Effects of Standards-based Electronic Prescribing Systems on Outpatient Primary Care Practice: A Physician Survey

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Abstract

Objective: To compare the experiences of e-prescribing users and non-users regarding medication management safety, quality, and workload, with a focus on medication history and formulary and benefit information -- two proposed standards for e-prescribing.

Research Design: We conducted a cross-sectional survey of physicians who had either installed or were on the waiting list to install one of two commercial e-prescribing systems.

Results: Of 395 eligible physicians, 228 (58%) completed the survey. E-prescribers were more likely than non-e-prescribers to perceive that they have enough information to identify clinically important drug-drug interactions (83% vs. 67%, p=0.04) and prevent callbacks from pharmacies for safety problems (68% vs. 54%, p=0.02). E-prescribers reported the same level of effort as non-e-prescribers in dealing with drug coverage problems. Among e-prescribers, only 37% were familiar with a feature that each system had for accessing medication history information from the patient's health plan. Many perceived that formulary and benefit information is more than occasionally missing (43%) or wrong (14%). Even though most e-prescribers were satisfied with the systems overall, 17% said they had quit using the system and 46% sometimes reverted to handwriting for prescriptions that they could write electronically; technical difficulties were the top reasons for non-use.

Conclusion: E-prescribing users reported patient safety benefits but they did not perceive the expected incremental benefits associated with using standardized medication history or formulary and benefit information. Mandating the use of these standards may not result in desired effects without additional work to improve the infrastructure in which they are used.

Introduction

Ambulatory electronic prescribing (e-prescribing) is a form of health information technology that is expected to have particularly strong and immediate benefits for multiple stakeholders in health care, including improved workflow for physicians, improved safety and access to medications for patients, and more cost-effective medication use for payers.[1-3] Yet for e-prescribing systems to create these benefits, they need to go beyond simply authoring and storing prescriptions to incorporate more advanced decision-support features such as drug interaction alerts based on the patient's complete medication list and guidance in selecting medications that match the patient's drug benefits.[1, 4, 5] Because most patients in the U.S. receive their pharmaceutical care from a network of organizations including retail pharmacies, prescription benefit management companies, and health plans, implementing advanced e-prescribing features requires the use of standards for exchanging data among these organizations.[6-8]

Recognizing the importance of standards for interoperable data exchange in e-prescribing, the Medicare Modernization Act of 2003 (the MMA) required the U.S. Department of Health and Human Services to issue a set of initial standards for electronic prescribing under Medicare by 2008.[9, 10] The MMA also required pilot testing of proposed standards for which there is not "adequate industry experience." Of the 6 standards that required pilot testing,[9] two — the *Medication History (MH) transaction of the NCPDP SCRIPT standard,* and the *NCPDP Formulary and Benefit (F&B) Standard* — are currently in use among some commercial e-prescribing systems, offering the opportunity to evaluate their use in actual patient care.

E-prescribing standards, like any structural component of health care, should be evaluated based on the extent to which they enable improvements in health care processes and

outcomes.[11, 12] In the case of the medication history standard, benefits are expected from the information's use in constructing more complete and accurate medication lists, which, in turn, could enable better drug interaction checks to avert potentially hazardous prescriptions as well as reminders for important omitted medications.[4] Previous studies have found that while safety alerting was common among commercial e-prescribing systems, the systems rarely integrate data from external sources to support this alerting.[5, 13] Obtaining standardized formulary and benefit information could help providers to minimize patients' out of pocket costs and to negotiate better patient adherence.[14] Both of these features could improve prescribers' workflow through the avoidance of telephone calls from pharmacies, pharmacy benefit managers (PBMs) or health plans when prescriptions are rejected due to safety or coverage problems. However, the extent to which the standards, as currently implemented, actually deliver these hypothesized benefits is not known.

The purpose of this study was to evaluate the experiences of outpatient e-prescribing with either of two commercially available systems which incorporated medication history and formulary and benefit standards. The study was designed to compare e-prescribing physicians' perceptions of medication history and formulary and benefit information quality, office workload, as well as prescribing safety and quality, with the perceptions of physicians who planned to use but had not yet installed these same e-prescribing systems.

Methods

Study Setting

Horizon Blue Cross Blue Shield of New Jersey (Horizon) launched an e-prescribing sponsorship program in late 2004, with plans to support the installation, training and ongoing use

of e-prescribing for up to 1000 prescribers. The e-prescribing systems made available were the Caremark iScribe® product, the Allscripts TouchScript® product, and the InstantDx OnCallData™ product, all of which were stand-alone e-prescribing systems without full electronic health record functionality. The program enrolled and installed e-prescribing systems for individual physicians rather than practices as a whole. Participants were required to be a Horizon network provider and to have high-speed Internet access in their office as well as a computerized practice management system capable of uploading patients' demographic information to the e-prescribing system. Once installed, prescribers could use the tool to write and transmit prescriptions for any patient, regardless of their insurance. The program covered the costs of hardware, software, installation, and training (estimated at $4200–$6400 per prescriber), and supported ongoing use of e-prescribing through quarterly honoraria of $150 to $500 per prescriber based on the estimated proportion of prescription claims written electronically and participation in biannual surveys.

Survey content

We developed a 35-item survey to assess prescribers' perceptions regarding various aspects of the prescribing process. The survey included questions about: 1) practice characteristics and prescriber demographics; 2) adequacy of currently available drug formulary and medication history information; 3) use of and barriers to using the e-prescribing system, including the formulary and benefit information and the medication history information provided by the system (e-prescribers only); 4) and computer-oriented attitudes and skills. Some survey questions were adapted from existing survey instruments.[15-19] We adapted an existing instrument to assess attitudes toward computers[20] (this adaptation included 6 items, maximum score 30 points). Draft questionnaires were revised for clarity, uniformity of language and appropriateness

of response categories by a survey research expert (MB) informed by pilot testing with 6 practicing physicians in Boston and Los Angeles.

Sampling and Data collection

Eligible physicians were sampled from those enrolled in Horizon's e-prescribing sponsorship program as of September, 2006. InstantDx enrollees were excluded because few practices had completed installation of this system at the time of the survey. For the e-prescribing group, we randomly sampled 250 of the 602 physicians who had completed iScribe installation and 50 of the 70 physicians who had completed Allscripts installation. For the non-e-prescribing group, we randomly sampled 200 of 249 physicians who had enrolled in the Horizon e-prescribing program and were on the waiting list for installing an e-prescribing system, but were not scheduled for installation before the end of 2006. For each e-prescribing physician, Horizon provided data on their volume of e-prescribing use. Physicians were excluded if they were retired, deceased, on leave during the survey period, or no longer in practice at the location of record with Horizon.

Recruitment for the survey began in October, 2006, with a faxed letter from Horizon introducing the study and offering $100 for survey completion. Three days later RAND sent each physician an e-mail invitation containing a randomly-assigned personal identification number to take the survey on the RAND survey website. We telephoned providers who had invalid, undeliverable or non-unique email addresses to obtain unique and correct email addresses where possible. Non-responders were sent weekly e-mail reminders. Six weeks after the start of the survey, we telephoned non-responders and new email prompts were sent when requested. A final reminder was sent by express mail to non-responders during the final week of the field period.

Recruitment efforts were completed in December, 2006. The RAND Institutional Review Board approved the study.

Data Analysis

Survey data analysis included descriptive statistics for each survey item, chi-squared tests to compare distribution of responses on categorical variables and Kruskal-Wallis equality-of-populations rank test to compare the distribution of responses to Likert scale items between e-prescribers and non-e-prescribers.

We used Pearson correlation coefficients to examine the association between data on clinician's e-prescribing use provided by Horizon and their self-report on the survey. We used logistic regression analysis to compare multiple factors associated with dichotomous outcomes (e.g. stopping vs. continuing use of the system).

Results

Survey Response and Prescriber Characteristics

Among the 500 sampled providers, a deliverable, unique email address was not found for 89 (18%), leaving 411 who were actually invited by email. Of these, 16 were ineligible because they were no longer in practice at their location of record. Of the 395 eligible respondents 228 (58%) completed the survey. Response rates were similar for Allscripts vs. iScribe enrollees (57% *vs.* 58%; p=0.9) and for e-prescribers vs. non-e-prescribers (59% vs. 56%; p=0.49). However, among e-prescribers, survey responders wrote more electronic prescriptions than non-responders (average 129 vs. 76 e-prescriptions per month; p=0.002), according to e-prescribing volume data provided by Horizon. All e-prescribers had started using the system at least four weeks prior to the survey (mean duration of use=12 months; SD= 11 months).

Most respondents were in solo practice or single-specialty groups, and most were located in small physician offices (**Table 1**). A majority of respondents were from traditional primary care practices such as family medicine, general internal medicine and pediatrics (63%) but other specialties and subspecialties were well-represented. Respondents' mean age was 47 (SD= 10; range 27 to 82). Approximately 20% of prescribers also used an electronic medical record in their practice. There were no statistically significant differences between e-prescribers and non-e-prescribers in age, composition of practice, or electronic medical record use. The e-prescriber group had modestly lower proportions of hospital-based physicians, physicians in larger practices (p=0.002), and non-primary care specialists (p=0.049).

All providers had positive attitudes towards computer use (Mean= 24.3; SD= 4.2), and their attitude scores did not differ significantly between e-prescribers and non-e-prescribers. The 6 items in the computer attitudes scale had a Cronbach's alpha of 0.90.

Experiences of E-Prescribers vs. Non-e-prescribers

E-prescribers and non-e-prescribers did not differ significantly in the resources they found useful for finding out about patients' medication histories. Most prescribers reported that they find medication history information elicited by a nurse or office staff member to be useful "most of the time" or "always" (64 % e-prescribers vs. 73% non-e-prescribers; p=0.26). A minority of prescribers reported that reviewing patients' actual medication bottles is useful "most of the time" or "always" (22% e-prescribers vs. 25% non-e-prescribers; p=0.94). Yet few reported that claims information from a patient's insurance is useful "most of the time" or "always" (4 % e-prescribers vs. 4% non-e-prescribers; p=0.72), despite that fact that a claims history feature based on the medication history standard was available in both of the e-prescribing systems studied.

E-prescribers were more likely than non-e-prescribers to "agree" or "strongly agree" that the information they typically have available about the patient's medication history helps them to identify clinically important drug-drug interactions (p=0.04), and to prevent call backs from pharmacies for potential safety problems (p=0.02). However, e-prescribers were not more likely to perceive the benefits that depend specifically on external medication history information, such as identifying medications prescribed by other providers (p=0.42), and keeping track of medications patients have tried in the past (p=0.55). E-prescribers also did not perceive that the medication history information they typically have enables them to prescribe medications more safely overall (p=0.17). (**Table 2**)

E-prescribers and non-e-prescribers reported similar rates of dealing with drug coverage problems. Most prescribers reported getting 10 or fewer calls about drug coverage problems in a typical week (76% of e-prescribers vs. 71% of non-e-prescribers; p= 0.64). Most also reported spending 30 minutes or less dealing with drug problems in a typical day (88% of the e-prescribers vs. 84% among the non-e-prescribers; p=0.54).

Experiences Specific to E-Prescribers

Use of e-prescribing. Among e-prescribers, 37% reported using the system to write all of their prescriptions (except DEA Schedule II Medications, which were not available in e-prescribing), 46% reported using the system for some prescriptions, and 17% reported that they were no longer using the system for any prescriptions. This self-report closely matched the e-prescribing volume data provided by Horizon — none of those who reported having stopped using e-prescribing had written electronic prescriptions within the 60 days prior to the start of the survey. Among those who had stopped, their mean e-prescribing volume was 51 prescriptions per month (SD=87) prior to stopping. Those who reported continuing to use the system to write

some prescriptions had a mean e-prescribing volume of 119 prescriptions per month (SD= 116), and those who reported using the system to write *all* of their prescriptions had a mean e-prescribing volume of 178 prescriptions per month (SD=158). Those who had stopped using the system had significantly lower scores on the computer attitudes scale than those who continued to use it for *some* or *all* prescriptions (means 21.8 *vs.* 23.8 *vs.* 25.4, respectively; ANOVA p=0.003). Among those who had stopped or who used the system for only some prescriptions, the top reasons given (rated "agree" or "strongly agree") for reverting to paper prescribing were technical problems with network connectivity (87%), failure of pre-populating the e-prescribing system with patients' identifying information from the practice management system (83%), and time pressure when "too busy" (66%). Somewhat less-frequent reasons included pharmacies not reliably receiving and processing the prescriptions sent electronically (47%), the system taking too much of the prescriber's time (42%), and prescribing for acute conditions that do not require refills (42%) which can be more expediently written with a paper prescription.

Medication History Information. Of the 139 e-prescribers, only 37% reported being familiar with how to access the medication history information available in their system. Among those reporting familiarity with accessing medication history information, only a minority reported positive experiences with use of the information (**Table 3**), and only 16% reported using this function either "often" or "very often".

The Formulary and Benefit Function. E-prescribers had mixed perceptions about the value of the drug coverage information they received (**Table 4**). Many respondents (43%) reported that formulary and benefit information is incomplete at least 20% of the time and a smaller proportion (14%) reported that this information is incorrect at least 20% of the time. Moreover, e-prescribers split evenly about the statement that e-prescribing drug coverage

information reduced the number of calls to their office from pharmacies and patients regarding drug coverage problems (29% "agreed" or "strongly agreed," 41% were "neutral," and 30% "disagreed" or "strongly disagreed"). Perceptions were slightly more favorable toward the statements that e-prescribing drug coverage information helps in managing patients' costs (39% agree or strongly agree, 37% neutral, 24% disagree or strongly disagree) and that they are satisfied with the drug coverage information overall (37% "agreed" or "strongly agreed", 38% were "neutral", and 25% "disagreed" or "strongly disagreed").

Overall Perceptions of and Satisfaction with E-Prescribing. E-prescribers reported positive experiences with their systems overall with most reporting that they "agreed" or "strongly agreed" with the statements that the e-prescribing system is easy to use (79%), makes their work easier (53%), improves the quality of care they can deliver (62%), and does not require a lot of mental effort (62%). Somewhat fewer "agreed" or "strongly agreed" that e-prescribing has made work easier for their staff (49%), or that e-prescribing increased their productivity (40%). Overall, 66% were satisfied with their e-prescribing system and 68% would recommend it to others (**Table 5**).

Discussion

E-prescribing offers a mechanism to improve the quality and safety of prescribing as well as to help incorporate the consideration of patients' costs in prescribing decisions. However, previous studies have estimated that only 11 to 24% of physicians have adopted e-prescribing in the outpatient setting.[21 22, 23] For e-prescribing to benefit patients, its rate of adoption will need to accelerate. Thus, understanding the barriers to e-prescribing adoption is an important step.

In this study of two "stand alone" e-prescribing systems, we found that most e-prescribers report positive experiences with the systems, including having better information to reduce the chances of drug interactions, thereby improving patient safety and reducing the inefficiencies associated with pharmacy telephone calls for these issues. The majority of e-prescribers also found that the e-prescribing system was easy to use, made their work easier, and improved the quality of care they can deliver.

However, many physicians also perceived difficulties with using the systems, including technical problems, functional deficiencies, and workflow challenges. Theses included problems with network connectivity and practice management system interfaces, the presence of other technical and workflow-related issues such as external systems not reliably receiving and processing the prescriptions sent electronically, and the e-prescribing system taking too much of the prescriber's time. For a minority of physicians (17%), these difficulties resulted in their abandonment of e-prescribing altogether; for a larger number, the difficulties appeared to result in the selective use of e-prescribing for some but not all eligible prescriptions. These findings support those from previous studies that have also documented the importance of physician attitudes, system efficiency, and negative early experiences in shaping the adoption and use of health information technology.[24], [25] They also suggest the need for more resources to be devoted to training, systems support, and systems integration.

E-prescribers in this study perceived few of the specific advantages that are expected from having external medication history information. Both of the systems included in this study enabled prescribers to review downloaded medication history data, but the majority of e-prescribers were not familiar with how to access this information and among those who were familiar, only a few reported using it regularly. Several factors could account for these findings,

including insufficient training, problems in user interface design, and perceptions that the data is either unreliable or not useful. Of note, one major problem limiting the value of medication history data is the fact that availability of external medication information is often limited to a subset of insured patients. Furthermore, the available medication history data were often not incorporated into an active medication list.[5, 13] Other studies have identified related interoperability problems, such as incompatible patient allergy lists[24] and incompatible drug identifiers,[26] as limiting the usefulness of e-prescribing systems.

In the case of formulary and benefit information, the relatively high incidence of cases in which the information was missing or wrong may have been due to patients being uninsured or having insurers or PBMs that did not participate in RxHub, the only provider of formulary and benefit information at the time of our survey. Furthermore, even patients whose insurers participate in RxHub can experience automatic look-up failures in which patients' formulary and benefit information is incorrectly matched. Accurate formulary and benefit information could help prescribers minimize cost-related barriers to medication adherence by selecting more cost-effective options. Such information is particularly important for Medicare Part D patients, who can experience high out-of-pocket costs when they enter the coverage gap or when their coverage changes. Our findings suggest the need to improve the infrastructure for exchanging formulary and benefit information among the organizations involved, including health plans, PBMs, state Medicaid programs, systems capturing data for cash paying patients, e-prescribing and practice management system vendors, pharmacies, and medication information service provider(s). Doing so will help to ensure the availability of up-to-date, patient-specific information at the point of care.

Several factors may limit the generalizability of our findings. First, our sample came from physicians in one state, whose adoption and use of e-prescribing was subsidized. This incentive may mitigate the financial barriers that inhibit many providers in other settings from adopting health information technologies.[27] Further, the infrastructure for e-prescribing may vary regionally, as do other factors of the practice environment, such as payer mix and state policies. Second, the higher electronic prescription volume that we observed among respondents may indicate that prescribers with less-positive experiences were less likely to respond to the survey. Nonetheless, our 58% response rate indicates that the majority of e-prescribers were represented in our survey. Third, prescribers self-selected into the e-prescribing program and may be more technically savvy; however, our control physicians had also volunteered for e-prescribing and they had similar positive attitudes towards computer use as e-prescribers. Fourth, only two e-prescribing systems (Allscripts and iScribe) were used by our survey respondents and experiences with these systems may not be representative. However, these systems have among the largest e-prescribing customer bases and the users' experiences are similar to those reported in other studies. Finally, our survey represents perceptions elicited in the second half of 2006 and some of the technical difficulties with e-prescribing reported here may have since been resolved.

In November 2007, the Centers for Medicare and Medicaid Services proposed to require use of the medication history and formulary and benefit standards, among others, if electronic prescribing is used for Medicare beneficiaries.[28] These requirements aim to increase the availability of critical information at the time prescribing decisions are being made. However, the findings of our study suggest that mandating the use of these standards is necessary but not sufficient for achieving the desired effects of e-prescribing. Additional work to improve the infrastructure in which these systems are used will also be needed. Finally, additional policy

incentives may be required to facilitate and ensure effective communications between organizations involved in various aspects of prescribing medications. Only when these systems communicate with each other in a timely, accurate, and patient-specific manner, can the full benefits of e-prescribing be realized.

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Table 1: Provider and Practice Characteristics

Characteristic	E-Prescriber, percent (N=139)	Non-e-Prescriber, percent (N=89)	P –value
Specialty			0.049
Family medicine	30%	15%	
General internal medicine	27%	25%	
Pediatrics	13%	13%	
Internal medicine subspecialty	14%	19%	
Other[†]	17%	28%	
Computer attitudes scale (mean score)--maximum score=30	24.1	24.5	0.414
Composition of practice			0.460
Solo practice	30%	35%	
Single-specialty group	58%	54%	
Multi-specialty group	8%	10%	
Other	4%	1%	
Practice setting			0.002
Hospital tertiary care center	2%	13%	
Large ambulatory care center	4%	8%	
Small physician office	91%	74%	
Community clinic and other	4%	4%	
Practice uses electronic medical records	20%	22%	0.417

† Including Neurology, OB/GYN, Pediatrics subspecialty, Physical medicine and rehabilitation, Psychiatry, and Surgery or surgical subspecialty.

Table 2: Experiences of E-Prescribers vs. Non-E-Prescribers Related to Medication History Information

	Agree or Strongly Agree, %		
The information I typically have available about the patient's medication history enables me to...	**E-Prescriber (N=139)**	**Non-e-Prescriber (N=89)**	**P –value**
Identify potential drug-drug interactions that are clinically important	83%	67%	0.04
Prevent callbacks from pharmacies for potential safety problems	68%	53%	0.02
Identify clinical situations where an alternative medicine may be less of a risk.	75%	65%	0.17
Identify medications prescribed by other providers that I didn't realize the patient was taking*	65%	60%	0.42
Identify clinical conditions that I didn't realize the patient had	63%	67%	0.69
Perform additional monitoring to prevent a possible complication	74%	72%	0.64
Keep track of medications patients have tried in the past*	74%	72%	0.55
Prescribe medications more safely, overall	83%	73%	0.17

* Functions that are specifically enabled by external medication history information.

Table 3: Experiences of E-prescribers Familiar with Medication History Information (N=51)

The medication history information in the e-prescribing system…	**Strongly disagree or Disagree, %**	**Neutral, %**	**Agree or Strongly Agree, %**
Is complete for most patients	22%	39%	39%
Helped me to identify and address patients' adherence problems	18%	43%	39%
Saves me time	16%	60%	24%
Overall, improves the quality of my prescribing	14%	45%	41%
Overall, I am satisfied with the medication history information in the e-prescribing system	22%	41%	37%

Table 4: Experiences of E-Prescribers Regarding the Formulary and Benefit Information in the E-prescribing system (N= 139)

The drug coverage information in the e-prescribing system…	**Strongly disagree or Disagree, %**	**Neutral, %**	**Agree or Strongly Agree, %**
Is clear and understandable	21%	32%	47%
Helped me to manage cost for my patients	23%	37%	39%
Made visits longer because I spend more time discussing drug costs	32%	45%	22%
Reduced the need to change prescriptions because of coverage problems	27%	39%	34%
Reduced the number of calls to my office from pharmacies and patients regarding coverage problems	30%	41%	29%
Overall, saves me time	29%	41%	30%
Overall, reduces costs for my office	31%	50%	19%
Overall, I am satisfied with the drug coverage information	25%	38%	37%

Table 5: Experiences with Using the E-Prescribing System

Item	Strongly disagree or Disagree,%	Neutral,%	Agree or Strongly Agree,%
The e-prescribing system is easy to use	17%	4%	79%
I use e-prescribing for most of my prescriptions	22%	16%	63%
e-prescribing has made work easier for my staff	20%	32%	48%
e-prescribing has made my work easier	23%	24%	53%
Using the e-prescribing improves the quality of care I can deliver	18%	19%	63%
Using the e-prescribing increases my productivity	30%	30%	40%
The system does not require a lot of mental effort	19%	19%	62%
I find it easy to get the system to do what I want it to do	27%	20%	53%
The system is not compatible with other systems I use	26%	45%	30%
I have the resources necessary to use	10%	15%	75%

Item	Strongly disagree or Disagree,%	Neutral,%	Agree or Strongly Agree,%
the system			
I have the knowledge necessary to use the system	6%	12%	82%
I could use the system more effectively if I had received better training	53%	18%	30%
It is up to me whether or not I use the system	10%	12%	78%
Overall, I was satisfied with the e-prescribing system	19%	15%	65%
I would recommend the e-prescribing system to my colleagues	15%	17%	68%