Adoption and Use of Stand-Alone Electronic Prescribing in a Health Plan–Sponsored Initiative

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Objectives: To quantify rates of stand-alone e-prescribing (SEP) adoption and use among primary care physicians (PCPs) participating in a SEP initiative and to determine which physician and patient characteristics were associated with higher rates of each.

Study Design: Using records from an insurer-led SEP initiative, we compared the characteristics of 297 PCPs who adopted SEP through the initiative with the characteristics of 1892 eligible PCPs who did not. Among 297 adopters, we studied the extent of SEP use.

Methods: Dependent variables included each physician's adoption of SEP and his or her e-prescribing use ratio (the ratio of electronic prescriptions to pharmacy claims in the same period). Independent variables included characteristics of PCPs (specialty, practice size, and prescribing volume) and their patients (patient age, sex, race/ethnicity, and household income).

Results: Solo practitioners, pediatricians, and physicians with more patients from predominantly African American zip codes were underrepresented among SEP adopters. The mean (SD) e-prescribing use ratio among adopters was 0.23 (0.28). Twenty percent of physicians maintained e-prescribing use ratios above 0.50. Available physician characteristics explained little of the variance in use, but physicians in smaller practices had greater use ($P = .02$).

Conclusions: Certain categories of physicians may need more tailored incentives to adopt SEP. On average, adopters used the SEP system for only about one-quarter of their prescriptions. Some adopters achieved high levels of SEP use, and further research is needed to elucidate the factors that enabled this.

(Am J Manag Care. 2010;16(3):182-189)

For author information and disclosures, see end of text.

There is evidence that in some settings health information technology (HIT) can improve patient outcomes and reduce healthcare costs.[1] Most of this evidence comes from 4 healthcare organizations at which academic physicians and employees are usually required to use homegrown electronic medical records (EMRs).[2-5] However, few physicians practice in these types of environments. More than 75% of physicians practice in groups of 5 or fewer.[6] Unfortunately, the structure of these small community private practices is not conducive to providing the financial and time investment necessary for EMR adoption.[7,8] As a result, only 9% to 14% of these practices have adopted EMRs compared with 23% to 50% of larger practices.[9]

Stand-alone e-prescribing (SEP) has been proposed as a possible method of transitioning community physicians toward EMR functionality without the initial investments required for a full EMR system.[10,11] Indeed, recent legislation promises to increase Medicare reimbursement for e-prescribing physicians in the short term and to decrease Medicare reimbursement for paper prescribers in the long term.[12]

We are aware of only 1 prior study that evaluates adoption and use of commercial SEP systems by community physicians. Fischer et al[13] examined use and adoption of the PocketScript system, which was offered without cost to high-volume outpatient prescribers in Massachusetts. A striking finding of their analysis was the low use of e-prescribing, which (although increasing throughout the period studied) was less than 30% of all eligible prescriptions 1 year after adoption. The authors cite anecdotal evidence of increased e-prescribing since that period but present data only through early 2005.

To further characterize experiences with SEP from other states using another e-prescribing system and in a more recent period, we quantified the rates of e-prescribing adoption and use that occurred when Horizon Blue Cross Blue Shield of New Jersey (Horizon BCBSNJ) offered SEP to community physicians participating in their health maintenance organization (HMO) and preferred provider organization network. Our primary study objectives were to quantify rates of SEP adoption and use and to determine which physician and patient characteristics were associated with higher rates of each.

METHODS

Setting and Intervention

Horizon BCBSNJ, New Jersey's

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largest health insurer, provides coverage for 3.2 million members. In late 2004, Horizon BCBSNJ launched an initiative offering its physicians Caremark's iScribe SEP software (Caremark is Horizon BCBSNJ's pharmacy benefits manager). The program installed SEP systems for individual physicians rather than for practices as a whole. All features of the program, including the target population, recruitment, and incentives provided, were determined by Horizon BCBSNJ for purposes of improving care delivery. Our analysis of physicians' SEP adoption and use was subsequently designed to use secondary data from the program and from other sources.

Take-Away Points

e-Prescribing is seen as a critical technology for improving medication use.

- In a health plan–sponsored e-prescribing initiative, the mean e-prescribing rate of participating primary care physicians (PCPs) was 1 prescription per 4 pharmacy claims, but some PCPs achieved high use.
- Given this low use, future initiatives may need to consider more resources to increase e-prescribing use.
- Efforts should be made to ensure that all patient demographics benefit from e-prescribing.
- Higher e-prescribing use among physicians in smaller practices suggests that e-prescribing may be an appropriate manner of extending health information technology to these physicians, who traditionally are reluctant users of such technology.

Of approximately 14,250 physicians in the Horizon BCBSNJ provider network, about 5890 were eligible for the program based on prescribing activity that resulted in at least 500 Horizon BCBSNJ pharmacy claims annually (this cutoff was determined by Horizon BCBSNJ for purposes of program feasibility). Eighty-seven percent of these eligible physicians were in practices containing 5 or fewer physicians. An initial wave of recruitment focused on the highest-volume prescribers (>2500 filled prescriptions per year), and subsequent phases targeted incrementally lower-volume prescribers. By the time the allocated resources were expended, 4457 physicians had received the e-prescribing offer (**Figure 1**).

Study Population and Dependent Variable for Physician Adoption Analysis

We retrospectively constructed 2 cohorts, one of physicians who adopted the offered SEP system and another of physicians who did not. Physician adoption was then used as the dependent variable in our adoption analysis. Physicians were also characterized based on their specialty, practice size, prior Horizon BCBSNJ pharmacy claims volume, and assigned primary care patient panel. Horizon BCBSNJ ensured that all patients in their HMO and point-of-service insurance plans had an assigned primary care physician (PCP), whereas all patients with other Horizon BCBSNJ insurance plans did not. To focus our analysis on PCPs, physicians without any assigned Horizon BCBSNJ primary care patients were excluded from the analysis. However, physicians with few Horizon BCBSNJ–assigned primary care patients were included in the analysis, with the expectation that they probably also provided primary care to many non–managed care patients insured by Horizon BCBSNJ.

Dependent Variable for e-Prescribing Use Analysis

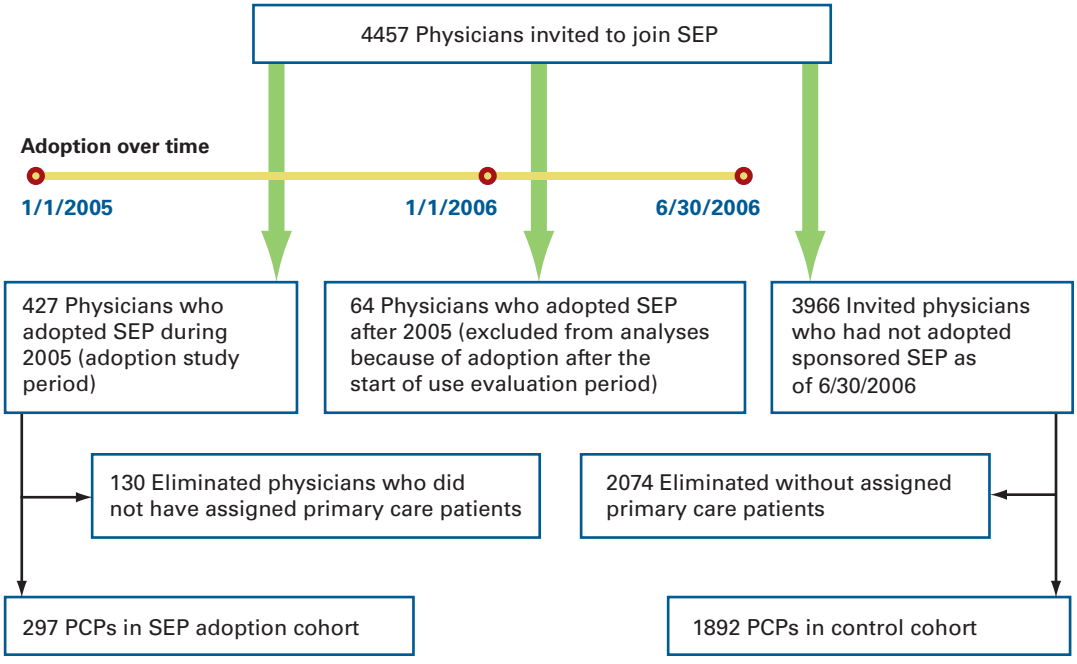
The second major goal of our project was to study physician use of SEP among adopters. We calculated an "e-prescribing use ratio" (range, 0-1) by dividing the number of SEP prescriptions the physician wrote for Horizon BCBSNJ patients by the number of Horizon BCBSNJ pharmacy claims attributable to the physician during the same quarter. Each physician's ratio was calculated for each quarter of the e-prescribing use evaluation period (January 1, 2006, to June 30, 2006). Because pharmacy claims may be generated for prescriptions written before a given quarter, it was possible for a PCP's ratio to exceed 1; this occurred in particular when total prescription denominators were low. Therefore, all e-prescribing use ratios were capped at 1 for the analysis. The ratio numerator included all prescriptions generated through the SEP system whether printed or electronically transmitted. Because we wanted to understand physician behavior rather than patient behavior, electronic renewals (physician behavior) were counted in the ratio numerator, and renewal claims were counted in the ratio denominator. Refills (patient behavior) of existing prescriptions were excluded from the ratio numerator and denominator.

After all PCPs were assigned e-prescribing use ratios, some physicians were also classified as "never having used" the system if records did not show any electronic prescriptions after the day of activation (when test prescriptions were often transmitted). Other PCPs were classified as having "quit e-prescribing" if they had initially used the system but later stopped synchronizing their personal digital assistant and sending any electronic prescriptions by the last quarter of the use evaluation period.

Independent Variables for PCP Characteristics and Patient Panel Data

Caremark provided physician specialty and practice size information, which was available only in previously determined groupings (1, 2-5, 6-10, and >10 physicians). Each physician's total pharmacy claims volume was provided by Horizon BCBSNJ for 2003 (the calendar year before the start of program recruitment) in categories (0-250, 251-500, etc), which we aggregated into approximate "high," "medium,"

Figure 1. Selection of Primary Care Physicians (PCPs) for Stand-Alone Electronic Prescribing (SEP) Adoption Analysis



and "low" tercile categories. Physicians were categorized as low-volume prescribers (<1750 Horizon BCBSNJ pharmacy claims in 2003, which represented the 35th percentile), mid-volume prescribers, and high-volume prescribers (>3500 Horizon BCBSNJ pharmacy claims in 2003, which represented the 71st percentile).

We used zip codes to estimate the racial/ethnic makeup of the neighborhoods from which the PCPs' patients were drawn. First, patients living in zip codes with more than 50% African American residents (per 2000 US Census data) were categorized as living in majority African American neighborhoods; those from zip codes with more than 40% Hispanic residents were categorized as living in Hispanic plurality neighborhoods. An analysis of the studied zip codes showed that these predominantly African American and Hispanic neighborhood categorizations were mutually exclusive more than 99% of the time. The PCPs were then categorized based on having at least 10% of their patients living in majority African American and Hispanic plurality neighborhoods (which represented the 80th and 87th percentiles, respectively).

Statistical Analysis

Our analysis consisted of 2 components. In the first component (SEP adoption analysis), we compared the physician characteristics of adopting PCPs versus control PCPs using *t* test, χ^2 test, and multivariate logistic regression. The second component measured use among adopting PCPs via a 2-part model. The first part was a logistic regression model in which the dependent variable was "never having used" or "quit e-prescribing" (as already described) versus having some evidence of e-prescribing use into the last quarter of the observation period. The objective was to identify factors that predispose physicians to stop e-prescribing. The second part was a multivariate linear regression model that examined the association between physician characteristics and extent of SEP use among the subsample of physicians who had started e-prescribing and did not quit. We excluded "never having used" and "quit e-prescribing" physicians to examine ongoing use barriers among those physicians who continued to try to use SEP.

Both regression models were constructed by beginning with all available predictor variables included, and then model fit was manually reassessed after elimination of each nonassociated (P >.05) predictor variable. Model fit was assessed using R^2 for the linear regression and C statistic for the logistic regression. Colinearity was assessed using correlation coefficients between all variables remaining in each of the final models. Only complete cases were analyzed in the regression models. All analyses were performed using statistical software (SAS, release 9.1; SAS Institute, Inc, Cary, NC).

RESULTS

PCP Characteristics Associated With SEP Adoption

Of 4457 physicians invited to join the SEP program, 427 adopted the SEP system during 2005 (Figure 1). An addition-

Table 1. Characteristics of Primary Care Physicians (PCPs) and Their Patients

Characteristic	Adoption Cohort	Control Cohort	*P*[a]
Primary Care Physicians, No. (%)	**(n = 297)**	**(n = 1892)**	
Specialty			.06
Family medicine	108 (36.4)	593 (31.3)	
Internal medicine	155 (52.2)	990 (52.3)	
Pediatrics	31 (10.4)	281 (14.9)	
Other	3 (1.0)	5 (0.3)	
Missing data	0	23 (1.2)	
Practice size			<.001
1	105 (35.4)	913 (48.3)	
2-5	152 (51.2)	736 (38.9)	
6-10	37 (12.5)	189 (10.0)	
>10	3 (1.0)	31 (1.6)	
Missing	0	23 (1.2)	
Horizon BCBSNJ pharmacy claims volume			.06
Low	92 (31.0)	701 (37.1)	
Mid	106 (35.7)	672 (35.5)	
High	99 (33.3)	519 (27.4)	
Patients[b]	**(n = 282)**	**(n = 1714)**	
Horizon BCBSNJ–assigned primary care patients, median No. (interquartile range)	69 (41-134)	68 (34-119)	
Age, mean, y	39.2	37.9	.12
Female sex, %	53.0	53.0	.95
Race/ethnicity, No. (%)			
>10% of patients live in majority African American neighborhoods	40 (14.2)	356 (20.8)	.01
>10% of patients live in Hispanic plurality neighborhoods	31 (11.0)	230 (13.4)	.26
Median household income, $, No. (%)[c]			.26
Low, <45,000	24 (8.5)	131 (7.6)	
Mid, ≥45,000 to <75,000	187 (66.3)	1218 (71.1)	
High, ≥75,000	71 (25.2)	365 (21.3)	

BCBSNJ indicates Horizon Blue Cross Blue Shield of New Jersey.
[a] χ^2 Test was used for comparisons of characteristics with multiple categories, while *t* test was used for other characteristics. "Other" and "Missing" categories were excluded from χ^2 calculations.
[b] Fifteen PCPs in the adoption cohort and 178 PCPs in the control cohort were excluded because they had too few study patients to generate a reliable estimate (<5 patients with nonmissing data for a given PCP).
[c] For each PCP, this represents the median household income of the PCP's patient panel. Each patient's household income is estimated using the median household income for the patient's zip code.

al 64 physicians who adopted the SEP system in 2006 (part way through the use evaluation period) were excluded from our analyses. Of 427 adopting physicians, 297 (69.6%) were classified as PCPs based on their having any primary care patients assigned from a Horizon BCBSNJ managed care plan as of January 1, 2006. There were 3966 control physicians; 1892 (47.7%) had primary care patients assigned to them. Therefore, PCPs participated at a higher rate than non-PCPs. The control and adoption cohorts had medians of 68 and 69 assigned primary care patients, respectively.

Table 1 compares the adoption and control cohorts of PCPs and their patients. Practice size distribution differed between the cohorts (P <.001). Pharmacy claims volume and specialty of the cohorts were not significantly different, nor were sex, age, and household income of the PCPs' patients. The PCPs in the adoption cohort were less likely to have more than 10% of their patient panel live in majority African American neighborhoods (P = .01).

Multivariate logistic regression analysis showed that the association of SEP adoption with practice size and neighbor-

Table 2. Characteristics Associated With e-Prescribing Adoption Among 1990 Primary Care Physicians (PCPs)[a]

Characteristic	Odds Ratio (95% Confidence Interval)	*P*
Practice size		<.001
1	1 [Reference]	
2-5	1.80 (1.36-2.37)	<.001
6-10	1.77 (1.16-2.70)	<.01
>10	0.96 (0.27-3.37)	.95
Specialty		
Nonpediatrics[b]	1 [Reference]	
Pediatrics	0.61 (0.41-0.92)	.02
Race/ethnicity of patient panel population		
>10% of patients live in majority African American neighborhoods	0.69 (0.48-0.99)	.04

[a]Since complete case analysis was used (as opposed to imputing missing data), only 1990 PCPs were entered into the regression model. Characteristics without association (not used as predictors in this model) are PCP family medicine specialty and pharmacy claims volume and PCP patient panel age, sex, household income, and Hispanic neighborhood (C = 0.60).
[b]More than 98% internists and family practitioners.

hood racial/ethnic makeup persists after controlling for other PCP characteristics (Table 2). No association was found between SEP adoption and PCP pharmacy claims volume or patient panel age, sex, or household income. χ^2 Test for physician specialty showed no statistically significant difference between the 2 groups of physicians. When adjustments were made for practice size and race/ethnicity, the regression model indicated that pediatricians were significantly less likely to adopt e-prescribing (odds ratio, 0.61; 95% confidence interval, 0.41-0.92; P = .02). None of the distinct variables in the final model had a correlation coefficient exceeding 0.15.

PCP Characteristics Associated With Extent of e-Prescribing Use

Among 297 SEP-adopting PCPs, the mean (SD) e-prescribing use ratio was 0.23 (0.28) (interquartile range, 0.00-0.39), which represents 23 electronic prescriptions per 100 pharmacy claims (Figure 2). Thirty-four PCPs (11.4%) never used the system after it was installed, and another 22 PCPs (7.4%) quit using it after at least some initial use. Among the remaining 241 PCPs, e-prescribing use ratios were less than 0.25 in 141 (58.5%), 0.25 to 0.50 in 51 (21.2%), and greater than 0.50 in 49 (20.3%).

In the first part of our 2-part model, we used logistic regression to estimate the association of physician and patient characteristics with being in the "never having used" or "quit e-prescribing" categories. However, these classifications were not significantly associated with any of our independent variables. In the second part of our 2-part model (Table 3), physician practice size was significantly associated with e-prescribing use ratio (omnibus P = .02), although this factor accounted for little of the variance (R^2 = 0.01). Among those using e-prescribing at all, PCPs in larger practices (6-10 and >10 physicians) tended to use their e-prescribing systems for fewer of their prescriptions. None of the distinct variables in the final model had a correlation coefficient exceeding 0.15.

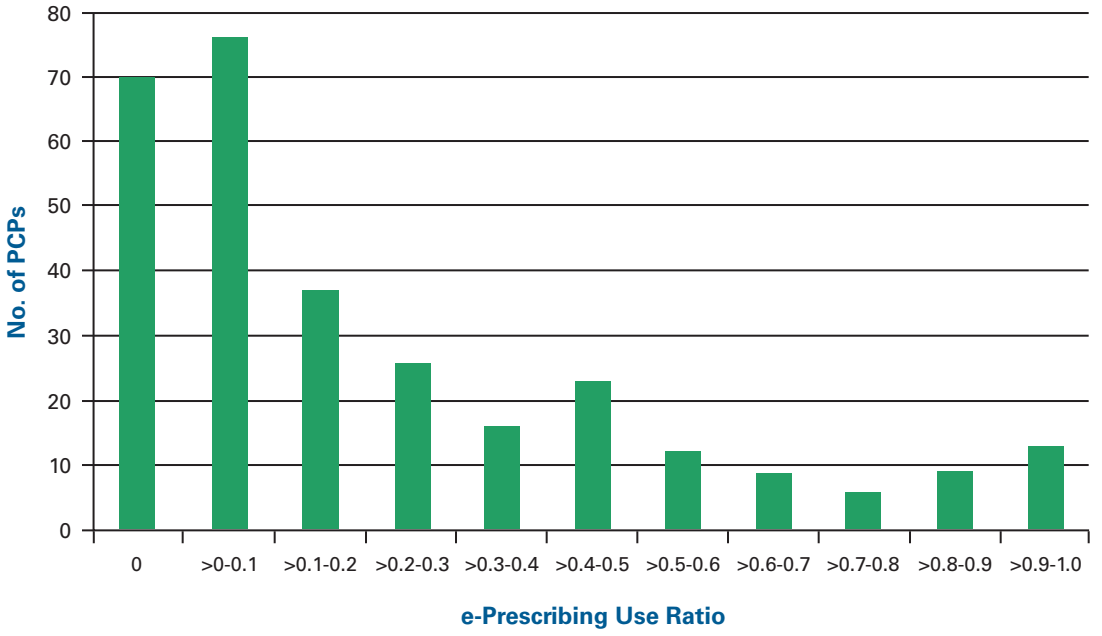
DISCUSSION

SEP has been proposed as an entry-level HIT accessible to most US physicians who work in small practices. Because small practices have been slow to adopt other forms of HIT,[9,14-17] several initiatives are promoting SEP to this group of physicians.[12,18-20] Despite the interest, there are limited data about which physicians actually adopt SEP and which patient populations might be affected.[13] Furthermore, levels of use are particularly important to understand for SEP because physicians can easily revert to paper prescribing.

SEP Adoption

Our adoption analysis found that PCPs who adopted SEP were more likely to be in practices with 2 to 10 physicians and were less likely to be pediatricians or have patients living in majority African American neighborhoods. A prior study[13] of SEP adoption reported the practice size and specialty of adopting physicians, but these physicians were not compared with nonadopters. Other studies[9,14] of EMR adoption found that adoption increases steadily with increasing practice size. In contrast, we found that physicians in practices of 2 to 5 physicians and 6 to 10 physicians were equally likely to adopt SEP and that both groups had 1.8 times the odds of adopting SEP compared with solo practice physicians. Because our sample underrepresented large group practices, our confidence interval for this group is large, and we cannot draw any conclusions about the relative likelihood of these physicians

Figure 2. Distribution of e-Prescribing Use Among 297 Adopting Primary Care Physicians (PCPs) During the Stand-Alone Electronic Prescribing Use Evaluation Period (January 1, 2006, to June 30, 2006)



to adopt SEP. Nonetheless, our results from small and midsize physician groups suggest that SEP is being adopted by physicians who might otherwise have been unlikely to use HIT.

In our study, pediatricians had significantly lower odds of adopting SEP compared with internists and family practitioners. Pediatricians might have less incentive to adopt SEP because they tend to prescribe fewer medications than physicians who treat adults. However, they also have greater need for age-based and weight-based dosage calculations, which could be assisted by SEP (but rarely is because of the additional drug knowledge required). The lack of this feature in the SEP systems offered by the Horizon program may have been a relative disincentive for pediatricians.

Our finding of lower adoption among physicians who have at least 10% of their patients living in majority African American neighborhoods contrasts with results from a nationwide survey of EMR adoption that found no association between EMR use and a county's percentage of non-Hispanic whites.[14] This discrepancy might be explained by differences in how race/ethnicity was analyzed (we assessed African American race/ethnicity and Hispanic race/ethnicity separately, whereas the nationwide survey compared all minority groups together vs non-Hispanic whites), differences in the geographic units of analysis (zip codes vs counties), or differences in the populations studied (New Jersey vs the United States). However, it remains likely that minority-serving practices considering SEP face greater challenges to HIT adoption than do the larger minority-serving practices that could consider full EMR adoption. Horizon BCBSNJ recruitment efforts were based only on prescribing volumes and not on geographic region, neighborhood, or patient panel characteristics. Because minority care tends to be clustered among a subset of providers,[21] additional work may be needed to address challenges of HIT adoption among this group.

SEP Use

In our study, some SEP users succeeded in achieving high levels of use, but the overall mean level of use was only 23%. This finding is consistent with the 26% level of use reported in a prior study.[13] Because these studies examined physicians in different states using different methods, our study provides independent evidence of low SEP use among most physicians who adopted it. The low use levels that we found occurred despite financial incentives of up to $500 per quarter for high use. Given that practices almost certainly installed e-prescribing with the intent of using it, our results strongly suggest the existence of unexpected barriers to e-prescribing use. Some of the known barriers to e-prescribing use are poor pharmacy connectivity, missing eligibility data, and unreliable drug identifiers.[22,23] Another important barrier may be the prohibition on e-transmission of prescriptions for controlled substances. Although controlled substances could be prescribed and printed through the system we studied, the complexity of handling these prescriptions dif-

Table 3. Linear Regression Evaluating Characteristics Associated With e-Prescribing Use Among 241 Primary Care Physicians

Characteristic	Relative e-Prescribing Usage Ratios (95% Confidence Interval)	*P*
Practice size		.02
1	1 [Reference]	
2-5	–0.01 (–0.09 to 0.07)	.76
6-10	–0.08 (–0.21 to 0.04)	.17
>10	–0.18 (–0.31 to –0.05)	.01

ferently may create a workflow barrier that discourages e-prescribing use overall. The results of this study underscore the importance of addressing these barriers.

In multivariate modeling, we found modestly lower SEP use associated with increasing practice size. This could have occurred if physicians enthusiastic about using e-prescribing technology stimulated SEP adoption but not use among other physicians within their practice (eg, by arranging for wireless Internet and personal digital assistant connectivity in the office). This finding contrasts with results by Fischer et al,[13] who found no difference in physician SEP use among groups with 1 to 15 physicians and found greater SEP use among groups with more than 15 physicians. Many differences between the studies might account for this discrepancy, including the SEP systems offered, e-prescribing infrastructure, and physician practices between states, but the most likely explanation is the relative lack of large practices participating in the New Jersey e-prescribing program. Moreover, the primary finding of our multivariate analysis is the low coefficient of determination, demonstrating that the primary determinants of SEP use were not associated with the factors we had available for analysis. Further basic research is needed to identify factors that enable high levels of SEP use for some physicians, despite barriers to e-prescribing use.

Limitations

Our methods had several limitations. First, this study was a post hoc analysis of a real-world initiative rather than a planned experiment. The program goals dictated that higher-prescribing physicians were recruited more intensely. Although we controlled for prescribing volumes statistically, there may have been other unmeasured sources of differential recruitment that caused differential adoption. Similarly, because the physician characteristics used in this analysis were not collected by us but were harvested from secondary data, we were unable to directly measure many factors likely to predict HIT adoption and use. For example, adopting PCPs probably had greater familiarity with and interest in HIT. While we could not assess these presumed HIT skills, we controlled for variables known to be associated with HIT adoption, such as practice size.[9,14]

Second, while our analysis accounted for physician practice size, targeted physicians predominantly practiced in small groups. This is a function of the area studied in that New Jersey has a relative decentralization of primary care, with a predominance of smaller physician practices. While this may limit the generalizability of our results, the advantage of studying these physicians is that they face the greatest challenges in the drive to increase HIT use.

Third, we could not measure whether physicians in either cohort were using other methods of e-prescribing. However, a recent survey showed that only 4% of US physicians had adopted "fully functional" EMRs that included e-prescribing capabilities.[9] As HIT penetration increases, assessing its use among control groups will become increasingly important in future research.

Fourth, we used study data to approximate physicians' real-world practice patterns. Physicians' patient panels were approximated using their Horizon BCBSNJ patients, and physicians' prescribing habits were approximated using their Horizon BCBSNJ pharmacy claims. Future studies of claims data might address this deficiency by also including an accompanying physician survey to better understand physician habits among patients of all insurance types.

CONCLUSIONS

Although overall SEP use levels were low, some physicians were able to use SEP successfully and consistently. In contrast to prior findings on HIT adoption and use, we found that physicians in smaller practices adopt and use SEP at least as much as other physicians. To better understand the most appropriate role for SEP in HIT policy, future research should seek to identify the specific factors that enable SEP use, to consider the costs and benefits of SEP, and to understand whether SEP systems can enable interoperability of prescription information. Perhaps most important will be to learn whether physicians using SEP continue to transition toward HIT with more advanced features (such as laboratory alerting or encounter documentation) or whether use of an SEP system might impede adoption of other HIT.

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Funding Source: This project was funded by grant 1U18HS016391-01 from the Agency for Healthcare Research and Quality as part of a larger set of e-prescribing pilot studies. This work was also supported by a health services research and development fellowship from the Department of Veterans Affairs (Dr Pevnick).

Author Disclosures: The authors (JMP, SMA, JLA, SM, MHP, SLE, DSB) report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (JMP, SMA, SM, DSB); acquisition of data (JMP, MHP, DSB); analysis and interpretation of data (JMP, SMA, JLA, SM, SLE, DSB); drafting of the manuscript (JMP, SMA, DSB); critical revision of the manuscript for important intellectual content (JMP, SMA, JLA, SM, MHP, SLE, DSB); statistical analysis (JMP, JLA, SLE, DSB); provision of study materials or patients (MHP, DSB); obtaining funding (DSB); administrative, technical, or logistic support (DSB); and supervision (SMA, DSB).

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