

**Project Title:** E-Prescribing Impact on Patient Safety, Use, and Cost  
**Principal Investigator:** Weissman, Joel S., Ph.D.  
**Organization:** Massachusetts General Hospital  
**Mechanism:** RFA: HS04-012: Demonstrating the Value of Health Information Technology (THQIT)  
**Grant Number:** R01 HS 015175  
**Project Period:** 09/04 – 12/07  
**AHRQ Funding Amount:** \$1,122,244  
**Summary Status as of:** December 2007, Conclusion of Grant

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**Strategic Goal:** Develop and disseminate health IT evidence and evidence-based tools to improve health care decisionmaking through the use of integrated data and knowledge management.

**Business Goal:** Synthesis and Dissemination

**Summary:** Medication errors can occur at every step in the medication process: ordering medications, transcribing the orders, preparing the medications, or administering the medications to patients. Medication errors that occur in the earlier stages of the process are more likely than others to be intercepted before causing harm. A systems-focused, multidisciplinary approach has been useful for preventing serious errors. Computer-based rules have been effective in preventing mistakes and injury in the inpatient setting and hold great promise for application in the ambulatory setting. Electronic prescribing (e-prescribing) by ambulatory physicians holds promise in terms of reduced cost and increased patient safety by providing real-time drug information to the prescriber.

The primary aim of the study was to conduct a pre-post study with concurrent controls to evaluate the effects of e-prescribing on patient safety, use, and cost of prescription medications. Physician adoption and the rate of e-prescribing use was also evaluated, as was the effect of e-prescribing on hospitalization rates of patients with selected chronic conditions (heart conditions, hypertension, diabetes, pulmonary conditions). The study used or modified current measures of poor prescribing habits, utilization, and selected patient outcomes.

To accomplish this aim, all pharmacy and medical claims from 2003 through the first quarter of 2005 were obtained, providing pre- and post-intervention data for patients of physicians who began using the e-prescribing technology from Tufts Health Plan and Blue Cross Blue Shield of Massachusetts, and as a concurrent control for patients of physicians who did not use the technology during 2004 and the first quarter of 2005.

Evaluation of e-prescribing uptake showed steadily increasing use of e-prescribing over the study period. E-prescribing with formulary decision support (FDS) led to the use of lower-priced medications. Early results also indicated that patients getting e-prescriptions had less severe potential drug-drug interactions (DDIs) among their dispensed medications.

### Specific Aims

- Conduct a pre-post study with concurrent controls to evaluate the effects of e-prescribing on patient safety, use, and cost of prescription medications. **(Achieved)**

### Impact and Findings:

*e-Prescribing Adoption*

There was a slow and steady increase in e-prescribing adoption over the 12 months of the study period. This suggests that clinicians may have become more comfortable with e-prescribing as they continued using it; however, it did not appear that a large proportion of clinicians became exclusive—or even majority—e-prescribers. By the end of the study period, the e-prescribing system had enrolled 2,055 prescribers, and 1,496 had the system in place; however, over the 12-month study period, only a total of 1,217 clinicians (81 percent) had actually written 1 or more e-prescriptions using the system. Use of the e-prescribing system increased steadily during the study period, with over 55,000 e-prescriptions written in March 2005. Clinician age (increased adoption by younger clinicians), size of practice (increased adoption in larger practices), and physician specialty all had an impact on adoption rates. This lack of full uptake may have multiple causes, such as problems with unusual doses or compounded medications, technical issues with the e-prescribing system, inability to access e-prescribing at all practice locations, or clinician preference for paper prescribing. In addition, some medications, such as controlled substances, require a hard copy with actual prescriber signature and thus cannot be e-prescribed.

### *Cost*

E-prescriptions in the intervention group showed a 6.6 percent increase in the proportion of Tier 1 drugs (generics) compared to the baseline period, while the control group had an increase of 2.6 percent. Although the size of the effect may appear modest, the potential financial impact is substantial. The size of the financial impact depends critically on the extent to which e-prescribing is utilized. The proportion of drugs in Tier 2 and Tier 3 (brand-name medications) decreased correspondingly. Multivariate models predicted that e-prescribing would correspond to a 3.3 percent increase (95 percent, CI 2.7 percent to 4.0 percent) in Tier 1 prescribing, controlling for baseline differences between intervention and control physicians and for changes over time. Based on average costs for private insurers, it is estimated that full adoption of e-prescribing with FDS could result in savings of \$3.91 million per 100,000 patients. These results suggest there are important economic gains achievable through the broader use of e-prescribing with FDS but that merely providing e-prescribing systems to clinicians will not necessarily achieve those savings. Rather, prescribers need to adopt the e-prescribing systems fully in order for these gains to be realized.

### *Poor Prescribing Habits*

Current measurements of the impact of e-prescribing on potential DDIs are limited by measurement problems but do show a tendency toward reduced frequency of the most serious potential DDIs with e-prescribing; however, the potential indications of increased safety with use of e-prescribing should stimulate further study. The ability to accurately measure the safety impact of e-prescribing systems, and thereby positively impact prescribing habits, will allow for a more complete understanding of their value and allow for insights into how to improve the next generation of software. Future research will build on the techniques that were developed for these analyses and allow for more conclusive studies.

### *People with Chronic Conditions*

There was no impact of e-prescribing on mortality or hospitalization. For each of the four specific condition cohorts examined (heart conditions, hypertension, diabetes, pulmonary conditions), there were minor differences between people in the control and intervention groups. Overall, 25 percent of patients with a chronic condition had either a death or a hospitalization in the year following their first e-prescription; however, e-prescribing had no impact on the risk of death for the four specific chronic conditions of interest or among patients with any chronic condition.

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## **Selected Outputs**

Fischer MA, Vogeli C, Stedman MR, et al. Uptake of electronic prescribing in community-based practices. *J Gen Intern Med.* 2008; 23(4): 358-63.

Fischer MA, Vogeli C, Stedman M, et al. Effect of electronic prescribing with formulary decision support on medication use and cost. *Arch Intern Med.* 2008;168(22):2433-9.

Fischer MS. Impact of electronic prescribing on medication use and cost in community-based practices. Presentation at SGIM; 2007 April; Toronto, Ontario, Canada.

Weissman JS. Impact of electronic prescribing on medication use and cost in community-based practices. Roundtable on The Electronic Health Record: From Research to Policy. Academy Health Annual Research meeting; 2007 June 4; Orlando, FL.

Fischer MS. Adoption of electronic prescribing in community-based medical practices. Presentation at Annual Meeting of Academy Health; 2006 June; Seattle, WA.

Weissman JS. Impact of electronic prescribing on use of generic and preferred medications. Poster at Annual Meeting of Academy Health; 2006 June; Seattle, WA.

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**Grantee's Most Recent Self-Reported Quarterly Status (as of December 2007):** At the end of the grant period, the project is completed with several evaluation activities completed or underway.

**Milestones:** Progress is mostly on track.

**Budget:** Spending is roughly on target.