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Improving Medication Safety in Ambulatory Care—The Role of E-Prescribing

Issue Brief

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Introduction

The first Issue Brief in this series described how innovations in health IT have produced measurable and important advances in health care quality and safety, but that the full potential of health IT has not yet been reached.[1] In this Issue Brief we focus specifically on electronic prescribing, or e-prescribing, as an important example of this duality. While e-prescribing has proven its ability to reduce the incidence of medication errors, these errors remain the most common type of avoidable serious adverse events in health care, particularly in the ambulatory setting. We review the evidence on the benefits of e-prescribing, as well as the residual problem areas. We conclude that much more can be done to make medication prescribing safer and easier to use. A number of recent valuable resources, identified here, should help drive enhancements to e-prescribing.

E-Prescribing Landscape

E-prescribing refers to a prescriber's ability to send an accurate, error-free, and understandable prescription directly to a pharmacy from the point of care through a dedicated secure network. Most prescribing and use of e-prescribing occurs in ambulatory care settings where prescribing errors have been common[2] and where e-prescribing has great potential to improve medication safety.

The adoption of e-prescribing and the use of interoperable electronic health records (EHRs) has been promoted by several major health policy programs in the United States, including the Medicare Prescription Drug, Improvement, and Modernization Act (MMA) of 2003[3] and the Medicare Part D prescription drug plan.[4] The Medicare Part D prescription drug plan supports e-prescribing as a voluntary program for providers and pharmacists, recognizing that e-prescribing can make prescribing through Medicare more efficient and well organized, while also reducing prescribing errors. The Medicare Improvements for Patients and Providers Act (MIPPA) (also called the "eRx Incentive Program") was passed in 2008 to accelerate e-prescribing for Medicare recipients, and included financial incentives to adopt and use this new technology.[5] The HITECH Act and the Meaningful Use standards set by the Centers for Medicare and Medicaid Services (CMS) have also increased the use of e-prescribing.[6,7]

The trend in physician e-prescribing using an EHR has increased rapidly since 2008. As of April 2014, 70% of physicians were e-prescribing using an EHR on the Surescripts network, a significant increase from 7% of physicians in 2008 when MIPPA was passed and from 24% of physicians when the Medicare and Medicaid EHR Incentive Programs began.[8] All states report physicians e-prescribing at a rate above 40%. The accelerated adoption reflects not only the incentive program, but also the value that providers find with e-prescribing and associated functionalities.[8,9]

The growth in e-prescribing has not been limited to physicians. In the same period, the percentage of community pharmacies enabled to accept e-prescriptions grew from 76% to 96%, and in some states almost all community pharmacies are enabled to accept e-prescriptions.[8] The growth in physicians and pharmacies using e-prescribing corresponds with a thirteen fold increase in the growth of new and renewal prescriptions sent electronically. In 2008, 4% of new and renewal prescriptions were sent electronically, compared to 57% in 2013.[8]

Importance of Medication Safety in Ambulatory Care

Patient safety presents a unique set of challenges in ambulatory care settings for multiple reasons, including the episodic nature of care, the reality that care is distributed over different providers and settings, and difficulties in monitoring the quality of care in this complex environment and providing this feedback to providers.[2] A recent systematic review examining patient safety in primary care concluded that medication errors remain common.[2] Prescribing is the step that is most susceptible to error, and both elderly patients and the young are at greatest risk for harm.[9,10]

Outpatient prescribing errors contribute to the estimated 8 million adverse drug events (ADEs) each year in the United States.[10] Approximately 500,000 of these ADEs are considered life-threatening events, and many or most of them are considered to be preventable. In an important patient safety study, approximately 25% of primary care patients reported having an ADE; and of these, 13% were judged to be serious.[10]

A study of four academic practices found a medication error rate of 8%. The findings also showed that more advanced computer checks with decision support could have prevented 95% of potential ADEs. Another study involving community practices found a medication error rate of 37%, with prescriber legibility issues being very common.[11]

Evidence of the Benefits of E-Prescribing

E-prescribing gives ambulatory care providers an important tool to safely and efficiently manage patients' medications. Compared with paper or fax prescriptions, e-prescribing provides a number of benefits. In a survey of prescribers, respondents reported that e-prescribing improved the quality of care delivered (78%), prevented medical errors (83%), and enhanced patient satisfaction (71%) and clinician efficiency (75%).[12]

Medication Safety

In several review studies, e-prescribing was found to improve medication safety for both stand-alone e-prescribing systems and those integrated with EHRs.[13-15] E-prescribing improves medication safety by improving prescribing legibility and accuracy, and reducing prescription errors and ADEs.[15] Abramson et al. quantitatively evaluated prescribing errors

early after EHR implementation and after sustained use among community-based primary care providers, and found relatively low rates of errors with e-prescribing early adopters, which were sustained after prolonged use.[16] Powers et al. investigated whether physicians who meet the Meaningful Use stage 2 threshold for e-prescribing (greater than 50% of prescriptions are e-prescribed) have lower rates of ADEs among their diabetic patients. They found that e-prescribing to Medicare beneficiaries with diabetes is associated with reduced risk of hospital or emergency department visits for hypoglycemia or ADEs related to antidiabetic medications.[17]

Cost Savings

E-prescribing can result in significant cost savings for both payers and patients. An analysis by Surescripts between 2008 and 2010 estimated $140 to $240 billion in savings over 10 years as well as improved health outcomes, mainly through improved medication adherence. E-prescribing increased the number of prescriptions that successfully reached the pharmacy by 12%, and increased the number of prescriptions picked up by patients by 10%.[18] Large savings are associated with the prevention of ADEs, and avoiding visits to primary care offices and emergency departments.[19] E-prescribing also contributes to cost savings by preferential prescribing of generic medications and less costly formulary alternatives.[20]

Increased Practice and Pharmacy Efficiency

E-prescribing can improve practice efficiencies because of the reduced number of calls to resolve issues with pharmacies, such as drug authorizations and refill requests. The patient's prescription formulary and eligibility information is often available in e-prescribing systems, and prescribers can then pick an appropriate medication and lower the probability of receiving a call from the pharmacy to change the medication to an alternative.[21-24]

At the pharmacy, entering prescriptions is also streamlined with software that allows for automated processing, resulting in less paperwork and fewer issues to be resolved.[9,23]

Prescriber and Patient Satisfaction

Providers report satisfaction with e-prescribing. In a study of primary care providers, most e-prescribers (83%) reported satisfaction with their e-prescribing system and a preference for e-prescribing over traditional prescribing. Although 22% of respondents indicated that they have started and stopped e-prescribing, most have resumed or intend to resume e-prescribing in the near future.[25]

E-prescribing is popular with patients as well. A recent survey found that 93% of respondents were satisfied with the e-prescribing process and 81% said they preferred it to using paper prescriptions.[26]

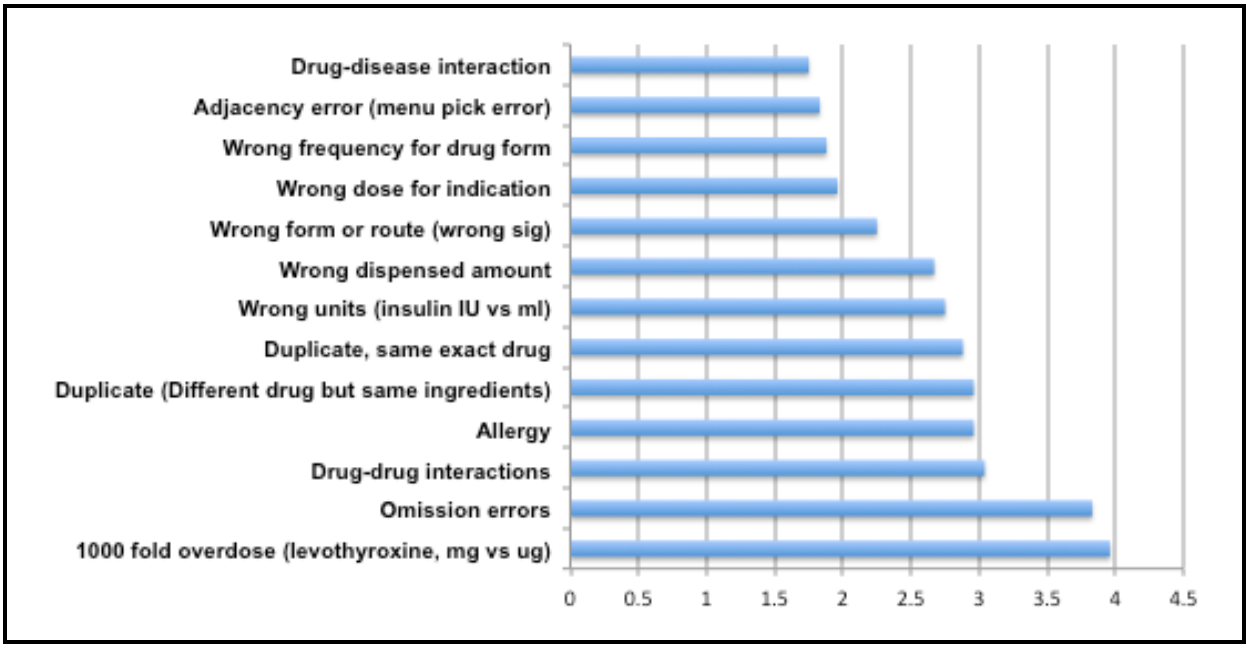
Reaching the Full Potential of E-Prescribing

The evidence that e-prescribing improves safety is convincing and continues to accrue. However, like other health IT innovations, it does not solve all prescribing-related problems. Before the full potential of e-prescribing can be met, several challenges need to be addressed.

First, e-prescribing does not eliminate prescribing errors. Even with extensive training provided to the physician users, residual error rates post-implementation in one study were 6% after 1 year of use.[16] An audit of 3,850 e-prescriptions in 2008 identified 12% with errors, a third of which were judged to be potentially harmful. The most common problem (61% of all errors) was omitted information (e.g., duration of treatment, dosage, number to dispense). Other types of errors were also encountered, including conflicting information and inappropriate abbreviations.[27] An observation in this study that deserves follow-up was that error rates varied substantially among different e-prescribing software platforms, ranging from 5% to 38%.[27]

The variability encountered across e-prescribing platforms echoes similar observations using computerized order entry (CPOE) systems for inpatient care. Based on an analysis of over 10,000 errors identified in the MEDMARX database, Schiff and colleagues identified 21 recurring error scenarios and tested these in 13 different CPOE systems at 16 sites. Substantial differences were found, both across the various CPOE systems and across vulnerabilities (**Figure 1**).[28]

Figure 1. Vulnerability Across Different E-Prescribing Platforms to Prevent Specific Types of Prescribing Error Scenarios



Note: A completely safe system would achieve a score of "5," and a completely unsafe system would score "1." Averages reflect the aggregate score from testing each scenario in 13 different CPOE platforms. Data from Schiff et al., 2015.[28]

The internal quality monitoring programs conducted by proprietary pharmacy programs provide informative insights on the types of problems encountered with e-prescribing. Data from the Surescripts program, for example, identifies problems with prescriptions that are confusing, incomplete, and inconsistent (**Table 1**). Many of these problems originate from prescribers using free text "Notes" fields to provide clinical information that is either inappropriate, confusing, or in conflict with other patient direction information.[29,30] Both the ONC[30] and the National Council for Prescription Drug Programs (NCPDP)—a standards development organization—have provided guidance on the proper use of these free text areas.[31]

Table 1. Types of Problems Using E-Prescribing, Compiled by the Surescripts Quality Monitoring Program, and Suggested Solutions[29]

Problem	Solution
Conflicts created by inappropriate use of the free text Notes field, especially in selecting a drug	▪ Regular drug database updates by the vendor and practice sites ▪ Limit ability to free text drug descriptions ▪ Standardize drug descriptions across the industry
Improper use of the patient direction (Sig) builder tool ▪ Incomplete or abbreviated instructions ▪ Conflicting patient direction(Sig) information in the free text Notes field	▪ Adopt the Structured Codified Sig Standard ▪ Enter free text in the Sig Builder, not in the free text Notes field
Appropriate selection of quantity and quantity qualifier (QQ) values ▪ Incomplete or non-metric values used	▪ Display to users all commercial package sizes along with corresponding metric quantity and QQ choices ▪ More accurate mapping of proprietary drug databases to NCPDP QQ code list
Conflicting days supply and quantity information	▪ Include "length of therapy per Rx fill" instead of days supply ▪ Avoid default values of days supply ▪ Better use of clinical decision support to check entries and alert providers to errors
Clinical or conflicting information sent in the free-text Notes field	▪ Better labeling instructions and user training ▪ Codification of the Notes field
Consistent use of final prescription summary screen	▪ Enforcing use of the summary screen to enable prescribers to see content as received by the pharmacy
Enabling e-prescribing of controlled substances ▪ Difficulty tracking prescriptions for controlled substances ▪ Inefficient process if both paper and e-prescription are used	▪ Adopt and use of electronic controlled substance providing by vendors and users

Abramson and others discussed some of the frustrations and difficulties associated with e-prescribing, including hardware, software, and usability problems.[11,25] The difficulties include the need for better training as well as the inevitable disruption of changing from a practice pattern used for years to a new one that is not completely intuitive and may take more time, at least initially, than the handwritten prescription system it replaces. Busy clinicians often do not have or take the time to learn how to use potentially timesaving features. Even with adequate training and implementation, usage may require an irritating number of mouse clicks, hard-to-navigate (and easy to misuse) drop-down menus, and inflexible data entry or search engines.

Users of e-prescribing in ambulatory care settings encounter many of same problems experienced in the inpatient setting using computerized order entry (CPOE) for medication ordering.[32-34] Both of these systems can take advantage of clinical decision support, which has high potential for both detecting and reducing medication errors. The Office of the National Coordinator for Health IT (ONC) has specific resources to promote safe use of CPOE, and medication ordering is one of the key focus areas in these SAFER guides.[35]

There is a need to improve decision support by streamlining knowledge bases and maximizing alert effectiveness and acceptance. Alert fatigue has emerged as the signature problem for both CPOE and e-prescribing. These safety alerts are designed with the best of intentions, but usage problems abound in actual practice. For example, providers override 49–96% of these alerts, finding them either irrelevant, repetitious, inaccurate, or too annoying.[36] Proposals to address alert fatigue focus on making alerts more intelligent, improving data displays, and streamlining knowledge bases.[37,38] Alerts need to prioritize the medication issues with the highest risk of harm. A trial of tiered alerts, for instance, increased accepted alerts from 20% to 67% (**Figure 2**).[39,40]

Figure 2. Example of a Tiered Alert Approach Designed to Reduce Alert Fatigue[37]

TIERED ALERTS

- **Level 1** – Potentially life-threatening; Creates a hard stop; user cannot proceed.
  Example: Increased risk of ventricular fibrillation in patients on diltiazem who are prescribed erythromycin
- **Level 2** – Potential for serious injury; Creates an interruption; user has to respond.
  Example: Interaction of rizatriptan with linezolid to increase risk of the serotonin syndrome
- **Level 3** – Use with caution; Displays but does not interrupt workflow.
  Example: Increased prothrombin time in patients on warfarin who are prescribed levofloxacin

The Future of E-Prescribing

The use of e-prescribing will almost certainly continue to increase, reflecting the expectations of the CMS Meaningful Use program and the growing satisfaction with e-prescribing among both providers and patients. It is very likely that as this young, innovative technology matures, both users and vendors will be able to make substantial progress in addressing the spectrum of issues that currently detract from usability and safety. A number of publications have summarized problems that need to be addressed, and have provided recommendations on the needed improvements.[13,16,39,41-43] Follow-up studies of the same e-prescribing system show that medication error rates continue to improve over time as initial concerns are remedied.[16] Besides resolving known problems with existing systems, health informatics innovations offer the opportunity to address new safety concerns that emerge from safety monitoring programs.[44]

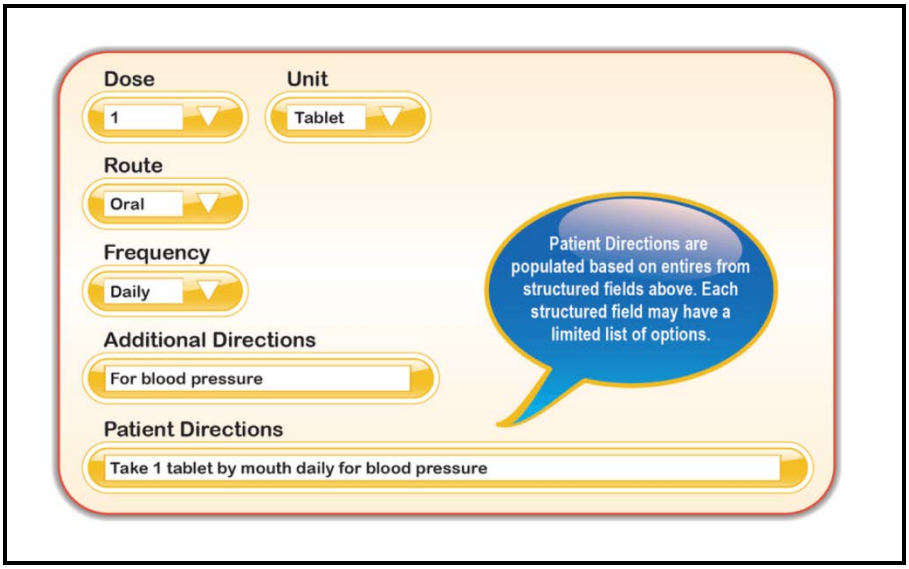
In a landmark 2006 report, the Institute of Medicine presented a unified vision for "Identifying and Preventing Medication Errors" and outlined the efforts that would be needed on the part of consumers, providers, healthcare organizations, industry, research, and oversight organizations.[45] More specific guidance is available through resources collected by the ONC in a document entitled A Prescription for e-Prescribers: Getting the Most Out of E-Prescribing.[30] This resource outlines a workflow and process for creating and managing a prescription electronically and provides guiding questions and advice for each process. The specific recommendations for improving e-prescribing are based on those from the NCPDP. Recommendations based on these standards include the following:

- Reviewing an actionable medication history record for each patient
- Using standardized and structured drug descriptions and names
  - Using a standardized patient direction-building tool that allows the use of free text for complicated prescription regimens. (Additional best practices can be found in the current NCPDP SCRIPT Implementation Recommendations[31] or Surescripts Quality Best Practices Guidelines[46] [**Figure 3**].)
- Utilizing decision support resources to view any alerts or advisories.

The Pharmacy Health IT Collaborative, a national coalition of pharmacists and professional organizations, has endorsed a wide range of e-prescribing and medication-management measures supporting the goals of improving safety.[47] One of the key recommendations is using standard medication vocabularies, such as RxNorm from the National Library of Medicine.[48] Industry guidelines comprise another source of best practice guidance.[22]

Safety will also be improved by more widespread use of the Universal Medication Schedule (UMS), which standardizes, simplifies, and clarifies the instructions for the patient by using best practices from the fields of health literacy, safety science, and patient education.[31,49-51]

Figure 3. Screenshot Example of a Patient Direction Tool for E-Prescribing[31]



The UMS recommendations are grounded in medication-timing to four time periods and replace the use of teaspoons, tablespoons, and ounces with instructions solely based on the metric equivalent in milliliters, along with recommendations to always provide a milliliter measurement device to the patient with each prescription, if needed.[52] More recently, the UMS concept has been expanded to promote more patient-friendly drug labeling, which improves comprehension, medication adherence, and overall safety.[51,52]

E-prescribing could also play an important role in making the pharmacist a more effective member of the health care team. The many benefits of including pharmacists on primary care teams,[53] including teams within accountable care organizations,[53,54] are well recognized, and include intercepting medication errors, improving patient compliance, and reinforcement of health goals.[54,55] Although the pharmacist in most e-prescribing programs is physically remote from the ordering clinician, the e-prescription platform can simulate direct involvement by enabling and facilitating bidirectional communication, promoting efficiency (by eliminating phone calls back and forth), and improving safety and care coordination at the same time. What is needed at this point are new practice standards and collaborative practice agreements to help accelerate the adoption of this practice, as well as payment models and work flow adaptations that encourage its use.

Summary and Conclusions

E-prescribing has reduced medication errors and will continue to improve medication management safety as the shortcomings of existing products and processes are recognized and addressed. Although much has been gained through health information technology to improve medication safety, medication errors remain the leading cause of adverse events in

medicine,[56,57] a reality that provides the impetus for continuous improvements in e-prescribing. It is the medication ordering step, at the interface between the ordering clinician and the computer that is most commonly involved.[28] A second challenge for e-prescribing, as with many other aspects of health IT, it to improve usability, a key expectation of the Meaningful Use provisions.[58]

The e-prescribing platforms now available address many of these problems, and continuing attention to these issues will be paramount in optimizing safe use in the future. Ultimately, medication safety will be enhanced when all providers have the necessary and usable information to manage a patient's medications, and e-prescribing of the future should support this.

Medication prescribing needs to meet several different goals. From the perspective of an ambulatory care provider, speed and efficiency are the keys; from the pharmacy perspective, accuracy is paramount; and from a safety perspective, the goal is to optimize all of the following at the same time—user performance, system functionality, intelligent use of data and knowledge, and effective integration of these elements in everyday workflow.

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