

Electronic Prescribing: Improving the Efficiency and Accuracy of Prescribing in the Ambulatory Care Setting

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Abstract

Electronic prescribing (e-prescribing) is an important part of the nation's push to enhance the safety and quality of the prescribing process. E-prescribing allows providers in the ambulatory care setting to send prescriptions electronically to the pharmacy and can be a stand-alone system or part of an integrated electronic health record system. The methodology for this study followed the basic principles of a systematic review. A total of 47 sources were referenced. Results of this research study suggest that e-prescribing reduces prescribing errors, increases efficiency, and helps to save on healthcare costs. Medication errors have been reduced to as little as a seventh of their previous level, and cost savings due to improved patient outcomes and decreased patient visits are estimated to be between \$140 billion and \$240 billion over 10 years for practices that implement e-prescribing. However, there have been significant barriers to implementation including cost, lack of provider support, patient privacy, system errors, and legal issues.

Keywords: electronic prescribing, cost, benefits, barriers to implementation, safety

Introduction

Electronic prescribing (e-prescribing) is an important part of the United States' push to enhance the safety and quality of the prescribing process.¹ E-prescribing has been defined as the computer-based electronic generation, transmission, and filling of a prescription, taking the place of paper and faxed prescriptions.² Most prescribing occurs in the outpatient care setting, where paper-based prescribing is most heavily used, so this type of community-based setting holds the greatest potential for e-prescribing to be achieved.³

E-prescribing has allowed prescribers to electronically send patients' prescription information to pharmacy computers. This process has decreased prescribing and medication errors and has resulted in fewer call-backs from pharmacies to physicians for clarification.⁴ Electronically sending and receiving prescriptions has streamlined the clinical practice workflow, and patient satisfaction and compliance have increased.⁵ Additionally, connecting physician and pharmacy systems has reduced paperwork and the associated mistakes that may occur from reliance on handwritten notes.⁶ This change has produced time and cost savings for all parties involved.

Even with all the benefits of e-prescribing, many providers and pharmacists have remained hesitant about completely adopting an e-prescribing system.⁷ The main purpose of this research study was to explore the benefits that e-prescribing has had in improving the efficacy, accuracy, and cost of prescribing in ambulatory care settings and to assess the barriers to its implementation.

E-prescribing systems can be incorporated into electronic health record (EHR) systems or can be stand-alone systems in the ambulatory care setting. EHR systems include patient information such as clinical notes, laboratory orders and results, and clinical decision support (CDS) functions that stand-alone systems do not provide.⁸ When e-prescribing is part of an EHR system, providers are able to access all patient information, not just prescription information.⁹ The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 proposed that healthcare professionals throughout the United States have access to EHRs and use them meaningfully according to standards set by the Centers for Medicare and Medicaid Services (CMS).¹⁰ The purpose of meaningful use is to use technology to coordinate and improve patient care.¹¹ E-prescribing is a way of using EHRs meaningfully because the technology is used to enhance the quality of patient care.¹² Allowing providers to access patient histories, diagnoses, and medication information increases patient safety by reducing

medical errors. The less expensive and easier-to-manage option is the stand-alone system for e-prescribing. Medication data that is pertinent for e-prescribing is the only information that providers are allowed to store and update in a stand-alone system.¹³ The use of an EHR system that allows providers to store and manage prescription information electronically has the potential to be safer and more cost efficient than the use of written prescriptions.¹⁴

In 2011, the United States spent \$263 billion on prescription drugs, which was a 2.9 percent increase from 2010.¹⁵ With this growth in the prescribing of pharmaceutical drugs, e-prescribing is expected to enhance the exchange of patient prescription information among many organizations including physician offices, pharmacies in retail settings, prescription benefit management companies, and insurance providers. E-prescribing has also helped to involve patients in the prescription process by automatically sending e-mails, text messages, or voice mails to the patients confirming a physician's order and pharmacy of choice; pharmacies can then notify patients by the same pathways when a prescription is ready.¹⁶ E-prescribing is also expected to increase the safety and quality of prescribing, enable patients to have more cost-effective medication choices, and enhance the efficiency of the ambulatory care workflow.¹⁷

Growth in e-prescribing came with the passing of the Medicare Prescription Drug, Improvement, and Modernization Act (MMA) of 2003.¹⁸ The MMA included the establishment of prescription drug coverage under Medicare as of January 2006.¹⁹ This Medicare Part D prescription plan has supported e-prescribing as a voluntary program for providers and pharmacists. It has the capability to make prescribing through Medicare more efficient and well-organized by reducing prescribing errors and coordinating patients' treatments.²⁰ To spur the use of e-prescribing for Medicare recipients, the Medicare Improvements for Patients and Providers Act (MIPPA) was passed in 2008.²¹ Additionally, the HITECH Act and the meaningful use standards set by CMS have also increased the overall use of e-prescribing in the United States.^{22, 23}

Methodology

This study's examination of the benefits of and barriers to e-prescribing was conducted following the basic principles of a systematic review. The research approach followed the steps and research framework utilized by Yao, Chu, and Li.²⁴ The use of this conceptual framework in the current study is appropriate because the focus of both studies is to show how new technologies can be applied to medical settings to enhance the care of patients.

The study was conducted in three stages: (1) identifying the literature and collecting the data, (2) analyzing and evaluating the literature found, and (3) categorizing the literature.

Step 1: Literature Identification and Collection

The key phrases "electronic prescribing" or "e-prescribing" were combined with the terms "Meaningful Use" or "ambulatory" or "quality" as inclusion criteria to search online scholarly databases for articles. Databases included EBSCOhost, PubMed, Academic Search Premier, and Google Scholar. The government websites of CMS, the Centers for Disease Control and Prevention, the US Drug Enforcement Administration (DEA), and the US Department of Health and Human Services, as well as the website of Center for Healthcare Research and Transformation, were used to obtain updated statistics and data regarding e-prescribing.

Step 2: Literature Analysis

Literature was selected for review in the categories of governmental acts, meaningful use, and benefits of and barriers to e-prescribing implementation. Given that the use of e-prescribing has been growing in recent years as a result of legislation and incentive programs, the search results were limited to those published between 2005 and 2013 in an attempt to stay current in research studies, and only studies written in English were included. E-prescribing was limited to the ambulatory care setting in order to distinguish the research topic from computerized provider order entry (CPOE) in hospitals. Only primary and secondary data from articles, reports, reviews, and research studies written in the United States were included in this research. References were reviewed and determined to have satisfied the inclusion criteria if the material provided accurate information about e-prescribing with particular attention to the benefits of and barriers to its implementation. The literature search was conducted by the first and second authors and was validated by the third author, who acted as a second reader and also double-checked that the references met the inclusion criteria. From a total of 138 initial references, only 47 sources were deemed suitable for use in this research study.

Step 3: Literature Categorization

Abstracts of the articles were reviewed first to determine the relevancy of the data to the study. If academic articles and studies were found to be relevant from the abstract reviews, the data were analyzed and categories were generated on the basis of the findings. The findings of the systematic review are presented in the results section below, in the categorizations of benefits and barriers of e-prescribing implementation.

Results

An important factor in the quality of patient care is whether medical errors are present.²⁵ In the United States, an estimated 200,000 deaths occur yearly from preventable medical mistakes and hospital infections.²⁶ Errors in medication prescribing and filling are some of the most common types of medical errors. Medication errors have been defined by the National Coordinating Council for Medication Error Reporting and Prevention as preventable events that may cause or result in inappropriate use of medications or harm to patients while the medication is being used by a healthcare professional, patient, or consumer.²⁷ These errors can occur in any part of the medication use process, which includes mistakes from prescribing to dispensing of the drug and monitoring of how it is taken.²⁸ The ambulatory care setting is the most common place for prescribing errors to occur.²⁹ (See [Table 1.](#))

An adverse drug event (ADE) can be the result of preventable or non-preventable medical interventions related to medications. ADEs are considered preventable if they are caused by medication errors, and potential ADEs are errors that could result in harm to the patient.³⁰ The Institute of Medicine has estimated that 1.5 million preventable ADEs occur in the United States each year and more than 7,000 patient deaths can be linked to poor handwriting and prescription filling errors.³¹ The patient may never be harmed if the error is discovered before it reaches the patient or if the error does not cause any negative effect.³²

Benefits and Advantages of E-prescribing Implementation

1. Patient Safety and Use of E-prescribing

Patient safety can be improved through e-prescribing by increasing prescription legibility, decreasing the time required to prescribe medications and dispense them to patients, and decreasing medication errors and ADEs.³³ The National ePrescribing Patient Safety Initiative started to provide physicians with a free e-prescribing web-based tool called eRx to encourage them to learn how to write prescriptions electronically in order to reduce preventable medication errors.³⁴ When e-prescribing is part of an EHR system, prescriptions can be checked for interactions with patient medications, health conditions, and allergies.³⁵ Kaushal et al. found that error rates decreased from 42.5 per 100 prescriptions to 6.6 per 100 prescriptions, nearly a seventh of the previous level, in just one year after the adoption of e-prescribing in 12 community-based practices.³⁶ In a prospective case study of 17 physicians in an ambulatory clinic conducted by Abramson et al., prescribing error rates decreased from 35.7 per 100 prescriptions to 12.2 per 100 prescriptions after one year of e-prescribing.³⁷ (See [Table 1.](#))

Most e-prescribing systems include medication decision support (MDS), which helps providers avoid errors in prescribing and ADEs. This program checks for drug-drug, drug-allergy, and drug-disease interactions as well as drug cost and dosing recommendations. Physicians who use an e-prescribing system integrated into an EHR system are more likely to use MDS. However, according to Kannry, there is little evidence that MDS used in this manner is more beneficial to patient safety and reduction of medication errors than when e-prescribing is part of a stand-alone system.³⁸ (See [Table 1.](#))

2. Efficiency of E-prescribing

E-prescribing improves the efficiency of the prescribing process. Though the actual entering of a new prescription takes about 20 seconds longer per patient than writing a prescription, this time is offset by the time saved because of the fact that less clarification is needed for electronic prescriptions.³⁹ Prescribers spent more time on the computer, on average an extra 6 minutes per prescriber per day or an increase of 20 seconds per patient when seeing 20 patients per day.⁴⁰ If implemented correctly, e-prescribing should cause little disruption in the workflow of ambulatory care settings.⁴¹ (See [Table 1.](#))

At the pharmacy, the entering of prescriptions is more streamlined when software allows for automated processing. An increase in efficiency is seen after implementing e-prescribing, mainly due to less paperwork and fewer issues needing to be

resolved (Petrus Lindeque, personal communication, April 14, 2013). Patient and prescriber names are matched up automatically by the system, while other fields are generally automatically populated but often require manual manipulation; the main fields are drug name, quantity, and patient instructions.⁴²

Providers have found that less time is spent resolving issues with pharmacies, including prior authorizations and refill requests.⁴³ By having patients' prescription formularies and eligibility information available, prescribers can pick an appropriate medication and reduce the probability of receiving a call from the pharmacy to change the medication to an alternative.⁴⁴

3. Cost Savings Associated with E-prescribing

E-prescribing has the potential to save money. An analysis of a study done by Surescripts between 2008 and 2010 estimated \$140 to \$240 billion in savings and improved health outcomes, mainly through improved medication adherence, over 10 years.⁴⁵ Large savings occur with the reduction of ADEs, mostly due to reduced visits to primary care offices and emergency rooms.⁴⁵ A study done in Massachusetts in 2006 found that each hospitalization due to an ADE costs about \$9,000; each emergency room visit, \$427; and each visit to the doctor's office, \$111. From these numbers an annual estimated savings of \$402,619 was found.⁴⁶ (See [Table 1.](#))

4. Increase in Patient Medication Adherence and Patient Cost Savings

Another potential cost savings results from the increase in patient medication adherence. Increased adherence to medication therapy can promote better health outcomes and reduce costs. The Surescripts study from 2008 to 2010 found a 10 percent increase in prescriptions picked up when e-prescribed compared to written prescriptions.⁴⁷ (See [Table 1.](#))

Along with medication adherence, substitution of generic medications or less costly formulary alternatives can reduce the cost to patients and insurance companies. E-prescribing systems that have employed MDS can help physicians choose a low-cost option that may be clinically better for the patient by eliminating bias. A study by McMullin, Lonergan, and Rynearson (2005) involving 19 clinicians found a 17.5 percent decrease in prescriptions for high-cost drugs among the intervention group compared to the control group.⁴⁸ This decrease led to savings of \$109,897 on new prescriptions in 12 months or an average of \$482 per prescriber per month during the follow-up study.⁴⁹ (See [Table 1.](#))

Meaningful Use and E-prescribing

The HITECH Act of 2009 proposed that eligible healthcare providers throughout the United States have access to EHRs and use them according to the standards for meaningful use set by CMS.⁵⁰ CMS has made e-prescribing one of the core requirements of meaningful use, requiring eligible providers to transmit at least 40 percent of eligible prescriptions electronically during Stage 1.⁵¹ Other meaningful use criteria that relate to e-prescribing include the ability of technology to check for drug-drug and drug-allergy interactions, the ability to maintain a medication list, and the ability to perform drug formulary checks.⁵² The e-prescribing provisions in Medicare have increased the overall use of e-prescribing in the United States. The number of electronically routed prescriptions increased from \$570 million in 2011 to \$788 million in 2012.⁵³ Through the EHR incentive program, CMS has provided incentive payments of \$44,000 for Medicare-eligible providers demonstrating meaningful use of EHRs through 2014; then, starting in 2015, eligible providers failing to demonstrate meaningful use will receive Medicare payments reduced by 1 percent, with penalties increasing to 5 percent in 2020.⁵⁴ Though these efforts have helped to increase the use of e-prescribing from 38 percent of prescriptions dispensed in 2011 to 44 percent in 2012, most prescriptions are still sent to pharmacies outside of an electronic system.⁵⁵

Barriers to Implementation of E-prescribing

1. Cost of Implementing an E-prescribing System

While e-prescribing offers many benefits, not all providers have been excited about implementing e-prescribing systems. A major barrier, reported by more than 80 percent of primary care physicians, has been lack of financial support.⁵⁶ New technology requires training and information technology support for installation and upkeep. A practice must take these costs into account when deciding whether to implement an e-prescribing system and also when choosing a stand-alone system or one that is integrated into an EHR system.⁵⁷ According to the Health Resources and Services Administration, in a 2007 study

the total cost of implementing an e-prescribing system was found to be \$42,332, with annual costs after implementation of about \$14,725 per year, for a practice of 10 full-time equivalent psychiatrists.⁵⁸ (See [Table 1.](#))

Policies and financial rewards are not sufficient incentives for all prescribers to adopt e-prescribing. Providers have faced many barriers with the complex technology and lack of complete patient record availability through e-prescribing systems.⁵⁹

2. E-prescribing System Errors

If an e-prescribing system has not been designed properly, new types of errors can occur. A major error is lack of alert specificity and overload of alerts, producing a phenomenon called alert fatigue: when presented with loads of alerts when each prescription is entered, prescribers tend to stop reading the alerts and just quickly scroll through them.⁶⁰ When alerts are ignored, a major interaction can be missed. One study done in 2010 found that design issues were among the reasons to stop using e-prescribing software; reasons included hardware problems (12.4 percent), workflow issues (27.9 percent), software problems (34.0 percent), and other problems (25.5 percent) such as cost, time consumption, and connection issues.⁶¹ (See [Table 1.](#))

3. Privacy and Legal Issues

Privacy of patient information can also be a concern for providers and patients. Most EHR systems are web based, and some deliver information wirelessly. Information can be leaked at numerous points, and if proper firewalls and intrusion prevention systems are not in place, the opportunity exists for protected patient information to be stolen.⁶² Most information breaches actually occur as a result of internal employees' actions, so continuous training on security is imperative and can incur additional costs.⁶³

Legal issues arise when providers need to prescribe controlled substances. On March 31, 2010, the DEA made a final ruling on e-prescribing of controlled substances that took effect on June 1, 2010.⁶⁴ The rule made it legal to transmit controlled substance prescriptions electronically, though the many standards contained in the ruling make it cumbersome to implement. These standards include identity proofing, two-factor authentication, digital certificates, monthly logs, third-party audits of software, and a requirement to keep two years of records.⁶⁵ Potential costs of implementing these systems were estimated by the DEA in 2010 to be between \$43 million and \$1.54 billion for different options that include features such as identity proofing, authentication protocols, and various security requirements.⁶⁶

Discussion

The purpose of this research was to explore the benefits that e-prescribing has had on the efficacy and accuracy of prescribing in clinical settings throughout the United States. The results of this study suggest that increasing use of e-prescribing has resulted in improved patient safety, cost savings, and a more streamlined and efficient prescribing process.

More medications are being prescribed than ever before, and with this increase comes the potential for more mistakes. E-prescribing has eliminated some of the possibilities for mistakes and can potentially help prevent more than 2 million ADEs a year, 130,000 of which are life threatening.⁶⁷ It also has been shown to reduce medication errors in the ambulatory setting by as much as sevenfold. E-prescribing removes mistakes due to illegibility and helps providers make better informed decisions about what medications to prescribe on the basis of patient histories and allergy data, all of which are available in systems that are integrated with EHRs. The systems alert prescribers when an allergy or interaction with other medications or health conditions is detected. A problem with these alerts is that in some cases alerts pop up when there is minimal risk or when there is not a true complication. Prescribers may be overloaded with alerts and click through them rather than read each one, potentially missing an important interaction.

E-prescribing also helps to make patient care more efficient. It streamlines the process of getting the prescription to the pharmacy, dispensing the medication, and obtaining refills. Because the patient is not given a hard copy of the prescription, the potential for losing the prescription is eliminated. The instances of pharmacy-initiated clarifications have decreased, reducing the amount of time pharmacists and providers spend on the phone and thus reducing the time taken to fill the prescription and get it to the patient. Increased compliance and monitoring of compliance are also results of implementing e-prescribing.

The potential for cost savings has been estimated to be \$27 billion per year in the United States.⁶⁸ Cost savings are created through reduction in ADEs, improved efficiency, and improved provider access to formularies. The amount of time that is spent dealing with clarifications is greatly reduced, allowing prescribers to focus on patient care. Cost savings, along with incentives and improved efficiency, will increase the use of e-prescribing in the future.

Another purpose of this study was to explore the barriers to implementing an e-prescribing system, the primary one being cost. Many smaller practices have had a hard time with both the cost of the system and the cost of training staff.⁶⁹ Although the HITECH Act has provided incentives for meeting the meaningful use requirements, providers continue to incur substantial costs in implementing and supporting their health information technology systems.

Another hindrance is an inability to send controlled substances as electronic prescriptions. For some prescribers, controlled substances represent a large portion of the medications they prescribe. New legislation has made it possible to send controlled prescriptions, but there are many stipulations that make doing so difficult. An issue also arises with the inability of multiple systems to share information effectively because of the lack of interoperability, which reduces the effectiveness of e-prescribing systems. Errors that arise from lack of alert specificity and overload can result in major drug interactions.

This research study could be limited by the search strategy used and the number of databases searched, and publication bias may have restricted the articles that were available for this review. Researcher bias may have been an issue because articles were evaluated by the researchers to determine the relevancy to the study. Research on e-prescribing in ambulatory care settings is also limited compared to that in hospital settings. Fewer studies have addressed the benefits of e-prescribing and error reductions in the ambulatory setting as compared to hospital settings.

Conclusion

The findings of this research study suggest that e-prescribing has the potential to increase patient safety and patient medication adherence; create cost savings for medical clinics, hospitals, and patients; and improve efficiency in the ambulatory care setting. However, barriers to its implementation still persist, the main one being the cost of implementation.

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Table 1**Benefits and Barriers to the Adoption of E-prescribing**

Author and Year	Study Design	Result
McMullin, Loneragan, and Rynearson (2005)	Follow-up analysis with two database queries to identify additional prescription claims data for all Network Health Plan patients included in the authors' original six-month study.	Found a 17.5 percent decrease in prescriptions for high-cost drugs among the intervention group compared to the control group, which resulted in a savings of \$109,897 on new prescriptions in 12 months.
Weingart et al. (2009)	Study of 279,476 alerted prescriptions from Massachusetts ambulatory care clinicians using a single e-prescribing system to estimate the likelihood and severity of an ADE with each alert.	Each hospitalization due to an ADE costs about \$9,000; each emergency room visit, \$427; and each visit to the doctor's office, \$111. An annual estimated savings of \$402,619 was found on the basis of these numbers.
Devine et al. (2010)	A direct observation and time-motion study conducted in three community-based primary care clinics to evaluate the impact of e-prescribing on prescriber efficiency.	Prescribers spent more time on the computer. On average, prescribers spent an extra 6 minutes per day, or 20 seconds per patient for prescribers seeing 20 patients per day.
Kaushal et al. (2010)	Nonrandom prospective study of 15 providers who adopted e-prescribing compared with 15 providers who still used paper prescriptions to monitor prescribing error rates.	Prescribing error rates decreased from 42.5 per 100 prescriptions to 6.6 per 100 prescriptions in one year, nearly a seventh of the previous level, after the adoption of e-prescribing.
Abramson et al. (2011)	Prospective case study of 17 physicians in an academic-affiliated ambulatory clinic with an enhanced clinical decision support e-prescribing system to observe prescribing errors.	Prescribing error rates decreased from 35.7 per 100 prescriptions to 12.2 per 100 prescriptions after one year of e-prescribing.
Kannry (2011)	Literature review of e-prescribing with MDS to determine where MDS enhances patient safety.	Found little evidence that e-prescribing with a MDS program is more beneficial to patient safety and reduction of medication errors than when e-prescribing is part of a stand-alone system.
Surescripts (2012)	Reviewers analyzed de-identified data sets from 40 million prescription records that compared medication adherence in patients with e-prescriptions vs. paper, phoned-in, and faxed prescriptions.	\$140 billion to \$240 billion in estimated savings and improved patient health outcomes, mainly through improved medication adherence, over ten years. Increase of 10 percent in prescriptions picked up when e-prescribed compared to written prescriptions.
Health Resources and Services Administration (2013)	Case study that examined the implementation and costs of an e-prescribing system in a 10-FTE practice of psychiatrists in a nonprofit public mental health agency.	Found a cost of \$42,332 to implement an e-prescribing system, with annual costs after implementation of about \$14,725 per year.
Jariwala et al. (2013)	Internet survey administered to a national convenience sample of physicians to observe e-prescribing implementation.	Reasons to stop using e-prescribing software included hardware problems (12.4 percent), workflow issues (27.9 percent), software problems (34.0 percent), and other problems (25.5 percent), such as time consumption and connection issues.

Abbreviations: ADE, adverse drug event; FTE, full-time equivalent; MDS, medication decision support.

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