Effects of Electronic Prescribing on Formulary Compliance and Generic Drug Utilization in the Ambulatory Care Setting: A Retrospective Analysis of Administrative Claims Data

S. MICHAEL ROSS, MD, MHA; DIANA PAPSHEV, PharmD; ERIN L. MURPHY, MS, DAVID J. STERNBERG; JEFFREY TAYLOR, MS; and RONALD BARG, MD

ABSTRACT

OBJECTIVE: Electronic prescribing (e-prescribing) provides formulary information at the point of care. The objective of this study was to assess the effects of e-prescribing on formulary compliance and generic utilization.

METHODS: This was a retrospective analysis of pharmacy claims data from a large national managed care organization. A sample of 95 providers using predominantly e-prescribing was randomly selected (e-prescriber group). A matched sample of 95 traditional prescribers was selected (traditional prescriber group), matched to the e-prescriber group by zip code and medical specialty. A total of 110,975 paid pharmacy claims, for the 12 months from August 1, 2001, through July 31, 2002, were analyzed to assess the effect of e-prescribing on formulary compliance and generic utilization. All paid pharmacy claims were examined for each group; for the e-prescriber group, this included all claims, not just those prescribed using an e-prescribing device. A written qualitative survey was distributed to physicians and office managers to assess e-prescribing usage, sources of formulary information, and effects of e-prescribing on office resources.

RESULTS: Both predominantly e-prescribers and traditional prescribers demonstrated high levels of formulary compliance, 83.2% versus 82.8%, respectively (P=0.32). Formulary compliance for these groups did not differ from the overall prescriber population (82.0%). There was not a difference in generic drug utilization rates between e-prescribers and traditional prescribers (absolute rates 37.3% versus 36.9%, P=0.18). Qualitative survey responses supported previously reported research indicating reductions in calls both to and from pharmacies for prescription orders.

CONCLUSIONS: An examination of paid pharmacy claims from a large, national managed care organization demonstrated no differences between predominantly e-prescribers and traditional prescribers in measures of formulary compliance or generic drug utilization. Future studies should examine keystroke data at the point of care to observe more detail about drug selection methods.

KEYWORDS: Formularies, Prescriptions, Drug, Drug therapy, Computer assisted, Drugs, Generic, Physician practice patterns

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Electronic prescribing (e-prescribing) supports physicians in the process of prescribing by providing drug and formulary information at the point of care. Several studies have indicated that computerized physician order entry (CPOE), a form of e-prescribing used in inpatient settings, has a positive effect on prescribing practices in terms of patient safety, drug cost savings, and quality of care. However, e-prescribing in the ambulatory setting is not as well established. In 1999, only 2% of outpatient prescriptions written by 650,000 physicians in the United States were written electronically. There is increasing interest in e-prescribing use in the outpatient setting: a survey of 1,200 practicing physicians revealed that 8% used e-prescribing in 2003, and researchers estimated that 17% of physicians would use e-prescribing by 2004. Forty-seven state boards of pharmacy have approved the use of e-prescribing, and the recently passed Medicare Modernization Act requires the establishment of standards for e-prescribing and offers incentives to improve adoption.

E-prescribing offers numerous potential benefits, including the potential for a reduction in medication errors, due, in part, to more legible prescriptions and the ability to check for drug-drug and drug-allergy interactions; a reduced administrative burden; and the potential for a reduction in duplication of medication orders.

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burden that results in provider time savings and improved efficiency; improved patient satisfaction; and improved formulary compliance and cost savings. Preliminary results from a prospective year-long pilot study on e-prescribing completed in 2002 showed time savings, fewer calls between pharmacists and physicians, and a high level of satisfaction among physicians. However, barriers to implementation, including technological issues and financial obstacles, have impeded the widespread adoption of e-prescribing.

Prescription cost-management strategies have traditionally included use of formularies, generic utilization, copayments, and prior authorization. In a study that assessed the effects of a tiered copayment system on formulary compliance, the study authors noted that physicians were generally unaware of the differential in prescription copayment amounts until informed by the patient or pharmacist. Physicians recognize the importance of drug costs in prescribing decisions, but most report a lack of access to drug cost data, hindering their ability to advise patients and modify their prescribing decisions. E-prescribing offers the ability to provide physicians with immediate access to the formulary and generic status of prescribed agents, allowing them to discuss medication costs and alternative choices with patients at the point of care.

Previous research on the effects of e-prescribing on formulary compliance has largely relied on physician self-reporting. A year-long study by the Tufts Health Plan indicated that the use of e-prescribing helped physicians prescribe more generic and preferred brand drugs. A 2000 study commissioned by Allscripts (Libertyville, IL) found that the use of their e-prescribing device increased formulary compliance (to more than 96%) and generic utilization (from 46% to 55%; an absolute 9-point or relative 20% increase) among users.

Our study is a retrospective examination of the relationship of predominant e-prescribing to formulary compliance and generic utilization, performed from the perspective of a health plan. In order for a managed care organization (MCO) to invest in e-prescribing technology for their providers, they would need evidence to support the investment; therefore, an overall cost advantage of e-prescribing would need to be demonstrated. The study hypothesis was that predominant e-prescribers would demonstrate higher ratios of formulary compliance and generic utilization than traditional prescribers because of the informational support offered at the point of care during drug prescribing.

Methods
This retrospective, between-group analysis was conducted within the Aetna (MCO)-affiliated provider network. Aetna is one of the largest health insurers in the nation, with more than 12 million enrolled members during the study period. Integrated MCO medical and pharmacy claims from August 1, 2001, through July 31, 2002 (the study period), were utilized.

Physicians using the e-prescribing (Allscripts) system were identified as part of a larger investigation into the impact of e-prescribing on physician behavior. Subsequent studies examined the impact of point-of-care electronic messaging on physician compliance with treatment guidelines, and the impact of targeting physicians for continuing medical education through a handheld electronic device. This system provides drug and formulary information during the prescribing process as well as the capability to submit prescriptions electronically. At the time of prescribing on a handheld computer or a PC workstation, the system indicates the formulary status of a drug, using color-coded icons. A green smiling icon indicates a preferred or first-tier drug, a yellow neutral face indicates a second-tier drug, and a red frowning face indicates a nonformulary drug.

All members of the e-prescribing group used e-prescribing during the study period. A comparison group was selected by matching traditional prescribers (physicians not using the e-prescribing system) with e-prescribing physicians using a computerized matching procedure; matching criteria included the number of MCO pharmacy claims generated by the physician, the number of MCO members served by the physician, and the categories of drugs prescribed by the physician, physician specialty, physician survey instrument.
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<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Descriptive Statistics for E-prescribers Versus Traditional Prescribers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E-Prescribers (n = 95)</td>
</tr>
<tr>
<td>Average number of claims</td>
<td>585.8</td>
</tr>
<tr>
<td>Average number of members</td>
<td>129.1</td>
</tr>
<tr>
<td>Average copayment paid by members</td>
<td>$13.65</td>
</tr>
<tr>
<td>Formulary compliance ratio</td>
<td>83.2%</td>
</tr>
<tr>
<td>Absolute generic utilization ratio</td>
<td>37.3%</td>
</tr>
<tr>
<td>Adjusted generic utilization ratio</td>
<td>74.7%</td>
</tr>
</tbody>
</table>

Chi-square tests were used to test the differences between groups and derive a P value. Absolute generic utilization ratio refers to the percentage of generic drug claims to total pharmacy claims. The adjusted generic utilization ratio refers to the percentage of claims for a generic drug in those cases where a generic is available. The MCO generic code is assigned at the time of claim adjudication and indicates whether a drug is a generic. The data are for the period 08/01/2001-07/31/2002.

MCO = managed care organization.

and physician location (state and/or zip code).

Formulary compliance was assessed using the formulary code field in the pharmacy claims data. This code is entered by the MCO claims processing system at the time a prescription claim is adjudicated, identifying the formulary status of the drug, using 4 values: formulary, exclusion (i.e., a drug that is not covered in a closed formulary plan), nonformulary (i.e., a drug that is not listed on the formulary but may be covered under some circumstances, with a higher copayment from the member), and other (i.e., a drug that has not been examined by the MCO and thus has no classification).

Generic utilization was assessed using First DataBank NDDF Plus software to determine the brand or generic status of each drug. The proportion of claims for generic drugs in each group were compared to assess the impact of generic indicators provided at the time of prescribing on the e-prescribing device. Generic utilization was assessed using 2 methods: absolute generic utilization (defined as the percentage of claims for generic drugs to total pharmacy claims) and the adjusted generic utilization (defined as the percentage of claims for generic drugs in those instances in which a generic is available; i.e., examination of the subset of only those drugs with generics available).

A qualitative survey instrument was designed to collect data from physicians, midlevel practitioners, and office practice managers. The survey assessed use of e-prescribing devices, sources of formulary information, perceived effects of e-prescribing on office resources, and other information related to e-prescribing (Figure 1). Surveys were distributed to 398 e-prescribers and 601 traditional prescribers in July 2003, representing each region of the United States. All providers surveyed were part of the MCO network. The survey was distributed one year following the period of the administrative claims data that were used in the present study.

The proportion of claims classified as formulary generated by each study group were compared, and formulary compliance was assessed in both study groups and in the overall, nationwide provider network of the MCO. Chi-squared analysis was used to test for differences between proportions.

### Results

A total of 95 predominantly e-prescribers and 95 matched traditional prescribers were identified. There were no significant differences in number of claims, number of members, drug categories, specialty, or geography observed between the 2 study groups.

Table 1 presents the percentage of generic utilization for both categories of interest. No significant difference was found between e-prescribers and the traditional prescribers in formulary adherence, 83.2% vs. 82.8%, respectively; $P = 0.32$, and neither group differed significantly from the overall MCO provider universe (82.0%; $P = 0.24$ (Table 1).

Table 1 presents the percentage of generic utilization for each of the 3 categories of interest. No significant difference was found between e-prescribers and traditional prescribers in measures of absolute generic utilization results or adjusted generic utilization.

A subanalysis was conducted to assess whether there was a difference in copayment or coinsurance amount between groups. No statistically significant difference in average copayment amount was observed between e-prescriber claims and traditional prescriber claims (Table 1). Drug-class-specific analyses were also conducted to assess whether differences in formulary compliance would be observed between the study groups. Ten of the most prescribed categories of drugs were assessed (selective serotonin reuptake inhibitors, angiotensin-converting enzyme inhibitors, gastric acid secretion reducers, lipotropics, antihistamines, narcotic analgesics, calcium channel-blocking agents, beta-adrenergic blocking agents, beta-adrenergic agents, glucocorticoids). No differences were observed between groups in terms of formulary compliance for these drug classes (data not presented).

### Survey Analysis

The qualitative survey was distributed to 999 physician practices; 110 surveys were returned, representing an 11% overall response rate: 49 of 398 (12%) surveys were returned by e-prescribers and 61 of 601 (10%) surveys were returned by traditional prescribers. The survey results indicated that the e-prescribers had been in practice for a mean of 17.8 years, had used the Allscripts system for e-prescribing for a mean of...
2 years and 5 months, and had generated 90% (mean) of their prescriptions using the Allscripts e-prescribing system. The 10% of prescriptions that were not generated through the device may have included controlled substances that, in some states, may not be prescribed electronically, or liquid formulations for which instructions may be difficult to generate on the e-prescribing device.

In addition to confirming that all of the traditional prescribers did not use e-prescribing, the survey determined that the traditional prescribers had been in practice for a mean of 20.0 years, 55.2% used a handheld device for personal use or to support patient care, and 25% used ePocrates as a source of formulary information. The companion surveys of office managers of e-prescribing practices indicated a 53% reduction in calls from pharmacies, a 62% reduction in calls to pharmacies, and the belief that e-prescribing made it easier for the office staff to complete new prescriptions (69% of respondents) and to complete refill requests (82% of respondents).

**Discussion**

To the best of our knowledge, this research represents the first study to use an administrative claims database to examine the relationship of e-prescribing on formulary compliance and generic utilization. It was predicted that, with the support of the e-prescribing device at the point of care, physicians in the e-prescribing group would demonstrate better formulary compliance and a higher generic utilization ratio than physicians in the comparison group.\(^1\)\(^3\)

A recently published study demonstrated an impact of e-prescribing on prescription drug costs in which e-prescribers continued to have lower costs over a 12-month period compared with control clinicians.\(^2\) This cost advantage of e-prescribing held for both new prescriptions and refills. Perhaps the difference is due to the integrated decision support provided by this alternative e-prescribing system, which provides evidence-based information and therapeutic reviews, in contrast to the system evaluated in the present study, which provides only formulary status and generic drug identification at the time of prescribing.

Overall, our study findings were unexpected compared with the initial hypothesis and previous research. Formulary compliance and generic utilization (adjusted and absolute) were comparable between e-prescribers and traditional prescribers. Additionally, there was no overall difference in copayments paid by members whose physicians were e-prescribers versus traditional prescribers. There were also no differences in formulary compliance and generic utilization for the 10 most commonly prescribed classes of drugs.

There are several possible reasons for these results. The MCO has a well-managed formulary, and formulary decisions by prescribers may be less influenced by the prescribing mode than anticipated. The MCO regularly sends communications to its providers on their performance with regard to formulary and to its members regarding formulary changes and other information. Moreover, economic and psychographic influences (such as technology-aversion) may influence the adoption of e-prescribing.\(^2\)\(^5\)\(^-\)\(^23\)

**Limitations**

Foremost among the limitations of this study was its reliance on retrospective analysis of all pharmacy claims data for both groups, with no designation of the mode of prescribing because the MCO does not have the ability to tag and thereby differentiate pharmacy claims generated with an e-prescribing device versus traditional methods (e.g., paper or telephone prescribing). While the e-prescriber group self-reported an average of 90% of prescriptions written electronically, this estimate is unlikely to be reliable since (a) the survey generated only a 12% response rate (49 of 398 surveys were returned by e-prescribers) and (b) the survey was performed one year after the data collection period for the current study. Therefore, we estimate but cannot verify that the e-prescriber group included only predominant e-prescribing. On the other hand, it is reasonable to expect that predominant e-prescribers would be more familiar with the formulary status of drugs, and this knowledge may carry over to any prescriptions not generated with the e-prescribing device.

Second, the results from the prescriber self-report, qualitative survey were not contemporaneous with the dates of service for the pharmacy claims in this analysis of administrative claims. The qualitative survey of prescribers was distributed in July 2003, one year following the end of the period of the claims data that were used in the present study.

Third, our study was not sensitive to differences in pharmacy benefit design, so any differences due to type of pharmacy benefit (i.e., 2-tier versus 3-tier designs) could not be assessed.\(^24\) While we found no difference in the ratio of formulary prescribing for predominant e-prescribers compared with traditional prescribers, we could not investigate the relationship of drug benefit design to the formulary ratio for the 2 types of prescribers. Modest differences in out-of-pocket expenses for the patient can influence the patient's decision regarding formulary compliance.\(^16\)

Fourth, since we used administrative claims data, we could not differentiate events influencing prescribing at the point of care from events that influenced the ultimate drug dispensed. For example, when a brand drug is prescribed when a generic is available, pharmacists in many states are required to dispense the generic alternative. Alternatively, in some cases, a generic drug may have been prescribed but the patient requested the brand. Only the drug actually dispensed at the pharmacy is identified on the claim. While a patient request for brand drug has a DAW (dispense as written) value of “2” on the pharmacy claim, we chose not to analyze DAW values on pharmacy claims since we judged these values to not be reliable indicators of the reason for the switch in dispensed medications.
Selection bias may have been a factor since e-prescribers tend to belong to larger medical practices with the ability to cover initial start-up costs. Further examination is needed to ascertain whether there are significant differences with regard to financial resources and adoption of new technology. The qualitative survey indicated that e-prescribers tended to be in larger practices than traditional prescribers. While there is a perception that users of technology are younger physicians who may be more comfortable with computers, our qualitative survey found that e-prescribers reported 18 years in practice versus an average of 20 years in practice for the traditional prescribers.

Future studies should examine both point-of-care and claims data. Linking with the point of care would clarify the workflow and information flow processes as well as the prescriber, patient, and pharmacy influences that impact formulary compliance and generic utilization. Future research should also examine the impact of e-prescribing on various resources, including economic, time, and personnel, for both managed care organizations and prescribers. In addition, to avoid selection bias and identify causal connections, a prospective, randomized study should be conducted to assess the effects of implementing e-prescribing.

The Leapfrog Group mandated in 2002 that all hospitals should have CPOE by 2004. This type of mandate is not possible in an ambulatory setting, and there are still unanswered questions regarding outpatient e-prescribing. For example, what benefit is there for prescribers who comply with formularies or utilize generic substitution? Would financial incentives for formulary compliance offset costs of e-prescribing for physicians? Could e-prescribing have a greater impact on practices with poor baseline formulary compliance? If e-prescribing provides a tool to increase formulary compliance of poorly performing practices, how could it be implemented in such practices?

Is it less expensive for MCOs to achieve formulary compliance with e-prescribers than traditional prescribers? The communications that are triggered to physicians to improve formulary compliance have an associated cost, so e-prescribing may provide a cost savings for MCOs if they require fewer communications to attain the desired of formulary compliance, separate from the possible drug cost savings.

Conclusion
This retrospective analysis of administrative pharmacy claims determined that neither the formulary compliance ratio nor the generic utilization ratio differed between e-prescribers and prescribers using traditional methods of prescription orders.

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Ross served as principal author of the study. Study concept and design were contributed by Ross, Papshev, Taylor, Murphy, and author Ronald Barg. Analysis and interpretation of data were contributed Murphy, Papshev, Ross, and author David J. Sternberg. Drafting of the manuscript was the work of Barg, Murphy, Papshev, and Sternberg, and its critical revision was the work of all authors.

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