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e-Prescribing in the Acute Care Setting

Determining the Educational and Motivational Needs of Healthcare Providers

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The study sought to determine the barriers to e-prescribing particular to the acute care setting, the educational and motivational needs of acute care providers, and the optimal process for incentive, education, and implementation of e-prescribing. A theoretically based survey instrument was adapted from previous work. Four domains were assessed: finesse, intent to use, perceived usefulness, and perceived ease of use. The survey was offered to a group of acute care providers. The educational and motivational needs of acute care providers are different from those in primary care. Perceived barriers centered on uncertain pharmacy hours, unconfirmed transmittal, and accidental transmission to wrong pharmacy. Healthcare providers with more self-assessed knowledge of e-prescribing are more likely to use e-prescribing. Providers with fewer years in practice seem to have greater knowledge of e-prescribing. Providing education and exposure to e-prescribing has the potential to decrease perception of barriers and increase perceived usefulness for acute care providers. Software redesign may be needed to remove barriers associated with uncertain pharmacy hours, controlled substance prescribing, transmittal confirmation, and bidirectional communication needs, thereby improving motivation to e-prescribe.

KEY WORDS: Acute care, Education, e-prescribing, Health information technology acceptance, Health information technology adoption, HIT, IT, Motivation, Prescribing

e-Prescribing is an electronic exchange of health information between the healthcare provider and a pharmacist, thus affecting care quality and supporting delivery of patient care through legible prescribing.[1] Meaningful use is using certified electronic health record (EHR) technology to improve quality, safety, efficiency, and care coordination and maintain privacy and security of patient health information.[2] Centers for Medicaid & Medicare Services has made e-prescribing a required core objective for stage 2 of meaningful use, for 2015 to 2017.[3,4] It can support patient care delivery activities through (1) better communication with pharmacy via complete and legible prescription, (2) clinical documentation completeness through automatic inclusion into the electronic patient record, (3) care planning through provider ability to view prior prescriptions avoiding duplications and drug interactions, and therefore (4) improvement of quality, safety, and efficiency.[1] e-Prescribing contributes to the long-term federal goal of universal medication reconciliation, which contributes to the meaningful use domain objective of improving care coordination.[3]

If poorly designed or implemented, health information technology (HIT) including e-prescribing can create patient safety risk by introducing a source of medication errors.[5] Improperly implemented systems can result in new types of errors that reduce workflow efficiency, increase medication costs, and threaten patient safety.[6] Preventable medication errors for outpatient prescriptions cost approximately $4.2 billion annually, and up to 100 undetected dispensing errors can occur daily.[7] Using e-prescribing in ambulatory care can reduce medication errors by approximately 85%.[7] There is a potential cost savings of an estimated $140 billion and $240 billion for 10 years for practices that adopt and use e-prescribing because of better patient outcomes and reduced patient visits.[4]

Urgent care facilities are ambulatory facilities specializing in acute care of patients. Ambulatory care facilities can qualify for federal reimbursement if they meet the requirements of (1) full use of EHR with certification and clinical decision support, (2) use of e-prescribing, (3) participation in health information exchange, and (4) submission of clinical quality measures. Acute care facilities including urgent care and emergency departments may meet those requirements because they treat Medicare and Medicaid patients. However,

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not all of these clinics participate in primary care or preventative care measures. Total charges for primary care must be 60% or greater for a physician or nonphysician urgent care to qualify for incentive payments.[8] In addition, physicians and physician groups which spend 90% or more of their time practicing inpatient or in the emergency department are not eligible for incentive payments through the Medicaid and Medicare EHR incentive program.[9]

Multiple barriers to e-prescribing are known to exist,[10,11] and the acute care setting faces additional challenges in regard to incentive to use HIT, such as e-prescription, despite the presence of legislation and viable technological infrastructure, because of decreased likelihood of qualifying for federal reimbursement. Federal incentives for e-prescribing have been successful, as evidenced by the 40% increase in e-prescribing with a growth rate of 9% to 11% per month from 2008 to 2010 in primary care.[10,12] Without a financial catalyst, determining the motivators and barriers for e-prescribing in the acute care setting will be key to meet federal objectives of universal medication reconciliation and at least 40% of all prescriptions e-prescribed.[3]

The perception of facilitators versus barriers is an important variable to consider for increasing healthcare provider intention to use new technology.[13] A survey to determine the perceived barriers to e-prescribing, knowledge and attitudes of acute care providers, and their readiness to use e-prescribing was offered to the Michigan providers of a large national physician group, which provides emergency medicine and urgent care services. The providers included physicians, physician assistants (PAs), and nurse practitioners (NPs). The study sought to determine (1) the barriers to e-prescribing particular to the acute care setting, (2) the educational and motivational needs of acute care providers, and therefore (3) the optimal process for incentive, education, and implementation of e-prescribing.

Literature Review

Devine et al[14] provided a quasi-experimental study to identify prescriber and staff characteristics that would predict attitudes and behavior toward e-prescribing in the context of any existing EHR. An instrument based on the Information Technology Adoption Model (ITAM), Information Technology in Primary Care Practice,[15] was used. The objective was to determine strategies to maximize the adoption of e-prescribing. The data were collected between 2005 and 2007 at three primary care offices in Washington State during two phases of e-prescribing implementation. Phase 1 included hardware configuration and early implementation, and during Phase 2, all sites had been e-prescribing for 2 years. The participants included prescribers (physicians, PAs, and NPs; n = 59) and staff (nurses and medical assistants; n = 58).

The major findings were that scores increased significantly for intent to use technology for prescribers (4.8–5; $P < .04$) and staff (4–5; $P < .03$) and for perceived usefulness for staff (3.7–4.6; $P < .02$) from phases 1 to 2. There was a significant association ($P < .05$) found between home computer use and each domain, and between self-assessed computer knowledge and three of the domains. The authors concluded that the Dixon instrument could be useful in tailoring strategies for successful adoption of e-prescribing, and that prescribers' self-assessment of at-home computer use and computer knowledge predicted attitudes toward adoption.

Lapane et al[11] used a mixed method study design to determine clinician and staff perceptions of e-prescribing efficiencies and inefficiencies in ambulatory care. Qualitative data from 64 focus groups (N = 276; participants were providers, patients, partners, and office staff) were analyzed. e-Prescribing was rated as efficient by 64%. The study determined that the perceived inefficiencies were not about the actual time required to physically write the prescription. Availability of point-of-prescribing formulary was perceived as efficient; however, incorrect information on formularies, pharmacy, and warnings were seen as inefficiencies. e-Prescribing of scheduled medications is still perceived as a significant inefficiency. The investigators concluded that assurance of accurate information and reducing redundancies within the software and system is an opportunity to improve efficiencies and therefore decrease barriers of e-prescribing.

Gagnon et al[13] created a questionnaire (N = 93), based on the technology acceptance model (TAM), to examine the factors that could influence the decision of healthcare professionals to use a telemonitoring system. Perceived usefulness was the only significant predictor of use (odds ratio, 5.28; 95% confidence interval, 2.12–3.11).

Shah and Peikari[16] used a quantitative survey of community physicians (N = 188) to investigate the impact of usability of e-prescribing systems on physician prescribing errors and mental workload. The study found that prescribing errors were reduced through improvement of information quality ($P < .01$), system ease of use ($P < .05$), consistency within user interface ($P < .05$), and reduced mental workload ($P < .01$). In addition, physician mental workload was lessened by ease of use ($P < .01$), error prevention ($P < .01$), and interface consistency ($P < .001$). The researchers concluded that the e-prescribing system should be designed to be easy to use with improved error prevention and interface consistency to reduce the mental workload of the users.

Theoretical Underpinnings

The TAM is a predictive behavioral model not specifically designed for the healthcare context; however, it can be applied to HIT acceptance.[14,17] It was originally developed

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by Davis[18] on the basis of the theory of reasoned action (TRA), within which the roles of attitudes, intentions, and social norms are important. According to the TRA, people are rational decision makers, deciding consciously upon a course of action based on analysis of potential cost versus benefit of each behavior alternative.[19] Davis[18] further posited that a person's attitude, which is formulated by perceived use and ease of use, is what drives intention to use information technology.

The ITAM is based on the TAM.[14] It includes further breakdown of interrelated subdomains of perceived usefulness and perceived ease of use such as end-user fit, requirements, capability, available resources, end-user sophistication, finesse, and breadth and depth of user knowledge.[20] The survey, Information Technology in Primary Care Practice,[15] is intended to cover these four domains of the ITAM: finesse, intent to use, perceived usefulness, and perceived ease of use. The e-Prescribing in Acute Care survey used questions adapted from Dixon survey to cover these four domains of ITAM: intent to use, perceived usefulness, perceived ease of use, and end-user fit. The questions regarding fit addressed the acceptance by colleagues, the support of patients, and the comfort of patients with e-prescribing.

METHODS

Setting

The study was conducted with a national physician-owned practice, Emergency Physicians Medical Group (EPMG), based in Ann Arbor, MI. Healthcare providers employed by EPMG include physicians, PAs, and NPs. The group extends into Delaware, Illinois, Indiana, Iowa, Michigan, and Ohio. Emergency medicine practice locations range from large, medical school-affiliated teaching hospitals to rural critical access hospitals. The Michigan group also provides urgent care services at three urgent care clinics. The surveyed Michigan group serves more than 500 000 patients per year; 540 259 patients were served in 2014.[21]

Electronic health record for providers is used by approximately 80% of the sites. Not all of the sites with EHR participate with e-prescribing. The e-prescribing software is Web based and interfaces with the EHR at the sites. Some of the sites use EHR software that does not interface with e-prescribing. Not all of the sites with EHR software have implemented this in the emergency department, and not all sites have access to e-prescribing.

The software used by most of the group has interaction and allergy alerts, dosing guidance, duplicate therapy checks, and access to the patient's medical insurance formulary. It generates new and renewed prescriptions selected from search menu or self-generated and maintained favorites list. Directions can be selected or free texted. Physicians, PAs, and NPs can all prescribe. Prescriptions can be printed or e-prescribed to the patient's preferred pharmacy. Ability to retrieve outside medication prescription history for reconciliation was added after completion of the survey.

Study Design and Survey Administration

A cross-sectional study design was used; the survey was deployed to the active providers of the EPMG Michigan group (N = 348). Permission from EPMG was obtained to use the company internal email to send a Web link for the survey to the providers. The surveys were voluntary and anonymous; there was no collection of personal or potentially self-identifying information. The survey was part of a quality improvement project and was included in an expedited review by the Saint Joseph Mercy Health System (Ann Arbor, MI) Institutional Review Board in August 2015. An informational email was sent inviting anonymous voluntary responses from the group. Then, a total of four emails were sent with links to the survey, an initial email on the first day followed by three reminders. The survey remained open and valid from July 24, 2015, to August 17, 2015. Qualtrics (Qualtrics, Provo, UT) survey software was used with assistance from Wayne State University of Detroit, MI. Sixty-two surveys were started, and 61 were completed. The partially completed survey was discarded.

The survey, e-Prescribing in Acute Care, contains 31 items including 30 questions and one open-ended response for feedback and/or comments about the survey and/or e-prescribing. The survey was adapted from two surveys found in the public domain on the Agency for Healthcare Research and Quality (AHRQ) Survey Compendium Web site: Information Technology in Primary Care Practice[15] and Rhode Island Health Care Quality Performance (HCQP) Program: Physician Health IT Survey.[22] Some of the terminology and verbiage were changed to reflect the current language. Per the AHRQ Web site, permission had been obtained from the survey developers for unrestricted use of the Information Technology in Primary Care Practice survey—that it may be modified or used as is without additional permission from the authors. However, there was email correspondence with the author of the correlating manuscript[14] to clarify.

Demographics were queried (gender, years of practice, type of licensure, department). Questions (5, 6, 7, and 9) inquired about the mean number of patients per hour, whether computer is used at home for professional use, the mean number of hours the computer is used at home for professional use, and what percentage of prescribing are e-prescriptions, respectively. The respondents were asked to rate their knowledge of e-prescribing on a 7-point visual analog scale ranging from 1 (novice) to 7 (expert). To inquire about perceived barriers to e-prescribing, question 10 (adapted from the Rhode Island survey) asked respondents

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to rate whether each listed item was (1) not a barrier, (2) a minor barrier, or (3) a major barrier to e-prescribing. Inquiry was made regarding which device (desktop computer, laptop computer, tablet, or smartphone) was most often used to e-prescribe and whether they do not e-prescribe. Question 30 asked the respondents to rate the helpfulness of allergy alerts, duplicate order entry alerts, drug interaction alerts, dosing guidelines, and dosing calculator as (1) not at all helpful, (2) somewhat helpful, or (3) very helpful. The remaining 18 survey questions about e-prescribing were adapted from the Dixon[15] survey and were recorded on a 5-point Likert scale that ranges from 1 (strongly disagree) to 5 (strongly agree).

Statistical Analysis

The survey data were maintained in a single database and were transferred using the Qualtrics software directly into IBM SPSS Statistics (IBM Corporation, Armonk, NY) software program for analysis. Before conducting the analysis, instrument performance was assessed with Cronbach's α to calculate internal consistency reliability. The research questions that were addressed are the following:

1. Are there differences among gender, clinical role, and department in each domain (intent to use, perceived usefulness, perceived ease of use, and end-user fit)?
2. Is there a relationship between self-assessed knowledge of e-prescribing and (a) each domain, (b) clinical role, (c) percentage of e-prescriptions written, (d) perceptions of barriers to e-prescribing, and (e) years in practice?
3. Is there a relationship between percentage of time e-prescribing and (a) each domain (b) number of patients seen per hour, (c) number of years in practice, (d) helpfulness of software tools, and (e) perceptions of barriers?
4. Do perception of software tool helpfulness and perception of barriers predict intent to use, perceived usefulness, perceived ease of use, and end-user fit?

RESULTS

Participant Characteristics

The survey participants (N = 61) included medical physicians (n = 33), osteopathic physicians (n = 8), PAs (n = 13), and NPs (n = 7). Male-female respondent ratio was nearly evenly matched at 52.5:47.5. They reported a collective range of 1 to 37 years of clinical experience, with a mean of 14.7 years. Eighty-two percent work in the emergency department, 6.5% work in the pediatric emergency department, and 11.5% are urgent care clinicians. Forty-four percent of the surveyed providers reported seeing two patients per hour (range, 1-5 patients per hour). A computer is used at home for personal use by 80% (n = 49) of the participants, with 54% (n = 33) using the computer at home for professional use 1 to 2 hours daily (range, 0–5 hours). More than half of the providers reported that they never (0% of the time) transmit e-prescriptions (55.7%, n = 34) and do not e-prescribe (45%, n = 27). The remainder of the providers reported e-prescribing 1% to 100% of the time; the most common answers were e-prescribing 5% (11.5%, n = 7) and 50% (8.2%, n = 5) of the time. The providers who e-prescribe are using a desktop computer 50% of the time and a laptop computer 5% of the time. None reported using a tablet device or smartphone to e-prescribe. The participant characteristics are outlined in Table 1.

Scores

Sixty-one surveys were completed, of a total possible 348 provider surveys. This represents an 18% response rate. Cronbach's α reliability coefficients were .70 (intent to use), .85 (perceived usefulness), .85 (perceived ease of use), and .75 (end-user fit). The mean scores for each of the domains for gender, department, and clinical role are presented in Table 2.

Question 1

There were no statistically significant differences in total scores between genders, among clinical roles, or among

Table 1. Survey Participant Characteristics (N = 61)

Degree/clinical role	
Medical physician	33 (54.1%)
Nurse practitioner	7 (11.5%)
Osteopathic physician	8 (13.1%)
Physician assistant	13 (21.3%)
Specialty/department	
Emergency medicine	50 (82%)
Pediatric emergency	4 (6.5%)
Urgent care	7 (11.5%)
No. patients per hour	
Mean	2.35
Range	1–5
Years experience	
Mean	14.71
Range	1–37
Gender	
Female	29 (47.5%)
Male	32 (52.5%)
Home computer for professional use	
No	12 (19.7%)
Yes	49 (80.3%)
e-Prescription use	
No	34 (55.7%)
Yes	27 (44.3%)
Device used to e-prescribe	
Desktop computer	30 (49.2%)
Laptop computer	3 (4.9%)

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Table 2. Mean (SD) Scores by Gender, Department, and Professional Role

	Total	Intent to Use	Perceived Usefulness	Perceived Ease of Use	End-User Fit
Degree/clinical role					
Medical physician	58.1 (12.7)	20.4 (4.5)	18.0 (4.8)	12.5 (3.7)	10.5 (2.5)
Nurse practitioner	67.3 (6.9)	23.4 (3.0)	22.3 (2.9)	15.1 (2.0)	10.4 (1.8)
Osteopathic physician	58.5 (10.1)	20.4 (1.7)	19.3 (3.3)	12.9 (3.0)	9.6 (2.9)
Physician assistant	59.2 (11.2)	19.6 (3.0)	19.8 (4.1)	13.3 (4.0)	9.8 (1.6)
Specialty/department					
Emergency medicine	58.9 (11.3)	20.4 (4.0)	18.9 (4.6)	12.9 (3.4)	10.1 (2.3)
Pediatric emergency	60.3 (8.5)	22.0 (2.2)	18.3 (3.9)	13.3 (1.5)	10.5 (3.0)
Urgent care	62.6 (11.2)	21.1 (3.4)	20.3 (4.3)	13.4 (5.6)	11.3 (1.8)
Gender					
Female	61.8 (11.2)	21.6 (3.7)	20.1 (4.1)	13.2 (3.8)	10.7 (2.5)
Male	57.2 (11.0)	9.7 (3.9)	18.1 (4.6)	12.8 (3.4)	9.9 (2.0)

departments. Independent samples test did not reveal any differences in scores between genders and theoretical domains; analysis of variance did not support differences among clinical roles or departments.

Question 2

Using Spearman's ρ, it was established that there were significantly positive correlations between self-assessed knowledge of e-prescribing and intent to use ($r = 0.34$, $P = .008$), perceived usefulness ($r = 0.35$, $P = .006$), perceived ease of use ($r = 0.57$, $P < .0001$), and end-user fit ($r = 0.34$, $P = .007$). Self-assessed knowledge also positively correlated with percentage of time e-prescribing ($r = 0.63$, $P < .0001$). Significant negative correlation was identified between self-assessed knowledge and perception of barriers ($r = -0.44$, $P < .0001$). No correlations were found within clinical role and years in practice.

Question 3

Percentage of time e-prescribing and perception of software tool helpfulness are negatively correlated, however not significantly. As expected, percentage of time spent e-prescribing is significantly positively correlated with intent to use ($r = 0.58$, $P < .0001$), perceived usefulness ($r = 0.46$, $P < .0001$), perceived ease of use ($r = 0.52$, $P < .0001$), and end-user fit ($r = 0.49$, $P < .0001$), with a strongly negative correlation with perception of barriers ($r = -0.46$, $P < .0001$). There is a strong correlation between self-assessed knowledge and percentage of time spent e-prescribing ($r = 0.63$, $P < .0001$) and a moderate correlation with number of patients seen per hour ($r = 0.33$, $P < .009$).

Question 4

Multiple linear regressions were calculated to predict each domain separately against perception of barriers and software tool helpfulness. A significant regression equation was found for each domain: intent to use ($F_{2,58} = 2.985$, $P = .058$, $r^2 = 0.093$), perceived usefulness ($F_{2,58} = 8.535$, $P = .001$, $r^2 = 0.227$), perceived ease of use ($F_{2,58} = 9.713$, $P < .0001$, $r^2 = 0.251$), and end-user fit ($F_{2,58} = 9.719$, $P < .0001$, $r^2 = 0.251$).

Additional Findings

With independent samples test of home computer for professional use against the domains, none of the scores were statistically significant; however, scores were close for perceived ease of use ($P = .089$). Regression was performed to analyze this further, and it was found that home computer for professional use was a moderate predictor of perceived ease of use ($F_{1,59} = 2.988$, $P = .089$, $r^2 = 0.048$). In addition, a negative correlation was found between self-assessed knowledge of e-prescribing and years in practice ($r = -0.32$, $P = .014$); those with less years in practice report that they have greater knowledge of e-prescribing.

Perception of Barriers

With regard to perceived barriers to e-prescribing, most of the major barriers were involving uncertainty around pharmacy hours, unconfirmed transmittal, and accidental transmission to the wrong pharmacy rather than technical skills, training, or productivity issues. Most saw lack of tangible prescription for the patient as either not a barrier or a minor barrier. Transversely, inability of the patient to take the prescription to any pharmacy was viewed as a major barrier. Controlled substance prescribing was a perceived major barrier to e-prescribing. The answers to the perception of barriers are displayed in percentages on Table 3.

The free-text comments suggested that the quality of the e-prescribing system could make a difference with ease of use. Some prescribers expressed a concern that, if the medication is not available at the pharmacy, then a hard copy is not available to take to another. Dissatisfaction with lack of confirmation as to whether the script was received was

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Table 3. Perception of Barriers (Percentages)

	Not a Barrier	Minor Barrier	Major Barrier
Access to technical support	44.3	45.9	9.8
Computer skills	78.7	21.3	0
Lack of uniform industry standards	40	48.3	11.7
Privacy or security concerns	55.7	31.1	13.1
Technical limitations of systems	27.9	45.9	26.2
Necessary training	50.8	44.3	4.9
Productivity loss	59	27.9	13.1
Lack of bidirectional communication with pharmacies	25	45	30
Lack of tangible prescription for the patient	41	44.3	14.8
Unconfirmed prescription transmittal	14.8	42.6	42.6
Accidental transmission to the wrong pharmacy	16.4	45.9	37.7
Alert fatigue	30	46.7	23.3
Controlled substance prescribing	18	36.1	45.9
Uncertain pharmacy hours	18	32.8	49.2
Patient's inability to take the prescription to another pharmacy	8.2	37.7	54.1

reiterated in the free-text comments. Few prescribers felt that, if the patient is not using his/her usual pharmacy and if the prescription would be sent after hours, then the emergency department was not an ideal place for e-prescribing. One prescriber felt that younger patients expected e-prescribing, while older ones preferred paper.

DISCUSSION

The study sought to determine (1) the barriers to e-prescribing particular to the acute care setting, (2) the educational and motivational needs of acute care providers, and therefore (3) the optimal process for incentive, education, and implementation of e-prescribing.

Barriers particular to the acute care setting seem most centered around pharmacy issues such as uncertain pharmacy hours, unconfirmed transmittal, and accidental transmission to wrong pharmacy. Unconfirmed transmittal and accidental transmission could potentially be addressed with education and training. However, an uncertain pharmacy hour is a barrier that providers and educators do not control. Acute care providers could maintain awareness of the business hours of the local pharmacies. It may be necessary to use the pharmacies that stay open later in the evening or those that provide 24-hour services. It could enhance the usability of an e-prescribing platform if pharmacy hours were indicated; many handheld device applications and Internet search Web sites already have such technology in place. This could improve provider motivation to e-prescribe if systems were easier to use with existing quality information (pharmacy hours in this case) reducing mental workload, as has been proposed by Shah and Peikari.[16]

There seems to be a fixation on patient's inability to choose or change pharmacy after discharge. It is not clear whether this is related to late-day (after business hours) use of pharmacy. It is also not clear whether this is related to additional work for the provider if an e-prescription needs to be redirected electronically or by telephone to a different pharmacy or if simply for patient convenience. Lack of pharmacy availability after hours is not particular to written versus electronic prescription. It is possible to e-prescribe with intention to have prescription found at the pharmacy in the morning. If a medication needs to be started right away, then the prescription in the hand of the patient or electronically to the pharmacy of the patient's choice equals the same thing.

It seems as though provider unfamiliarity with the e-prescribing portion of the EHR software is a major barrier. Providers typically develop routines for purposes of efficiency. Our particular group felt that breaking the habit of printing, therefore breaking the routine, could decrease efficiency and therefore be a time burden, which is opposite the findings of Lapane et al[11] that healthcare providers were not concerned with the time burdens associated with writing the prescriptions. Interestingly, providers did not perceive technical skills, training, or productivity as major barriers. However, it is evident that education with emphasis on the technical portion of e-prescribing software needs to be emphasized.

Those healthcare providers with more self-assessed knowledge of e-prescribing are more likely to use e-prescribing because they perceive its usefulness, which was consistent with both results obtained by Devine et al,[14] that self-assessed knowledge is correlated with the domains, and findings by Gagnon et al,[13] that perceived usefulness is the only significant predictor of technology use. The providers feel that it is accepted by their patients and colleagues and are more likely to find e-prescribing accessible and straightforward to use. More knowledge will contribute to decreased perception of barriers, and more time will be spent e-prescribing. Therefore, increasing knowledge though education should have a positive motivational effect on e-prescribing.

Decreasing perception of barriers can also increase the amount of time spent e-prescribing. There are actual barriers and difficulties to e-prescribing, such as lack of bidirectional communication and controlled substance prescribing. Participants in the study of Lapane et al[11] also felt that controlled substance prescribing was a point of significant inefficiency, which could be addressed with software redesign creating user-friendly and less cumbersome ways to provide two-factor authentication. A system-wide platform and/or infrastructure

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redesign may be needed to allow e-prescribing to function more like email with a "sent" folder for providers to review or with functionality such as an online chat to communicate with pharmacy staff in real time, which would potentially bridge the void of bidirectional communication.

However, some of the perceived barriers could be removed with education. For example, if a provider is avoiding e-prescribing because of discomfort with lack of tangible prescription or unconfirmed transmittal, education can be provided so that the provider might use e-prescribing. In addition, the results support that simple exposure to e-prescribing could actually decrease perception of barriers; Devine et al[14] discovered that perceived usefulness and intent to use scores improved after providers had been exposed to e-prescribing for 2 years. So, it seems as though education and exposure go hand in hand with successful implementation.

A moderately negative correlation was found between self-assessed knowledge of e-prescribing and years in practice ($r = -0.32$, $P = .014$); those with fewer years in practice reported that they have greater knowledge of e-prescribing. The younger generation of providers is brought up with technological training in HIT and EHR. It is predictable that HIT upgrades and changes will be easier to implement as the older generation retires. However, this is another area that requires attention and education.

There was no suggestion that software tools or device used made a difference to providers in regard to e-prescribing. The differences among scores for devices could actually be differences among those who e-prescribe and those who do not; one of the response options was "I don't e-prescribe." It is known that not all members of this group have the option to e-prescribe. It is also not known whether all members of this group have access to e-prescribing on a tablet or smartphone in the clinical setting.

The study by Devine et al[14] ascertained that there was a significant association between home computer use and each domain. Instead of asking about home computer use, which was new technology at the time of the old survey, email use may have been a better current predictor of e-prescribing acceptance and use. General computer use is now commonplace. Email use is similar to e-prescribing in that it also allows the user to electronically send information to a selected recipient. Differences between e-prescribing and emailing are (1) there is no confirmation that the information was sent, as in a sent folder, and (2) bidirectional communication does not exist, as in the ability of the pharmacy to respond e-prescription received or reply with questions for clarification. It is possible that provider intimidation by the technology and perception of barriers is related to lack of compatibility with familiar technology such as sending and receiving emails on tablets and smartphones. In addition, it is interesting to consider that, in the day and age of live chat support for online purchasing, this mode of electronic bidirectional communication is not prioritized and immediately available in healthcare.

Implications

Separate but relatable studies might be needed to determine whether increased e-prescribing by acute care providers will cause pharmacy burden. It is known that prescriptions are generally processed in queue. Pharmacies receive the bulk of their prescriptions from primary care clinics for both new medications and refill authorizations. If barriers are decreased through education, technology exposure, improved software, system redesign, and enhanced ability to collaborate with pharmacists online, acute care settings may increase the use of e-prescribing. It is possible that pharmacies could become overwhelmed as primary and acute prescriptions are intermixed in queue. Increased pharmacy burden could create longer wait times and potentially raise costs for patients if increased pharmacy staff is needed to distinguish or recognize acute prescriptions, for example. Future studies could investigate the feasibility of developing a transmission queue dedicated to acute prescriptions so that they can be identified and processed for the patient with acute care needs.

It would be ideal to have a stronger collaborative relationship with pharmacy chains outside the hospital and clinic. For example, including a pharmacy representative in workflow processes would add another stakeholder to the conversation. Alternatively, a nurse or clinician could be assigned pharmacy liaison to maintain an open line of communication with the most commonly used local pharmacies. Allowing all stakeholders to provide counterbalance and feedback has the potential to add increased efficiency and safety for all involved. Communication with the local pharmacies is crucial and unavoidable; perhaps, a universal or national prescribing network of healthcare providers, clinics, hospitals, and pharmacies can be a future model. Providers might feel confident about transmission, and perhaps, there could also be a way for pharmacy to communicate with providers and patients in this way.

There may need to be a shift in thought regarding e-prescribing; those who have less knowledge and exposure are less likely to use it because it is perceived as having barriers. If e-prescribing can be comparatively likened to emailing, it might be easier for those with less knowledge to grasp its usefulness. This might also be a way to help the older providers. Perhaps, in the future, more user-friendly e-prescribing platform similar to email could be developed for e-prescribing.

An association between home computer use existed between perceived usefulness and intention to use e-prescribing

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according to Devine et al,[14] and this was supported by our study results. Integration of e-prescribing's compatibility with tablets and smartphones could be investigated regarding increasing perceived usefulness and actual use because those devices are now widespread and commonplace for daily personal use. Further research could be focused on emergency and urgent care workflow with actual use of e-prescribing software on handheld devices to determine the acute care settings' specific needs with regard to platform and application use on those devices.

Strengths and Limitations

Strengths included theoretical construct of the instrument and the acceptable to high reliabilities of a questionnaire that was adapted from previous work. The group transitioned to Microsoft Office 365 (Microsoft Corporation, Redmond, WA) on the day of the final survey reminder email. This caused a very brief service interruption and may have affected the number of survey responses by delaying deployment of the final email. Participation was lower than desired likely due to the voluntary nature of the study; therefore, the sample size was small. Generalizability may be limited to the acute care setting. There are differences in the e-prescribing software used within the group for e-prescribing, and some respondents did not e-prescribe. It is not possible to know whether the responses are representative of the entire population of acute care providers. There were very few responses from NPs and PAs compared with physicians.

CONCLUSIONS

Face and content have been validated; however, test-retest reliability will be needed to determine whether this questionnaire "e-Prescribing in Acute Care" will be a valid and useful tool. It may be beneficial to query email use, rather than computer use, because it is a more closely related process. Equating e-prescribing with emailing could decrease technological anxiety because many healthcare providers are already adept with email.

Benefits of e-prescribing seem consistent between acute and primary care settings. Barriers are different and focused on uncertain pharmacy hours, unconfirmed transmittal, and accidental transmission to the wrong pharmacy rather than technical skills, training, or productivity issues. It has been ascertained that the acute care setting has unique challenges and barriers to adoption of e-prescribing. The vast majority of the current literature is only reflective of primary care. Future research could be focused on emergency and urgent care workflow with actual use of e-prescribing software. Acute care settings can consider maintaining a liaison with the local pharmacies, communicating the needs and preferences of prescriptions written after usual business hours. Future research regarding feasibility and technicality of a dedicated prescription queue for acute care prescriptions allow for more rapid identification and processing and universal prescribing networks and applications to improve transmission confidence and interdisciplinary communication. e-Prescribing software could also be redeveloped into a more user-friendly interface with similarity to email, allowing for bidirectional communication, easier user assimilation, and, possibly, even live support. Application for smartphones or tablets for ease of patient-provider-pharmacist interaction has high potential for future use.

The educational and motivational needs of acute care providers are different from those in primary care. Despite technology perceived as a minor barrier, it seems that acute care providers need education and exposure to the technology. Acute care settings such as emergency department and urgent care clinic do not qualify for federal financial incentives and yet are expected to participate. Motivation might involve simply exposing the healthcare providers to the technology, which may remove intimidation, unfamiliarity, and perceptions of barriers. The optimal process for incentive, education, and implementation of e-prescribing might also include providing education with special attention to older providers in regard to potential barriers. This may decrease perception of barriers and increase perceived usefulness. Acute care users are often using the technology in a fast-paced setting and might fear productivity loss from its use. However, with proper acquaintance and guidance, acute care providers may appreciate and prefer the technology in time.

Providers are becoming increasingly familiar with e-prescribing; this may contribute to efficiency and decrease actual and perceived barriers. It is easy to anticipate that the younger generation fostered with HIT will more easily accept and adapt to e-prescribing. Future generations may not even know paper prescribing if federal goals of universal patient records and medication reconciliation are met. Through example, research, practice, and collaboration with other stakeholders, healthcare providers have opportunities to optimize, increase, and strengthen the use of e-prescribing in the acute care setting.

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