

Effects of Electronic Prescribing on the Clinical Practice of a Family Medicine Residency

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Background and Objectives: *Electronic prescribing is one of the components of the Patient-centered Medical Home and is one of the “meaningful use” criteria to qualify electronic medical records for financial incentives. While there are many potential benefits of electronic prescribing, documentation of these is currently sparse. The purpose of this study was to measure practice improvement as a result of the implementation of electronic prescribing.* **Methods:** *Using telephone logs, the number and nature of after-hours calls were reviewed before, immediately after, and 1 year after the initiation of electronic prescribing. Patient and provider satisfaction studies were also conducted.* **Results:** *One year after the onset of electronic prescribing the overall rate of after-hours calls was reduced by 22% from baseline, significant at $P \leq .05$, though calls related to medications were significantly increased. Both provider and patient satisfaction with electronic prescribing was very high.* **Conclusions:** *Electronic prescribing was positively received by patients and providers and resulted in a reduction in total after-hours calls, despite a paradoxical increase in medication-related calls. Further study is warranted to document other evidence-based outcomes of electronic prescribing.*

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Recent years have seen a great deal of attention to health care reform, much of it focused on the adoption of electronic medical records and the Patient-centered Medical Home. Electronic prescribing is a prominent component of the Medical Home¹ and is one of the “meaningful use” criteria required to qualify for federal financial incentives to encourage implementation of electronic medical records.² As of 2009, such incentives were in place for physicians demonstrating effective electronic prescribing for Medicare patients. Given this impetus, it stands to reason that more physicians will use electronic prescribing systems.

Purported benefits of electronic prescribing are reduced prescribing errors, improved prescription safety, greater practice efficiency, lower drug costs, and enhanced patient and provider satisfaction. While these outcomes may be intuitive, to date the literature gives only limited and mixed testimony to them. Adherence to evidence-based medicine begs the demonstration of such improvements from the adoption of electronic prescribing.

This study’s purpose was to document and quantify measures of quality improvement in a family medicine clinic before and after the institution of electronic prescribing. Among the many possible measures of practice improvement, we focused on after-hours patient call frequency, patient satisfaction, and provider satisfaction. These measures were chosen in part because they were easily surveyable or obtainable through a review of existent clinical records and in part due to anecdotal reports by our providers that many telephone calls over the last year appeared to be related to electronic prescribing issues. It was also noted that these particular measures were discussed in the Secretary of Health and Human Services 2007 report on pilot studies of electronic prescribing standards, noting that they needed further study.³ We hypothesized that after-hours calls would be reduced, and patient and provider satisfaction would be high, as a result of effective electronic prescribing.

Methods

Subjects and Setting

Data were collected from a university-based family medicine residency clinic in Alabama from 2007 through 2009. The clinic is staffed by seven physician

faculty, two nurse practitioners, 18 residents, and one sports medicine fellow. It is the medical home for a racially diverse, urban, working-class population of approximately 10,000 patients; more than 50% of the patient mix has Medicaid or is self-pay. The clinic provides a wide array of adult, pediatric, and obstetrical services for more than 20% of the underserved population of the city.

After a 2-month period of trial and provider education, the clinic adopted a policy of exclusive electronic prescribing, using a free online service (Allscripts ERx Now), on November 1, 2007. Written prescriptions are not permitted except during power outage or disruption of service. Prescriptions that require paper copies, such as those for controlled substances or those necessitated by institutional requirement or patient request, are processed through Allscripts, then printed on security paper. Data for analysis were obtained from the handwritten after-hours telephone log kept by residents on call and surveys of patients and providers. The institutional review board approved this protocol.

Measures

Three time periods were chosen for after-hours telephone log analysis: January 1 through June 30, 2007 (pre-electronic implementation), November 1, 2007 through April 30, 2008 (immediately post-electronic implementation), and July 21, 2008 through March 31, 2009 (1-year post-electronic implementation). We obtained clinic visit volume from office records. One of the authors reviewed all call logs, recording total call volume and the patients' reasons for calling. Since residents entered patients' complaints freehand rather than from a pick list, the investigators applied clinical judgment to collate and aggregate reported problems into a list of 24 categories, and a 25th category for miscellaneous other complaints. Some of the daily telephone logs (28% overall) could not be located. To control for this, as well as potentially confounding seasonal variations in patient volume, the number of clinic visits prorated to the number of telephone log days in each time period was determined, enabling the calculation of a call rate (number of calls per 1,000 office visits). Our primary outcome measure was change in total call rate from baseline to 1 year after electronic prescribing implementation; secondary measures were the changes in call rates for the top five patient reasons for calling.

Additionally, all patients presenting at the clinic from June 8 through 19, 2009, received a written questionnaire assessing their satisfaction with electronic prescribing. Likewise, all medical providers were surveyed via intra-office e-mail regarding their experiences and satisfaction with electronic prescribing in June 2009. Results of these surveys are presented as additional secondary outcome measures.

Data Analysis

Z-scores, calculated assuming the normal approximation to the Poisson distribution, were used to assess differences in call volume per 1,000 clinic visits from baseline to 1 year after the implementation of electronic prescribing.

Results

After-hours Telephone Call Volume and Nature

Overall, we located telephone logs for 72% of the days for the three periods of review (82% pre-electronic prescribing, 63% immediately post-electronic implementation, and 73% 1-year post-electronic implementation), with 14,236, 13,970, and 18,462 clinic visits during each of these respective time periods. These figures were used to prorate the number of office visits to the proportion representative of the number of telephone logs available. Results are summarized in Table 1.

The number of calls, and the call rate for total calls and the top five reasons for calling, for each time period, are listed in Table 2. One year after starting electronic prescribing there were statistically significant call-rate reductions in total calls (-22%) and calls related to nausea, vomiting, and diarrhea (-46%) but an increase in medication-related calls (+81%).

Electronic Prescribing Patient Satisfaction

The questions and summarized responses to the patient satisfaction survey are shown in Table 3. Ninety-one percent of patients were happy that the clinic had adopted electronic prescribing. Positive and neutral answers combined for more than 90% of the responses on all questions.

Electronic Prescribing Provider Satisfaction

The questions and summarized responses to the provider satisfaction survey are shown in Table 4. More than 93% of providers were happy that the clinic had adopted electronic prescribing. Among the most

Table 1

After-hours Patient Calls in Relation to Clinic Visits

	<i>Before ERx</i>	<i>Immediately After ERx</i>	<i>Mature ERx</i>
Telephone log days	149	114	185
Calls	1,101	944	990
Calls per log day	7.4	8.3	5.4
Clinic visits prorated to percentage of log days out of calendar days	11,674	8,801	13,477
Clinic visits per log day	78	77	73

ERx—Electronic prescribing

Table 2
After-hours Call Rate (Total and Top Five Reasons)

Time Period	Calls/1,000 Office Visits (n=number of calls)					
	Total	URI	Fever	N/V/D	Pain	Med
Before ERx Call	94.3 (1,101)	16.1 (188)	15.9 (186)	15.7 (183)	11.5 (134)	6.4 (75)
Immediately After ERx	107.3 (944)	26.2 (231)	16.5 (145)	11.5 (101)	11.6 (102)	14.8 (130)
One-year After ERx	73.5 (990)	12.3 (166)	10.6 (143)	8.5 (115)	10.9 (147)	11.6 (157)
Change from Before to 1-year After ERx	-22%*	-24%	-33%	-46*	-5%	+81%*
Z-score	-2.14*	-0.95	-1.33	-1.82*	-0.18	+2.06*
P Value	0.02*	0.17	0.09	0.03*	0.43	0.02*

ERx—Electronic prescribing
 URI—Upper respiratory infection/pharyngitis
 N/VD—Nausea, vomiting, diarrhea
 Med—Medication problems and questions of any kind

* P<.05.

common unfavorable responses, more than 41% of respondents believed electronic prescribing did not reduce daytime or after-hours calls and overall workload. Approximately 30% of respondents indicated that patients and providers alike had difficulty identifying the patient’s pharmacy.

ted, but the patient went to the pharmacy too soon for it to be ready for pickup.

Discussion

We found a decrease in overall after-hours call volume after electronic prescribing had been in place long enough to become the familiar, standard operating procedure in our clinic. Although there was an increase

in calls during the initiation period, within a year calls dropped 22% from the pre-electronic prescribing baseline. Despite the methodological problems posed by attempting to demonstrate efficacy of a practice improvement intervention, we were able to document a reduction in call volume, while maintaining patient and provider satisfaction.

While it is to be expected that calls would increase during the get-acquainted period for electronic prescribing, the magnitude (+14% overall, +131% for medication-related calls) is

Table 3
Electronic Prescribing Patient Satisfaction Survey Results

1. Electronic prescribing makes obtaining my medications easier for me.	Yes	No Difference	No
	76.1%	16.9%	7.0%
2. Electronic prescribing results in fewer errors with my medications.	Yes	No Difference	No
	63.3%	28.2%	8.5%
3. I have gone to the pharmacy, only to find that my prescription is not ready.	Rarely or Never	Occasionally	Often
	58.6%	31.4%	10.0%
4. I have had my prescriptions sent to the wrong pharmacy.	Rarely or Never	Occasionally	Often
	91.5%	7.1%	1.4%
5. All things considered, I am happy my doctor uses electronic prescribing.	Yes		No
	91.4%		8.6%

71 respondents, out of n=845 patients offered the survey. Columns arranged to show favorable response to the left, unfavorable response to the right.

Providers were given an opportunity to identify specific problems with electronic prescribing that they considered a major inconvenience. Forty-seven percent of providers identified having the pharmacy tell the office or patient that a transmitted prescription had not been received as a major problem, and 35% had patients report that a prescription had been sent to the wrong pharmacy. Additionally, 35% reported episodes where it was determined that a prescription had been correctly transmitted

Table 4
Electronic Prescribing Provider Satisfaction Survey Results

	<i>Yes</i>	<i>No Difference</i>	<i>No</i>
1. Electronic prescribing takes less time for me than handwriting prescriptions would.	70.6%	11.8%	17.6%
2. Electronic prescribing leads to fewer office-hour medication questions, callbacks, and overall workload than I would have if I were handwriting all my prescriptions.	29.4%	29.4%	41.2%
3. Electronic prescribing leads to fewer after-hours medication questions, callbacks, and overall workload than I would have if I were handwriting all my prescriptions.	43.8%	12.5%	43.8%
4. Electronic prescribing leads to fewer prescription errors in our practice than handwritten prescriptions.	75.0%	18.8%	6.2%
5. I frequently have trouble determining exactly which pharmacy my patient wishes to use.	<i>No</i> 68.8%		<i>Yes</i> 31.2%
6. My patients frequently have trouble determining exactly which pharmacy they wish to use.	<i>No</i> 70.6%		<i>Yes</i> 29.4%
7. All things considered, I am happy we now use electronic prescribing.	<i>Yes</i> 93.8%		<i>No</i> 6.2%

17 respondents, out of n=28 providers. Columns arranged to show favorable response to the left, unfavorable response to the right.

noteworthy. One factor that likely contributed to this volume of calls was that we were the first large clinic in the community to adopt electronic prescribing, and initially there was a lack of pharmacy familiarity, even though the necessary technical resources were in place. We received a number of calls in the initial months from pharmacists who told us they had received no prescriptions, when they were actually checking the answering machine or fax machine rather than the electronic prescribing system. Likewise, patient unfamiliarity appeared to generate many calls; in particular, it was often not appreciated that, though the prescription had been immediately transmitted, it would still take a finite period of time, dependent upon the pharmacy’s patient volume at the moment, for the pharmacist to prepare and package the prescription.

Further, medication-related calls were still 81% above baseline after the first year. At first glance, it is hard to reconcile the reduced overall call rate with the increase in medication-related calls. By the end of the first year, pharmacy, patient, and provider familiarity with electronic prescribing was almost uniform. However, our providers anecdotally reported that patients were often still going to the pharmacy too quickly for

their prescriptions to be ready, potentially contributing to some of our callback volume. As a result of this practice improvement exercise, after our final data collection period we revised our practice information to reflect that patients would need to allow the pharmacy time to package their prescriptions.

Additionally, it should be noted that medication questions represented a relatively small fraction of the total after-hours calls (16% during the final data period) and that calls often included more than one type of question. Our triage nurses also had access to the electronic prescribing system and were quite possibly able to independently handle a larger number of calls during office hours, resulting in a reduction in after-hours calls. Such enhanced efficiency due to electronic prescribing could result in a decrease in overall calls despite an increase in medication-related calls.

Both providers and patients overwhelmingly expressed satisfaction with electronic prescribing. This is despite the facts that most providers did not feel electronic prescribing lessened workload and that a sizable minority (30%) experienced difficulty in determining the patient’s pharmacy of choice. The patient survey revealed few complaints, the most frequent being that

prescriptions were not ready when the patient arrived at the pharmacy (10%).

There is not an abundance of outcomes-based research on the utilization of electronic prescribing. Given the rapidly changing nature of computer technology and Internet resources, many of the available studies are already somewhat dated and discuss limitations and pitfalls that may no longer exist.^{4,5} Even the more recent literature regarding quality improvement being attributed to electronic prescribing, while generally supportive, also shows some contradictory and cautionary results. Some studies have documented increased use of generics and decreased medication costs,^{6,7} high patient satisfaction,^{3,8} positive provider acceptance,^{9,10} and increased identification of drug interactions,^{9,11} while others have detailed that, even as total errors are reduced, new errors specific to electronic prescribing may be introduced that can escape the initial notice of the prescriber or pharmacist.¹² There are reports illuminating the obtrusiveness of allergy and interaction alerts. Frequently appearing alerts may lead physicians to routinely override warnings, diluting the promise of improved patient safety¹³ or, instead, to increase cautionary discussions with patients.¹¹ The literature speaks to generally high provider satisfaction, while at the same time noting that patient callbacks were not reduced⁹ and that provider satisfaction may be more related to enhancement of productivity or workflow than to quality of care.¹⁰

This study adds support to the hypothesis that both providers and patients will be happy with electronic prescribing after the learning period has taken place. It is still unclear exactly why they are so satisfied. It is possible that patients perceive this as a more modern, technologically advanced, or safer way to prescribe medications or that perhaps it saves them time compared to having to carry a paper prescription to the pharmacy. In retrospect, these are questions that would have been valuable to add to the patient survey. While providers didn't perceive that electronic prescribing lessened their overall workload, they did feel it shortened the length of time required to actually create prescriptions and led to fewer prescribing errors—factors that likely contribute to their overall satisfaction with the system.

There are certainly other aspects and consequences of electronic prescribing that were not measured in this study, yet might lead to quality improvement or enhanced patient and provider satisfaction. It is possible that some adverse drug reactions were averted as a result of electronic prescribing. The electronic prescribing tool makes choosing various formulations, combinations, and generic equivalents quick and simple compared to using traditional methods, which was probably appreciated by many prescribers. Covering physicians value being able to review a patient's prescribing history off-site, especially in the emergency department

or during after-hours calls. Insurance formulary checks, another advantage offered by electronic prescribing systems, probably had little impact on our practice, since we already had adequate formulary resources in use. In other settings, integrated formulary references would hopefully lead to reduced medication costs to the patient and consequently improved compliance, while globally reducing health care costs.

Limitations

There are several limitations to this study. It was performed as a practice improvement study, using retroactively reviewed data and thus was inherently less rigorous than an experimentally designed, prospective study. It took place in a family medicine residency clinic; this potentially impedes generalization to private practice and to non-primary care specialties. The lack of clinical experience of the learners could have impacted the number of prescribing errors, while the relative youth and computer skills of our residents may have positively affected implementation and utilization. Our patient population, a large proportion of which is medically underserved, differs from many private practices. A more affluent and educated population might more readily and successfully adapt to electronic prescribing, though the high rate of patient satisfaction in our study suggests that most of our patients had adequate technical skills to appreciate the nature of this new method of providing medications.

We were unable to locate 28% of our after-hours telephone logs. Legibility was sometimes problematic, and some degree of subjectivity was involved in the categorization of the patients' reasons for calling. Despite the incomplete data, the large number of records that were obtained, in each case over at least 6 months of observation, and the normalization to clinic patient volume at the time, appear to attest to the validity of the sampling and calculation methods. Certainly the voluntary nature of both the provider and patient satisfaction surveys presents an opportunity for self-selection bias; the relatively small sample sizes are another potential problem. Finally, as discussed above, we acknowledge that the factors reported in our study do not include all of the potential measures of improvement that could result from electronic prescribing.

Conclusions

Our study demonstrated high patient and provider satisfaction, as well as a statistically significant reduction in total after-hours calls, following the implementation of electronic prescribing in a large, academic, outpatient primary care setting, despite a paradoxical increase in medication-related calls. Further study is warranted to further illuminate the effect on medication-related calls and to confirm these and other beneficial outcomes from this tenet of the Patient-centered

Medical Home; concrete measures of improved patient safety and reduced health system costs would be particularly welcome.

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