

Meaningful use is supported by five pillars of health outcomes policy priorities: 1) improving quality, safety, efficiency, and reducing health disparities; 2) engage patients and families in their health; 3) improve care coordination; 4) improve population and public health; 5) ensure adequate privacy and security protection for personal health information. CMS grants incentives to eligible professionals and hospitals who can demonstrate that they have engaged in efforts to adopt, implement or upgrade certified EHR technology. Hence, the use of e-prescribing has greatly increased in accordance with meaningful use deadlines. In 2012, 788 million e-prescriptions were transmitted to community pharmacies in the United States, compared to only 29 million in 2007. As of 2014, approximately 93 percent of community pharmacies had e-prescribing capabilities.

Despite the great increase in use and many advantages for community pharmacists, problems remain. The remainder of this lesson will focus on the advantages and disadvantages of e-prescribing, the role of clinical decision support, and alert fatigue as it relates to medication errors.

Advantages of E-Prescribing in Community Pharmacy

Advantages of e-prescribing include: impact on patient safety, decreased overall cost, and increased access to prescription records. Refer to Table 1 for a summary of these advantages.

Patient safety, as previously mentioned, is the cornerstone for the development of e-prescribing aiming to reduce ambiguity and unnecessary clarifications often encountered with handwritten prescriptions. Indecipherable orders alone account for 150 million calls from pharmacists to prescribers in the U.S. each year. Avoidable errors associated with written prescriptions include selection of an incorrect or unavailable drug, dosage form, or dosage; duplication of therapy; omission of information; and misinterpretation of the order because of illegible handwriting. Multiple studies have shown that e-prescribing can reduce prescription errors. Many e-prescribing software programs are equipped with clinical decision support (CDS) that notifies prescribers of potential prescription errors prior to submission. CDS programs prompt prescribers to verify allergies, confirm dosage accuracy, and identify drug-drug interactions (DDI) before the prescription is transmitted.

Cost benefits have also been associated with e-prescribing when clinical decision support is imbedded into the e-prescribing program. In a 12-month study conducted by McMullin *et al.*, an e-prescribing system was used in comparison to a control to evaluate cost savings of the e-prescribing system. McMullin *et al.* also assessed the impact of computerized decision support systems (CDSS) on all pharmacy claims and per-member-per-month expenditures. The evaluation compared 19 primary care clini-

cians using CDSS versus 19 control clinicians from the same medical group who were not using the e-prescribing system. Use of the CDSS showed a consistent reduction in prescription costs. Over the 12-month follow-up period, average prescription cost on new prescriptions was decreased by $1.00 (-2.4 percent) in the CDSS group, and increased by $3.75 (9.0 percent) in the control group. For 26,674 new prescriptions, the average cost was $4.12 lower than the control cost (p=0.003). In addition, the average drug cost savings on all pharmacy claims were $863 per prescriber per month based on average prescription cost. The savings were thought to be from the prescribers receiving alerts and provider diagnosis-specific messages. In addition, a study by Michelis *et al.* showed patients were more likely to receive a generic dyslipidemia medication and had a higher rate of LDL goal achievement if the e-prescribing system had formulary decision support. These alerts and messages prompted providers to select more cost-effective medications, avoid interactions, and select diagnosis-appropriate medications resulting in optimization of the e-prescribing system.

Access to patient records has been greatly enhanced with the advent of e-prescribing. Electronic storage of prescription records is invaluable in situations where patient safety is threatened, such as natural disasters and drug recalls. Secure networks such as the SureScripts network allow for the seamless exchange of health information among various health care applications. For instance, at the time of writing this lesson, SureScripts connectivity capabilities span over 700 EHR applications used by over 900,000 health care professionals. According to SureScripts, more than six billion transactions are processed each year, including 700 million medication histories, more than 1 billion e-prescriptions and nearly 10 million clinical messages. It is estimated that the SureScripts e-prescribing network covers more than 90 percent of U.S. pharmacies. This transfer of health information from one provider to the next allows timely sharing of vital patient information to make an informed decision with the goals of avoiding readmissions, avoiding medication errors, improving diagnoses, and decreasing duplicate testing.

There are three ways for health information to be shared in health information exchange (HIE). They include 1) directed exchange, 2) query-based exchange, and 3) consumer-mediated exchange. Directed exchange is the ability to send and receive information

Table 2
Causes of e-prescribing errors in community pharmacies*

Type of Error	Association with E-Prescribing
Order Entry Error from the Provider Side	
• Wrong drug, pharmacy, patient	• Easy to select incorrectly from drop-down menus
• Incorrect directions, conflicting information	• Auto-populated information may be incorrect or carried over incorrectly from prior prescriptions.
• Wrong quantity errors	• Many systems require providers to enter the quantity and type of unit to be dispensed, forcing providers to "guess" if they are unaware.
• Refill errors	• Obsolete or incorrect information may be propagated when old refill prescriptions are used as templates.
Transcription Errors	
• Incorrect physician or a patient selected by pharmacist	• Provider/patient appear differently in order entry and pharmacy databases so pharmacists may guess when multiple choices appear.
•Incorrect information entered by pharmacist into pharmacy system	• Provider order entry and pharmacy systems do not directly interface, forcing pharmacists to print prescriptions or memorize information to enter into pharmacy system. • System may interface, but not all necessary prescription information is available on a single screen.
Dispensing Errors	
• Errors associated with modified prescriptions	• Because providers cannot modify a sent prescription, they may send two back-to-back, which makes it unclear which is correct.
• Incomplete processing of all prescriptions for a single patient	• Prescriptions for the same patient may not arrive at a single time or may be mixed with other prescriptions. • Patients may have e-prescriptions and paper prescriptions.
• Dispensing of discontinued medications	• Providers may incorrectly assume that simply discontinuing a prescription from the provider side will filter to the pharmacy once that prescription has already been processed.
• Duplicate dispensing	• Pharmacy may process a prescription twice if they receive two requests (i.e., electronically and by facsimile).

*Abramson El. Causes and consequences of e-prescribing errors in community pharmacies. *Dovepress*. 2015.

Table 3
Disadvantages of using electronic prescribing

Omitted or Inaccurate Information: The most common e-prescribing errors are due to omitted or inaccurate information. Missing or incorrect components may include the wrong patient, incorrect drug selection, wrong quantity, incorrect directions, and wrong duration of therapy.

Design Elements: Drop down menus, auto-populated patient information and incorrect directions, and required fields for specific quantities, units, and package sizes are among the many design elements that contribute to medication errors.

System Failures and Incompatibilities: Prescribers' computer order entry systems do not always interface well with pharmacy e-prescribing technology, which can lead to mismatches, transcription errors, and delays in the arrival of new e-prescriptions. These software incompatibilities can halt the dispensing workflow, create inefficiencies and errors, and detract from patient care.

Cost Disadvantages: Both transaction fees to process e-prescriptions and added pharmacist time to address e-prescription errors increase the pharmacy's cost to dispense.

Adapted from U.S. Pharmacist, August 20, 2013 and International Journal of Medical Informatics, March 24, 2014

between health care providers to support coordinated care. Query-based is the ability for the provider to request or find information about a patient, and is usually used in an unplanned care experience (i.e., emergency departments). Consumer-mediated exchange allows patients to control what can or cannot be seen by certain providers. The availability of this information is intended to create a seamless continuum of care.

Disadvantages of E-Prescribing in Community Pharmacy

Despite the many benefits of e-prescribing, this technology does not come without drawbacks. E-prescribing has been shown to have potentiated new errors and re-introduced problems similar to those encountered with written prescriptions. The most common errors are due to omitted or inaccurate information. These missing or incorrect components of the prescription may include the wrong patient, incorrect drug selection, wrong drug quantity, incorrect directions, and wrong duration of therapy. One study showed that one in 10 computer-generated prescriptions received by pharmacies had at least one medication error, and one-third of the errors were potentially harmful. While pharmacists may no longer be tasked with deciphering illegible handwriting, pharmacists are still challenged to catch these errors. If inaccuracies exist with an e-prescription, the benefit of freeing up additional time for pharmacists to provide patient care services may be offset by the increased interaction required with prescribers to verify unclear or missing information. Ultimately, these errors result in reduced efficiency for pharmacists, delays to patient care, and cost burdens for pharmacies.

Design elements of e-prescribing systems may be partly responsible for the errors that occur. Drop-down menus make it easy for prescribers to select the wrong patient, drug, or pharmacy. Auto-populated patient information and directions may also foster errors, and result in conflicting information if a prescriber forgets to remove auto-populated information that is either obsolete or inaccurate. Further, many e-prescribing systems require prescribers to enter specific quantities and the type of unit to be dispensed. Prescribers may be unaware of the particular package sizes available for these medications in pharmacies, and thus be forced to make educated guesses. This is in contrast with handwritten prescriptions where a provider could indicate "quantity sufficient" and rely on the pharmacist to dispense the appropriate unit and package size. This may be of particular relevance, and lead to external pharmacy audit concerns, when the wrong package size is selected for ophthalmic and otic preparations, topical ointments and creams, inhalers, and insulin. To add to the challenges, prescribers' computer order entry systems do not always interface and connect well with the pharmacy technology, which can result in mismatches and transcription errors. Even if a provider catches an error after sending an e-prescription, his/her system will not allow the provider to alter the order once it has been sent. If the provider corrects the error by sending a second prescription, pharmacists receive back-to-back orders for the same patient, which can cause confusion and potential error. Moreover, providers may have to call pharmacies to clarify what should be filled, reducing efficiency for both providers and pharmacists

System failures and incompatibilities between technology designs have proven to be problematic and create workflow challenges. Contrary to the belief of many patients, e-prescriptions do not get transmitted instantaneously. Delays in the arrival of new e-prescriptions have been shown to result in patient dissatisfaction and increased wait times, as patients arrive at the pharmacy before a physician's order has been received. Additionally, e-prescriptions for the same patient may be transmitted at different times, instead of all at once. Or, a large number of e-prescriptions may be 'bundled' and transmitted together to a pharmacy, creating workplace tension and workflow challenges as pharmacy personnel try to accurately dispense these prescriptions in a timely manner. Many of these software and design issues can halt the dispensing workflow, create inefficiencies and errors, and detract from patient care. Table 2 summarizes the causes of e-prescribing errors in community pharmacies.

Previously in this lesson, cost

benefits were described as an advantage for employing e-prescribing. While costs savings may be attainable through formulary decision support and a reduction in adverse drug events (ADEs), there are some e-prescribing cost disadvantages that may be passed along to the dispensing pharmacy. Community pharmacies are often responsible for a transaction cost associated with e-prescription processing. Thus, incorrect or duplicate prescriptions can result in the accrual of significant fees for the pharmacies. While larger chain pharmacies are able to negotiate lower transaction fees, smaller chain and independent pharmacies pay more to utilize the same systems. Also, the additional time required by pharmacists to address e-prescription errors adversely increases the time and cost of dispensing prescriptions. Table 3 summarizes these disadvantages as discussed.

Despite the many benefits of e-prescribing, these drawbacks highlight many sources of error, patient safety concerns, and the need for pharmacists to remain vigilant when processing and dispensing electronically prescribed medications. Noting the discrepancies documented in the literature regarding e-prescribing medication errors, it is uncertain whether errors are decreased or increased with the use of e-prescribing software.

Clinical Decision Support (CDS) and Alert Fatigue

CDS represents an important tool for promoting patient safety and quality of care. The presence of an electronic health record appears to have little impact on quality by itself, while randomized controlled trials demonstrate that CDS can improve care by reducing adverse drug events. Clinical decision making is a complex process that depends on the human ability to provide undivided attention and to memorize, recall, and synthesize huge amounts of data. IT systems can improve access to pieces of information, organize them, and identify links between them. While clinicians often "know" the information, it can be difficult to consider all of the pertinent aspects at the time of prescribing. IT systems are effective in bridging this "knowing-doing" gap by presenting the relevant information to the clinician at the time of decision making.

However, these drug safety alerts, as a feature of EHRs, are subject to diminished effectiveness as a result of "alert fatigue." Alert fatigue is a state in which users become overwhelmed and unresponsive to alerts in general, which is a threat to patient safety. As a result, several studies have cited very high override rates ranging between 49 percent and 96 percent.

In a study conducted by Nanji *et al.*, the researchers aimed to better understand how alerts were being managed within their large academic health care center. Over a period of three years (2009-2011), the investigators obtained CDS alert override rates and system-coded reasons for overrides selected by providers at the time of prescribing from outpatient clinics and ambulatory hospital-based practices. The aim of the study was to: 1) to characterize the types and numbers of alerts delivered in the ambulatory setting; 2) to characterize the frequency with which they are overridden; and 3) to describe providers' reasons for overriding them and the appropriateness of those reasons. Eight types of alerts were included: patient allergies, drug-drug interactions, duplicate drugs, drug-class interactions, class-class interactions, age-based recommendations, renal recommendations, and formulary substitutions. The most common alert types encountered were duplicate drug (33.1 percent), patient allergy (16.8 percent), and drug-drug interaction (15.8 percent). The most likely alerts to be overridden were formulary substitutions, age-based recommendations, renal recommendations, and patient allergies. On average, 53 percent of the overrides were classified as appropriate, thus the remaining 47 percent of alert overrides were inappropriate. The highest rates of inappropriate alert type overrides were drug-drug interactions (88 percent), renal recommendation (85 percent), and age-based recommendations (60 percent).

Other studies have confirmed the very high override rates associated with drug-drug interactions (DDI) specifically. Kuperman *et al.*, cited lack of content specificity with respect to DDI as a particular reason for the high rates of DDI overrides.

In a report by Phansalkar *et al.*, an expert panel was utilized to rate drug-drug interactions. The group sought to identify alerts that result from DDI that occur often, yet are nearly always overridden, suggesting that they can safely be made non-interruptive to a provider's workflow in an attempt to reduce alert fatigue. Essentially, rather than interrupting the provider during order entry, these alerts may be communicated or addressed in an alternative format. The goal was to reduce the total number of alerts shown to providers to increase clinician attentiveness to clinically significant alerts.

The study outlined a process in which they developed a customized list of DDI that may be delivered in a non-interruptive manner at their institution in order to combat alert fatigue. The expert panel began by obtaining alert logs consisting of the DDI pairs most commonly occurring in a six-month period. The top 50 DDI pairs, determined by the number of alerts that they generated, were reviewed further. These pairs cumulatively accounted for half of the alerts shown to providers and they had an average override rate of between 95.1 percent and 99.3 percent. The panel was then tasked with determining whether the interaction could be safely made non-interruptive. Ultimately, the panel voted for 33 of the 50 interactions to be safely made non-interruptive. These 33 class-based interactions accounted for over a third of the alerts gener-

ated in the EHR. Phansalkar *et al.* determined that a small number of alerts accounted for a large proportion of interruptive alerting in their institution and, hence, their consensus-based method may potentially reduce alert volume by a third. The authors conclude that these findings need to be further validated to ascertain the actual impact on alert fatigue.

Finally, a group from the Children's Healthcare of Atlanta, a network of three pediatric hospitals in Atlanta, Georgia, created an automated filtering system as a strategy to reduce alert fatigue. Lee *et al.*, designed a system that captures the decision patterns of EMR users to identify alerts that are highly overridden by users and filter them. The group determined that over a three-month period, 1,568 superfluous alert instances were avoided at the expense of 106 "real" alert instances that were also filtered. The authors state that while the 106 instances may have been important, the benefits of filtering the 1,567 unnecessary instances were also important. Therefore, part of the ongoing research is to find a compromise between the quantity and quality of alerts and evaluate the risk and benefits of such an automatic filtering system. The authors emphasize that the overall goal of alerts and alter filters is to improve patient safety, and that critical analysis of tradeoffs must be performed to ensure that any alert filter would result in a net increase to patient safety. In conclusion, as the implementation and utilization of EMR systems continue to grow, the optimization of features and benefits is vital.

Many software systems currently lack the functionality to fine-tune alerts based on factors such as dosing, timing, age, gender, pharmacogenetics, comorbidity, or even the duration of drug therapy. As e-prescribing and health IT systems improve, the ability to distinguish between significant and insignificant alerts based on these properties will also help to reduce the volume of alerts.

The Role of the Pharmacist in Identifying and Minimizing Medication Errors Associated with E-Prescribing

For decades pharmacists have been highly regarded as one of the most trusted health care professionals. Referred to as the most accessible health care provider, pharmacists are also known as public health advocates. In the realm of patient safety, pharmacists once again find themselves in a pivotal location, positioned to intercept and minimize medication errors associated with e-prescribing. Acting as gatekeepers, pharmacists are tasked with using clinical and professional judgment in deciphering the electronic transmission of prescriptions, catching e-prescribing errors, while subject to overwhelming CDS-generated alerts embedded in the pharmacy system. Having an awareness for the types of errors that are often encountered in e-prescribing is a first step in identifying potentially incorrect prescriptions. Knowledge and awareness of the override rates associated with medication-related alerts, especially in the area of drug-drug interactions, are also imperative. Lastly, pharmacists also improve patient safety when engaging in effective and open communication with patients.

Drug-Drug Interaction Alerts and Alert Fatigue. Pharmacists, like physicians, are subject to alert fatigue. Knowing that providers override up to 90 percent of alerts, some of which are inappropriate, is a reminder that while providers may override potentially harmful alerts when prescribing, pharmacists must remain vigilant when these alerts are presented during prescription processing and dispensing. As previously stated, drug-drug interaction alerts are associated with higher rates of inappropriate overriding. It is key for pharmacists to know which drug-drug interactions are important to address and which ones are less concerning. Discontinued drugs may cause alerts, but most aren't serious. Interactions associated with medications with lingering effects, such as with amiodarone, fluoxetine, and MAOIs are important. Additionally, when cytochrome P450 inhibitors or inducers are discontinued, active affected medications on the patient's medication profile may require dosing adjustments. While serotonin syndrome alerts occur with frequency, they are rare. Combinations to avoid include MAOIs with other serotonergic drugs and linezolid with an SSRI or SNRI.

QT interval alerts are also common. Pharmacists are advised to watch closely for high-risk medications in patients who are at risk: women, elderly, patients with heart failure, low heart rate, or low serum potassium or magnesium. These are of particular concern when more than one moderate-to-severe QT prolonging medication is used in combination to treat a high-risk patient.

Other alerts that continue to deserve proper attention include those involving potassium-sparing diuretics with ACEIs or ARBs; TMP/SMX with warfarin or potassium-boosting medications; clarithromycin with digoxin or some statins; oral contraceptives with enzyme inducers (e.g., carbamazepine, phenytoin); as well as interactions with medications possessing a narrow therapeutic index.

Pharmacists can also apply their pharmaceutical expertise to evaluate and differentiate dose-dependent interactions where many software systems cannot. For example, the recently revised product insert for simvastatin now contains dose-dependent contraindications when used with certain CYP3A4 interacting medications. Time-dependent interactions, particularly those among quinolone antibiotics and cations (Ca^{++}, Mg^{++}) can be managed by pharmacists recommending an altered medication schedule to minimize this interaction.

E-Prescribing Errors. Collaboration between pharmacists, technicians, and prescribers is key to avoiding common errors with electronic prescriptions. Again, pharmacists find themselves in situations where careful attention is required. Reviewing patient profiles thoroughly can pick up inadvertent discrepancies. For instance, a provider may have transmitted in error a prescription for metoprolol tartrate in place of metoprolol succinate. Additionally, prescriber-texted notes in a separate part of an e-prescription may contain directions for use. Prescribers should be contacted anytime discrepancies or conflicting information is encountered. Communication with pharmacy team members to discuss and improve workflow pitfalls due to e-prescribing errors can be helpful in improving the overall efficiency of the dispensing system.

Creating a method for open communication and continued follow-up with prescribers can also minimize errors by correcting poor e-prescribing habits. Prescriptions that require discontinuation and editing due to errors may cut into the financial incentives associated with meaningful use. It is also important to track and report recurring errors or issues related to e-prescribing in order for solution and improvements to be incorporated into the software systems.

Patient Education. Not enough can be said about the importance of patient counseling, patient education and communication. Ineffective communication is the most frequently cited cause of serious patient harm. Pharmacists should employ the use of open-ended questions and simple, clear language when communicating with patients. Patient counseling, which is often the last step before a medication is dispensed, is a powerful tool and can often uncover and intercept potential medication errors before they occur.

In the next era of health care, pharmacists will continue to be called upon to educate patients on their medications and disease management and encourage patients to be engaged in their care. Pharmacists can improve medication use, improve safety and quality, and save money for the health care system.

Summary

The implementation of e-prescribing in clinical practice has several benefits. As technology improves, it is likely that most U.S. pharmacies that have not yet implemented e-prescribing will adopt it for the many advantages it affords. Additionally, more sophisticated alert systems that deliver more targeted, appropriate alerts would further improve patient safety by directing users' attention to clinically significant alerts. However, despite advancements in health IT, pharmacists will continue to assume a vital role in identifying and minimizing medication errors through careful patient profile review and effective communication with patients.

• • • • • • • • • • • • • • • • • •

This lesson qualifies for State of Ohio Board of Pharmacy patient/medication safety CPE credit.

Thanks to OPA APPE students Sarah Anderson, Jordan Nicholls, and R. Taylor Reed for their contribution to this CPE lesson.

The author, the Ohio Pharmacists Foundation and the Ohio Pharmacists Association disclaim any liability to you or your patients resulting from reliance solely upon the information contained herein. Bibliography for additional reading and inquiry is available upon request.

This lesson is a knowledge-based CPE activity and is targeted to pharmacists in all practice settings. **Disclosure.** The OPF trustees and other individuals responsible for planning OPF continuing pharmacy education activities have no relevant financial relationships to disclose.

Program 0129-0000-16-007-H05-P
Release date: 7-15-16
Expiration date: 7-15-19
CPE Hours: 1.5 (0.15 CEU)

The Ohio Pharmacists Foundation Inc. is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education.

continuing education quiz

A New Generation of Medical Errors with the Rise in Health Information Technology

1. Current thinking about medication errors places errors at the fault of:
   a. negligence.
   b. incompetence.
   c. weak medication systems.
   d. lack of education.

2. The HITECH Act supports the concept of use of certified electronic health record technology in a meaningful manner.
   a. True
   b. False

3. Advantages of e-prescribing include all of the following EXCEPT:
   a. decrease overall cost.
   b. increase convenience.
   c. increase access to records.
   d. increase patient safety.

4. Cost benefits of e-prescribing are thought to be related to alerts regarding:
   a. minimizing duration of treatment.
   b. selection of cost-effective medications.
   c. recommendation to discontinue therapy.

5. Health information exchange includes all of the following EXCEPT:
   a. directed.
   b. query-based.
   c. coordinator-based.
   d. consumer-mediated.

6. Types of errors encountered with e-prescribing include all of the following EXCEPT:
   a. order entry.
   b. patient counseling.
   c. transcription.
   d. dispensing.

7. All of the following design elements of e-prescribing systems may be responsible for errors EXCEPT:
   a. quantity sufficient selection.
   b. drop-down menus.
   c. auto-populated patient information.
   d. incorrect directions.

Completely fill in the lettered box corresponding to your answer.

1. [a] [b] [c] [d]	6. [a] [b] [c] [d]	11. [a] [b] [c]
2. [a] [b]	7. [a] [b] [c] [d]	12. [a] [b] [c]
3. [a] [b] [c] [d]	8. [a] [b]	13. [a] [b] [c] [d]
4. [a] [b] [c]	9. [a] [b] [c] [d]	14. [a] [b] [c] [d]
5. [a] [b] [c] [d]	10. [a] [b] [c]	15. [a] [b] [c] [d]

❑ **I am enclosing $5 for this month's quiz made payable to: Ohio Pharmacists Association.**

1. Rate this lesson: (Excellent) 5 4 3 2 1 (Poor)
2. Did it meet each of its objectives? ❑ yes ❑ no
   If no, list any unmet_____
3. Was the content balanced and without commercial bias?
   ❑ yes ❑ no If no, why?_____
4. Did the program meet your educational/practice needs?
   ❑ yes ❑ no
5. How long did it take you to read this lesson and complete the quiz? _____
6. Comments/future topics welcome.

Please print.

Program 0129-0000-16-007-H05-P
0.15 CEU

Name_____

Address_____

City, State, Zip_____

Email_____

NABP e-Profile ID_____Birthdate_____ (MMDD)

Return quiz and payment (check or money order) to Correspondence Course, OPA, 2674 Federated Blvd, Columbus, OH 43235-4990

8. Back-to-back orders for the same patient can result when a prescriber makes an error transmitting a prescription, and sends a second with the correction(s).
   a. True
   b. False

9. In a study by Nanji *et al.*, the highest rates of inappropriate alert type overrides were:
   a. patient allergy.
   b. renal recommendations.
   c. age-based recommendations.
   d. drug-drug interactions.

10. Phansalkar *et al.* suggested some CDS alerts could be communicated in a non-interruptive format to:
   a. reduce e-prescribing transmission costs.
   b. decrease amount of time spent by prescribers on e-prescribing.
   c. reduce the number of alerts shown to providers to increase attentiveness to clinically significant alerts.

11. Proposed methods to reduce alert fatigue include:
   a. increase disruptiveness of alerts.
   b. implement an automatic filtering system in software.
   c. increase education of health professionals.

12. Discontinued drug alerts may be important when associated with:
   a. amiodarone.
   b. cephalexin.
   c. paroxetine.

13. QT interval alerts may be more concerning in patients who are at high risk, including those who:
   a. are males.
   b. have low blood pressure.
   c. have low serum potassium.
   d. have high serum magnesium.

14. All of the following drug-drug interaction combinations may require attention EXCEPT:
   a. TMP/SMX with warfarin.
   b. warfarin with potassium supplements.
   c. clarithromycin with statins.
   d. oral contraceptives with phenytoin.

15. The most frequently cited cause of serious patient harm:
   a. is taking the medication incorrectly.
   b. is incorrect storage of the medication.
   c. is not reporting adverse events to prescriber.
   d. is ineffective communication.

To receive CPE credit, your quiz must be received no later than July 15, 2019. A passing grade of 80% must be attained. CPE credit for successfully completed quizzes will be uploaded to the CPE Monitor. CPE statements of credit can be printed from the CPE Monitor website. Send inquiries to opa@ohiopharmacists.org.