Show Your Work:

Do Prescription Annotations Impact Near-miss Medication Errors?

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Abstract

Purpose: The goal of this project is to assess the impact of prescriptions incorporating patient medications, allergies, weights, dosing guidelines and other prescribing-strategy data on near-miss medication errors.

Scope: Pharmacists are an integral part of the error detection system for prescription medications. However, the lack of clarity inherent in many prescriptions, coupled with the lack of patient-specific data on prescriptions, often generates calls back to prescribers for clarification or for additional detail. In an era when prescriptions may be generated electronically, and when these prescriptions may be interfaced with electronic health records, it is possible to include more information on the prescription automatically. In some cases, data have shown that, despite understanding the value of including such information, clinicians rarely include it, thereby foregoing the potential safety gains to be had by including these data.

Methods: The study was a randomized, controlled trial of prescriptions with (intervention) and without (control) annotations. Before the study was begun, a baseline callback rate was measured. Baseline data were collected using a callback reporting form developed for this project. Beginning 4 months after prescription annotations were implemented throughout the medical center, we randomly turned on or off the annotations feature each day for a period of approximately 3 months. Clinic and pharmacy staff were blinded to the days when annotation was off. During this time, trained pharmacy staff logged all callbacks into an electronic form that mimicked the original callback reporting form. Data collection was stopped after 200 callbacks were logged. In addition, prescriptions were manually counted from all three pharmacies for 10 days during the study period to estimate the frequency of each type of prescription (check box, electronic, phoned in, handwritten). These data were used to interpolate relative frequencies of each type of prescription for the rest of the study period. Finally, we sent surveys to the 50 most-used pharmacies in our area to get their perception of SYW. Data comparing the rate of callbacks between intervention and control were analyzed using the chi-squared test.

Results:
In the baseline phase of the study, there were 504 callbacks generated for 26,796 new prescriptions, for a callback rate of 1.9%. The 559 reasons given for callbacks primarily included insurance requirements (26%), rule violations (39%), and errors (29%). In the second phase of the study, there were 202 callbacks during the study, with an e-prescribing callback rate of 0.4% for SYW “on” and “off” days. We received 38 surveys (76%); 33 respondents commented about SYW. The majority of respondents agreed (69%) that SYW favorably impacted callbacks—especially with pediatric prescriptions (82%). Information about patient’s insurance eligibility was not helpful. Comments suggested that SYW increased callbacks in some cases and decreased them in others. These findings support the continued use of this approach.

Key Words: medication errors; e-prescribing; patient safety; pharmacist; callback rate

Purpose

There is mounting evidence that the use of electronic prescription writing tools decreases medication errors by improving the cognitive process of determining which medication is appropriate for a patient; improving the use of guidelines for generating correct doses of prescriptions and medications; improving physician recognition of potential drug-drug, drug-allergy, drug-food, or drug-indication reactions or contraindications; and improving compliance with dosing guidelines, especially in pediatrics. Another potential benefit of electronic prescription writing is through improving the communication between physicians and pharmacists, resulting in a lower number and higher quality of interactions between community pharmacy staff and prescribers. These interactions, which often focus on potential drug interactions or allergies, may be significantly decreased when pharmacists are made aware of the cognitive work that took place before the prescription was submitted to them.

Vanderbilt University Medical Center has developed an electronic prescription writer called RxStar, which is fully integrated within an electronic medical record. RxStar prescriptions include information about the prescribing process, especially any information about patient allergies, medications, dosing strategies, and alerts that were triggered and why they were overridden. We call this approach Showing Your Work (SYW). The purpose of this study is to assess the impact of electronic prescription writing with SYW on pharmacy callbacks to prescribers. Because the data about callbacks are limited, we accomplished our goal through two specific aims:

1. Assess the baseline rate and etiology of callbacks that pharmacists make to authorized prescribers.
2. Determine the impact of SYW on the rate and type of pharmacy callbacks.

Background

The prescription-writing process is one of the most complex processes in medicine. In 2000, Americans made over 800 million visits to doctors offices[1] and received 3 billion prescriptions from US pharmacies.[2] In the ambulatory environment, prescription writing is inherently multistep and multidisciplinary, with each step coupled tightly to the workflow in a particular clinic environment.[3, 4] Each step of the process is associated with specific potential causes of errors. Those errors include cognitive errors (wrong medication, no medication for an appropriate indication, wrong patient); prescribing errors (wrong formulation, wrong dose, wrong route, wrong frequency, errors related to interactions between a particular drug and alternative drugs); pharmacy transcription errors (illegible handwriting, dosage formulation substitution); dispensing errors (incorrect drug, incorrect dose); and errors related to medication administration and monitoring for side effects or adverse events. Collectively, medication selection and prescribing errors have an incidence ranging from 7.8% to 21% in the published literature.[5-10] The details about errors and adverse drug events associated with the prescribing process have been well described in recent Institute of Medicine reports.[11-13]

According to a report from the eHealth Initiative, electronic prescribing (e-prescribing) "refers to the use of computing devices to enter, modify, review, and output or communicate prescriptions."[14] E-prescribing tools come in a variety of levels of sophistication, with the most advanced tools providing legible orders, alerts and reminders, integration with medical record

data that affects prescribing decisions, and enhancements to improve integration within existing clinic workflows. This technology helps deliver relevant patient information and prescribing knowledge to the prescriber, with the potential at a national level to eliminate nearly 2.1 million adverse drug events each year, which would prevent nearly 1.3 million provider visits and about 14 preventable adverse drug events per provider each year.[15]

The use of e-prescribing systems adds an additional level of safety upstream, thereby preventing many of the near-miss medication errors that are caught by patients, nurses, and pharmacists. These data have been persuasive enough to catalyze the Centers for Medicare & Medicaid Services (CMS) to call for e-prescribing standards as a part of the Medication Modernization Act.[16] Despite the advantages that e-prescribing with decision support may confer to the cognitive and prescribing processes, existing electronic prescription writing tools generally do not transmit the information that would be required to involve pharmacists in the error-checking process.

Pharmacists are responsible for catching many errors related to prescribing, and pharmacy computer systems provide additional alerts and reminders. When pharmacists are uncertain about how best (or whether) to fill a prescription, or when alerts or reminders suggest a risk for a potential adverse drug, pharmacists traditionally contact the prescriber and discuss the situation. This dialog between the prescriber and the pharmacist after a prescription is completed is called a callback. Although communication between physicians and pharmacists is an extremely important and often neglected part of a high-quality medication delivery system, in today's world, callbacks are an onerous and unappreciated activity. Pharmacists make an average of 150 million calls each year to discuss potential medication errors or to clarify prescriptions,[17] which approaches a conservative estimate of calling prescribers for 5% of the prescriptions a pharmacist receives each day. When properly informed, as demonstrated by the collaborative prescribing approach employed by Isetts and associates,[18] callbacks may result in significant improvements in patient safety. In their study, for example, the rate at which therapeutic goals were achieved increased from 74% to 89%. Unfortunately, this collaborative model is difficult to implement in most clinical settings. The resulting model of relying on callbacks is difficult for the patient, who must wait for the pharmacist to contact a provider before the prescription can be filled. It is challenging for the pharmacist, who must interrupt his or her busy workflow to identify the prescriber from often illegible and incomplete information on the prescription and then initiate a call and wait for the prescriber to take a break away from patient care to return a call. This activity is one of many the pharmacists must complete while also being responsible for dispensing medications flawlessly and counseling patients or family members to mitigate administration errors. In Philips and colleagues' longitudinal study of more than 47,000,000 death certificates from 1979 through 2000, they reported a spike of medication error deaths by 25% above normal at the beginning of each month, most likely related to increased volumes of prescriptions, and therefore increased workload on pharmacists, at that time.[19] Flynn demonstrated an increase in dispensing errors when that activity was associated with interruptions.[20]

The inability to communicate the cognitive work completed by the physician adds time to the job of the pharmacist if there are any conflicts between the prescription and the information available in the pharmacy. In the era of electronic prescription writing, when so much

information may be applied to the prescription writing process, the potential to decrease the work of the pharmacist and to improve the rate of pharmacy callbacks is enormous.

At Vanderbilt University, we have constructed an electronic prescription writing tool called RxStar. RxStar is fully integrated within a web-based electronic medical record, sharing problems, medications, and allergies with that system as well as logging all activity occurring within the prescription writer. One of the most novel, but technically trivial (and therefore easily reproducible), of its innovations is the inclusion of notes at the bottom of the prescription. These notes currently include any alerts or reminders that were triggered during the prescribing process, along with the reason for overriding them. RxStar also includes patient allergy and patient medication information at the bottom of the prescription. As is often the case with any technology intervention, it is not clear whether SYW will increase or decrease the rate of callbacks. We believe that, by including SYW information on the prescription, prescribers will better inform pharmacists about the thought process that went into prescribing, thereby making callbacks more likely to directly impact patient safety. However, it is possible that pharmacists will increase the rate of calling because of other factors, including problems related to e-prescribing, lost faxes, or other problems. For this reason, it is important to conduct this pilot experiment and to determine whether unintended effects also exist.

Setting

Vanderbilt University Hospital and Clinics

The Vanderbilt University clinics and hospital were the sites for this project. Vanderbilt clinics include approximately 800,000 visits to primary and specialty care involving children and adults. These clinics are supported by both nurse practitioners and physician assistants who write prescriptions as well as nurses who are involved in the generation of renewal prescriptions, as has been described previously.[4]

Vanderbilt University Medical Center has three outpatient pharmacies on site. These pharmacies were the primary data collection site for this study. Each pharmacy has a director and a number of trained staff. Each pharmacy creates a daily log of all prescriptions, including the number of prescriptions and the number of new prescriptions, which shall be the primary source of callbacks. Pharmacies receive prescriptions from nurse practitioners, attending physicians, and residents as well as phoned-in prescriptions from other care providers. The patient mix for these pharmacies covers all specialties and age groups, including pediatric, surgical, obstetric, general medical, psychiatric, and oncology patients.

Pharmacy staff store all prescriptions in boxes sorted by date in a site adjacent to each pharmacy. Manual counting of prescriptions for this study was performed by a research assistant who removed these boxes from the pharmacy and counted prescriptions in a quiet, but nearby, location.

e-Prescribing Software

This study utilized RxStar©, an electronic prescription writer that has been in productive use at Vanderbilt since 2004. RxStar is in voluntary use by all clinical specialties except oncology, and it supports both printing and faxing of prescriptions to pharmacies. RxStar uses First Databank's

Drug Information Framework (FDB) as its source of medication and decision-support knowledge. FDB supports drug-allergy, drug-drug, drug-food, and drug-indication warnings as well as guidelines for minimum and maximum doses for adult patients. During the time this study was being conducted, RxStar provided dose-limit checking, formulary checking (using The Infoscan Formulary Database™, www.mminfotech.com) drug-allergy checking, and weight-based prescribing recommendations, all of which were included as appropriate on prescriptions during Show Your Work (SYW) periods.

RxStar is tightly integrated into an electronic medical record known as StarPanel™, which provides cross-continuum access to patient problems, medications, allergies, and demographic data. RxStar is not commercially available; however, its functionality is similar to that of most commercially available prescription writers that are integrated with electronic medical records, with the exception of the intervention under study (showing patient-specific alerts and other information on the prescription).

Methods

Callback Form Design

In an effort to systematically capture dialog data from the three outpatient Vanderbilt pharmacies during the assessment of baseline pharmacy callback rate, a Prescription Callback Study Form was designed in collaboration with the P.I. and lead pharmacists participating in this pilot. The initial form design was tested over a period of approximately 2 weeks and reviewed for utility and clarity in the data collection process. After pilot testing, the form was organized into itemized sections composed of Insurance, Rule Violations, Supply Issues, and Miscellaneous entries; the form was modified to decrease ambiguity in response information. The form was distributed to each pharmacy, and all staff who typically handled callbacks were trained to complete it.

This form was iteratively refined over the first phase of the study. After analysis of data from the first phase of the study, additional responses were added to the callback from based on the prevalence of comments that were not adequately represented on the initial form.

For the second phase of the project, after discussion with the pharmacists, we decided to pilot an electronic form. We used SurveyMonkey (www.surveymonkey.com) to construct an electronic version of the survey. The figures below are of this survey. SurveyMonkey allowed each pharmacy to be provided with a URL that uniquely launched the survey and allowed the pharmacy to review answers if necessary. Initial piloting of this approach was extremely well received by all pharmacy staff.

The second evaluation phase of the study involved a Show Your Work Perception Survey distributed to the 50 pharmacies receiving the highest volume of e-prescriptions from Vanderbilt University. This eight-item survey included items about perceived impact on callbacks, checking for errors, and checking for insurance eligibility. Survey questions are listed in the first column of Table 2. Each pharmacy director completed a survey for that pharmacy. Surveys were distributed to pharmacies using each pharmacy's preferred method (fax, e-mail, or land mail).

Results were then entered into SurveyMonkey (www.surveymonkey.com) for descriptive analysis. Quantitative callback data were analyzed using R, an open-source statistical package.

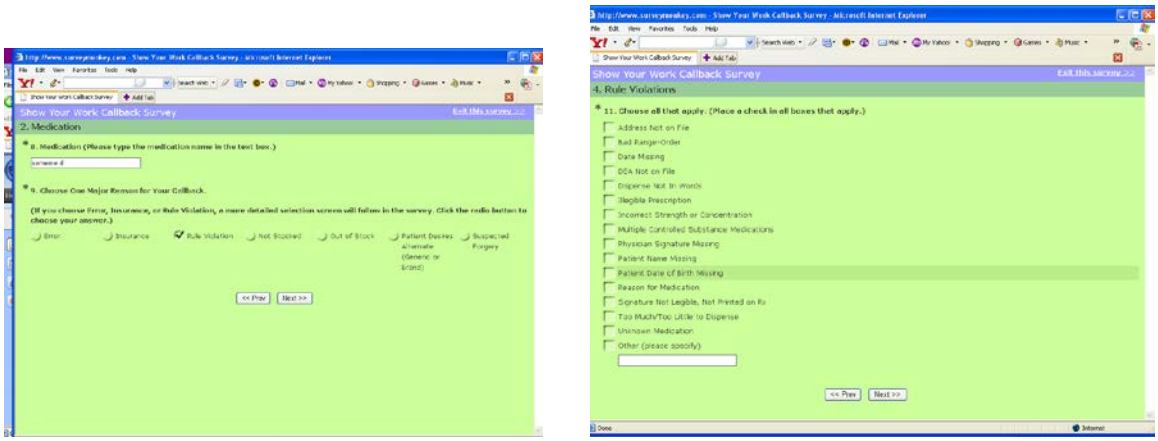


Figure 1. Electronic version of the callback form used for this project. The survey was developed using SurveyMonkey (http://www.surveymonkey.com).

Data Collection

Data collection for phase 1 began in April 2006 and continued for 2 months. All three pharmacies began official collection of callback data at this time.

Routine visits were made to each outpatient pharmacy by the research assistant to collect completed callback forms. Data were abstracted and organized into a customized Access database designed by the principal investigator and maintained by the research assistant.

Throughout the initial data collection phase, pharmacists were contacted by the research assistant via phone or e-mail for clarification of uncertain documentation entries or fields of missing data. Additional fields of callback reasons were added to the Access database as needed to appropriately capture categories not previously identified by the pharmacists during the form design process. Missing data were identified in the database and corrected before data were analyzed.

At the end of this phase, all pharmacies were visited by the P.I. and/or research assistant to perform a manual count of one random week of actual prescription types occurring within the time period of study collection. Manual counts were compared with actual summary statistics in each pharmacy to verify no larger than a 5% difference in values.

Data collection during the second phase of the study was conducted in a similar fashion. Because data were collected using an electronic form during this phase, pharmacies were visited by the research assistant to continue encouraging logging of callbacks (and to deliver doughnuts).

Measures

The list below summarizes the data collected for this study and its source as well as any relevant comments.

Data element	Source
SYW status (on/off)	Algorithmically defined
Number of callbacks	Callback study form
Total prescriptions	Collected by pharmacy routinely (new, refill)
Reasons for callbacks	Callback study form
Pharmacy staffing	Data collected by pharmacy

Analysis

The unit of analysis for this study was the prescription. Exploratory analyses were done with Excel 2003™ and Stata version 9.2.

Differences in callback rates are being assessed using a multiple regression model assessing the dependent variable, callback rate, and the independent variable, SYW status, along with pharmacy ID and delivery mode.

Limitations

One limitation recognized early in the study design was the need to rely on pharmacy self-report of callbacks. We aggressively worked to keep the morale in the pharmacies as high as possible. Early results during phase 1 were shared with each team in an effort to encourage consistent and thorough reporting of all callbacks. However, in phase 2, it became more challenging to ascertain the extent to which all callbacks were being recorded. Despite our concerns that the electronic survey might be a barrier to data collection, all sites insisted that they were accurately capturing all callbacks. Therefore, we continued to use this approach.

A second challenge to the study design was a delay of about 3 months due to issues with the release of SYW into production. IT was imperative that this new functionality be tested thoroughly before becoming generally available and that, once the study began, no additional changes should be made to it. Therefore, we delayed the start of phase 2 to accommodate all testing and the months of actual use.

Results

Phase 1 Findings

In total, 449 prescription callback forms were collected from the three Vanderbilt outpatient pharmacies during the 2-month collection period. In cases when a callback form had more than one medication listed, a separate entry was created for each in the database. This itemization process increased the sample size to 504 total callbacks.

Callback Rates

Table 1 contains a summary of prescription volumes and callbacks for each pharmacy in the study. The three pharmacies have different prescription volumes and slightly different callback rates.

Table 1. Baseline pharmacy prescription volumes.

Pharmacy	*New*	*Refill*	*Total*	*Callbacks*	*Callback Rate (new/callbacks)*
A	5606	4630	10,236	55	0.98%
B	16,452	10,441	26,893	365	2.22%
C	4738	2379	7117	84	1.77%
Total	26,796	17,450	44,246	504	1.88%

There were 504 callbacks in total reported by the pharmacies out of 26,796 new prescriptions, for a general callback rate of 1.88%. Based on a 12% sampling of prescriptions from each pharmacy site, we were able to estimate the relative frequency of prescription types, as shown in Table 2. The largest percent of callbacks was generated from handwritten prescriptions.

Prescription types were tracked in the following four categories: handwritten by prescriber, electronic, check box, and handwritten by pharmacy staff. Of note, 25 callback forms submitted were missing prescription type documentation.

Table 2. Callbacks as a function of prescription type.

Prescription Type	*Number of Prescriptions*	*Number of Callbacks*	*Percent*
Check Box Form	1074	7	1.4%
Electronic	8851	112	22.2%
Handwritten by Staff	4811	86	17.1%
Handwritten by Prescriber	12,069	274	54.4%
Missing Prescription Type		25	5.0%

Reasons for Callbacks

Table 3 lists the breakdown of callbacks, as reported by pharmacists. More than 40% of the callbacks were caused by rule violations, and 32% were related to errors on the prescription that made it ambiguous or potentially unsafe for the patient.

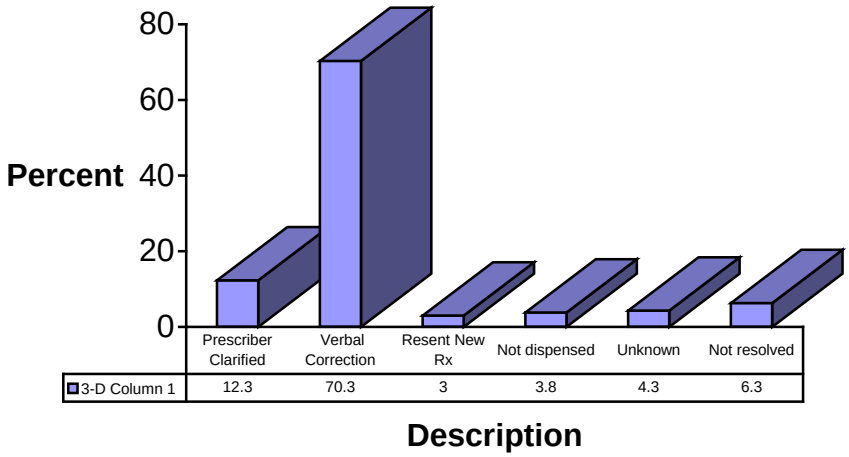
Table 3. Pharmacy-reported reasons for callbacks.

Description	*Count (n = 504)*	*Percent*
Insurance-related callbacks		
Need to Change Medication: Not Covered	20	3.97%
Prior Authorization Needed	48	9.52%
Therapeutic Duplication	14	2.77%
Wrong Duration: Should be 90 Days	29	5.75%
Early Refill	2	0.40%
Quantity	31	6.15%
Multiple Patients on One Prescription	1	0.20%
Total for Insurance-Related Callbacks	145	28.76%
Rule violation callbacks		
Illegible Prescription	24	4.76%
Unknown Medication	11	2.18%
Incorrect Strength or Concentration	105	20.83%
Bad Range for Order	20	3.97%
Too Much/Too Little to Dispense	21	4.17%
Dispensed Not in Words	9	1.79%
Signature Not Legible, Not Printed on Rx	6	1.19%
No Physician Signature	9	1.79%
DEA Not on File	4	0.79%
Date Missing	2	0.40%
Multiple Controlled Substance Meds	2	0.40%
Missing Patient Name	6	1.19%
Missing Patient Date of Birth	2	0.40%
Missing Required Reason for Medication	1	0.20%
Total for Rule Violation Callbacks	222	44.06%

Description	*Count (n = 504)*	*Percent*
Error-related callbacks		
Patient Instructions Contrary to Rx	15	2.98%
Directions	55	10.91%
Dosing	14	2.77%
Drug-Drug Interaction	1	0.20%
Duration	5	0.99%
Wrong Medication	2	0.40%
Clarification	67	13.29%
Frequency	4	0.79%
Route	1	0.20%
Total for Error Callbacks	164	32.53%
Medication Out of Stock	3	0.60%
Not Stocked	14	2.77%
Patient Desires Alternate	10	1.98%
Suspected Forgery	1	0.20%

Results of Callbacks

Figure 1 summarizes data provided by the pharmacists detailing how callbacks were handled by their staff. Of note, close to 10 % of prescriptions that were unable to be filled initially were never resolved or never pick up by the patient.



Phase 2 Findings

Figure 2 shows a breakdown of the types of prescriptions received during the randomized trial. There was no difference in the proportion of prescriptions received in any category. Table 4 shows the difference between pharmacy callback rates for RxStar prescriptions generated with (SYW on) and without (SYW off) the SYW functionality. Table 5 shows the breakdown of reasons for callbacks during the control and intervention periods. A chi-squared test of prescriptions with callbacks compared with no callbacks revealed no significant difference in the callback rates between the two periods, although there was a difference in the callback rate between the before and after periods related to the percentage of prescriptions that were generated electronically.

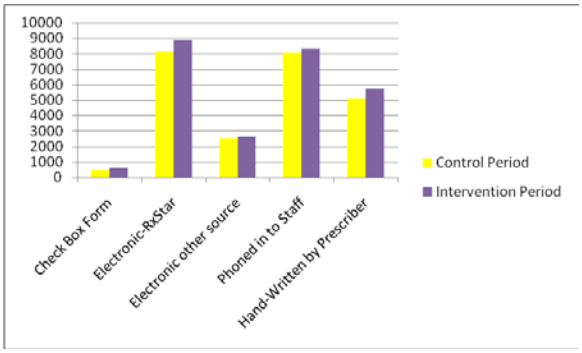


Figure 2. Breakdown of prescription types received by pharmacies. Data represent number of each type of prescription received during the trial period.

Table 4. Change in callback rate with and without SYW.

	SYW Off N (%)	*SYW On N (%)*	*P value*
Callback	91 (0.40%)	111 (0.45%)	0.47
No Callback	22,726 (99.6%)	24,761 (99.55%)	
Total	22,817	24,872	

Table 5. Callback reasons with and without SYW.

Callback Reason	**SYW Off (%)**	**SYW On (%)**
Error	19 (55.9)	20 (60.6)
Insurance	12 (35.3)	11 (33.3)
Not Stocked	1 (2.9)	0 (0.0)
Out of Stock	1 (2.9)	0 (0.0)
Rule Violations	1 (2.9)	2 (6.1)
Total	**34 (100)**	**33 (100)**

Chi-sq(4) = 2.388, p = .665

SYW perception survey results are summarized in Table 6. In total, 38 of 50 high-volume pharmacies responded (76% response rate), with five pharmacies unable to recall if they had noticed SYW at the bottom of a prescription. Therefore, responses were evaluated for the 33 pharmacies that responded and were able to recall seeing SYW annotations.

When asked if SYW helped avoid callbacks (question 1), the majority of respondents agreed or strongly agreed (69%). Pharmacists found the allergy override information helpful (question 6, 69% agree or strongly agree). Information about patient's insurance eligibility was less helpful, with the majority of pharmacists either neutral or in disagreement (total of 77% in these categories).

Table 6. Results of Show Your Work perception survey (n = 33).

SYW…	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
1. helped me avoid callbacks	0	1 (3.0)	9 (27)	16 (48)	7 (21)
2. helped me check for potential errors	0	0	4 (13)	20 (63)	8 (25)
3. caused me to call the prescriber back	1 (3)	20 (61)	9 (27)	2 (6)	1 (3)
4. was helpful in pediatric cases	1 (3)	0	5 (16)	18 (55)	9 (27)
5. was helpful with insurance eligibility	2 (7)	10 (31)	13 (41)	5 (17)	2 (6)
6. was helpful with avoiding callbacks due to patient-reported allergies	0	3(9)	7 (21)	17 (52)	6 (18)
7. was helpful avoiding callbacks due to low or high doses	0	1(3)	10 (32)	18(55)	4 (12)

Respondents provided many comments about SYW. For the question asserting that the SYW precipitated callbacks, respondents stated that, when an allergy is overridden without a good explanation entered by the prescriber, they would call the prescriber for clarification. They also called prescribers back when there were conflicting directions on the prescription (such as when a dosing direction entered in free text was unclear).

Comments about the impact on pediatric prescribing were uniformly positive. Fifteen respondents commented that adding the information about how the dose is calculated allowed them to more easily verify the dose. One pharmacist commented, “date of birth is the usual info we get from parents or on the Rx when it is received, but this is less accurate in terms of dosing accuracy.” Another noted, “explains excessive dosing above manufacturer recommendation.”

Other comments on the SYW functionality (11) are summarized in Table 7. Of note, pharmacy respondents noted situations in which SYW increased callbacks by providing additional information that generated concerns.

Table 7. SYW perception survey comment themes.

Theme	***# comments***
May increase callbacks	**4**
Decreases callbacks	**5**
Does not include Rx group # and ID #	**1**
Need to round doses better	**1**
Problems with garbled faxes	**1**

Discussion

Implementation of e-prescribing affords numerous opportunities to impact patient safety. This study was the first of its kind to examine the incorporation of a prescription annotations tool in an e-prescribing system. Results suggest that a relatively low-cost, easy-to-implement intervention can impact the pharmacist's perceived effectiveness. This impact can lead to increased safety, which, based on the qualitative comments provided by survey respondents, can be achieved in part specifically by increasing callbacks in some areas while decreasing callbacks in other areas.

Although qualitative data presented here support the implementation of SYW functionality in e-prescribing systems, we found no significant change in the callback rates in our randomized trial. There are several factors that may account for this. The study utilized a self-report method to detect changes in pharmacy callbacks and may well have been limited by collection challenges during the second phase of the study. Of particular note, during the second phase of the study, one of the pharmacies changed locations within the hospital system. Although the randomized design should have impacted both the control and intervention days equally, it is possible that callbacks were largely underreported during the relocation, making any difference between the callback rates appear negligible due to low numbers.

The study also was limited to quantitative callback data obtained only from pharmacies within close proximity to the investigators. This nonrandom selection of sites may not necessarily provide the best estimate of callback if these pharmacies are not representative of the community, and a larger, more random sampling of pharmacies may be necessary to reveal any noticeable difference in callback rates as a result of implementing the SYW functionality. The qualitative comments offered by other pharmacies in our area support the possibility that SYW had no net impact on the volume of callbacks. These pharmacies provided specific examples of when SYW generated callbacks as well as situations when it prevented them. It appears that these pharmacists, provided with SYW, are able to better partner with prescribers to ensure safe medication dispensing.

Although the study was limited to only one e-prescribing system, and although perceptions about the perceived value of SYW may have been confounded with perceptions of the e-prescribing system itself, we contend that this is an important first step in evaluating and developing SYW tools such as the one studied here. Additional studies should be done to more directly establish a relationship between prescription annotations and the types of callbacks that may be motivated by or mitigated by this technology.

Conclusions

This study was the first of its kind to examine the incorporation of a prescription annotations tool in an e-prescribing system. Results suggest that a relatively low-cost, easy-to-implement intervention can impact the pharmacist's perceived effectiveness and foster more effective partnering with prescribers.

Publications and Products

A manuscript describing this study has been submitted to the American Medical Informatics Association for presentation in 2009.

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