

By Catherine M. DesRoches, Ritu Agarwal, Corey M. Angst, and Michael A. Fischer

## TECHWATCH

# Differences Between Integrated And Stand-Alone E-Prescribing Systems Have Implications For Future Use

**ABSTRACT** Understanding the benefits of electronic prescribing systems has important implications for quality and efficiency in medical care. We surveyed physicians about their use of e-prescribing in outpatient practices. We found that physicians who use e-prescribing systems integrated into an electronic health record have different characteristics, usage patterns, perceived benefits, and levels of satisfaction than physicians who use stand-alone systems. For example, although only 56 percent of the physicians we surveyed said that they checked a patient's drug history most or all of the time when writing a prescription, those with integrated systems were significantly more likely to report doing so than their counterparts with stand-alone systems. Our findings have implications for the American Recovery and Reinvestment Act's requirements for e-prescribing and the future use of this technology. Because many stand-alone systems cannot meet meaningful-use requirements, there is likely to be a shift toward integrated systems.

Patient safety and quality of care are dominant themes in debates about health reform. Policy makers and providers are paying increasing attention to adverse drug events and the importance of interventions to improve the safety and quality of prescribing. The use of health information technology (IT) broadly, and of electronic prescribing specifically, has the potential to decrease prescribing errors and adverse drug events.

## Background On Electronic Prescribing

Thus far, much of the evidence for the benefits of e-prescribing comes from studies conducted in hospitals, where the use of such systems has resulted in safer medication use,<sup>1</sup> more-appropriate prescribing for elderly patients,<sup>2</sup> and

reductions in the use of costly medications.<sup>3</sup> However, a large proportion of prescribing takes place in outpatient settings, particularly in physicians' offices. If e-prescribing were widely used there, it could increase the safety and efficiency of prescribing for a substantial proportion of patients.

**TWO TYPES** In the outpatient setting, e-prescribing systems generally come in two forms: stand-alone, which means that they can be used only for e-prescribing; and installed in integrated systems, which are in turn part of an electronic health record system. Physicians who are considering adopting an e-prescribing system must weigh the benefits of these two forms before making a major investment in new technology. Yet it is not clear how these systems perform in the outpatient setting, and whether they differ in benefits to providers and patients.<sup>3-8</sup>

**SLOW ADOPTION** Adoption of health IT in gen-

DOI: 10.1377/hlthaff.2010.0557  
HEALTH AFFAIRS 29,  
NO. 12 (2010): –  
©2010 Project HOPE—  
The People-to-People Health  
Foundation, Inc.

**Catherine M. DesRoches** (cdesroches@partners.org) is a survey scientist and an assistant professor of medicine at the Mongan Institute for Health Policy, Partners Healthcare, in Boston, Massachusetts.

**Ritu Agarwal** is a professor and the Robert H. Smith Dean's Chair of Information Systems in the Decision, Operations, and Information Technologies Department, University of Maryland, in College Park.

**Corey M. Angst** is an assistant professor of management at the Mendoza College of Business, University of Notre Dame, in Indiana.

**Michael A. Fischer** is a health services researcher and primary care physician in the Division of Pharmacoepidemiology and Pharmacoeconomics, Department of Medicine, at Brigham and Women's Hospital, in Boston. He also is an assistant professor of medicine at Harvard Medical School.

eral, and e-prescribing systems in particular, has been slow. These systems can be expensive to purchase and implement, and physicians may be uncertain about recouping their investment through improvements in efficiency or quality.<sup>9</sup> However, this situation may change as the Centers for Medicare and Medicaid Services (CMS) begins to implement the “meaningful use” incentive program authorized by the American Recovery and Reinvestment Act (stimulus legislation) of 2009.

**POLICY RESPONSE** Beginning in 2011, a physician who demonstrates “meaningful use” of electronic health record technology can receive Medicare payments equal to an additional 75 percent of his or her allowable Medicare charges for a given year.<sup>10,11</sup> Physicians must meet specific criteria for meaningful use in three areas: “using a certified [electronic health record] technology in a demonstrably meaningful way, using a certified...technology that allows for the electronic exchange of health information, and reporting on clinical quality.”<sup>12</sup>

Within each of these goals, CMS has designated a set of IT functionalities, or activities that must be implemented as part of a “core set” (see the Technical Appendix for a complete list of objectives and functionalities).<sup>13</sup> Required activities for meaningful use directly related to e-prescribing within this core set are, first, the use of computerized provider order entry; second, implementation of drug-drug interaction and drug allergy checks; third, maintenance of active medication lists in an electronic format; and fourth, electronic generation and transmission of prescriptions.

Physicians may also choose to implement drug formulary checks, to verify that a drug is on the list of medications covered by the patient’s health plan. Prescribing a drug not on a formulary can cost the patient more or require the physician to [please provide].

**PURPOSE OF PAPER** In this paper we explore two questions. First, do physicians with stand-alone systems differ in demographic and practice characteristics from those with integrated systems? And second, what benefits in terms of ease of prescribing, office administration, and patient safety do physicians see with their stand-alone or integrated systems, and which group is more satisfied? Answers to these questions will further our understanding of the differential use and benefits of the two types of systems and provide insight into how the use of e-prescribing systems might change as the new meaningful-use incentives are put into effect.

## Study Data And Methods

**SURVEY DEVELOPMENT** The survey we developed was informed by focus groups, cognitive testing, and site visits to practices using e-prescribing.<sup>14</sup> The survey was approved by the Institutional Review Board at Massachusetts General Hospital and Brigham and Women’s Hospital.

The final survey consisted of thirty-seven multipart questions on the following topics: practice characteristics; use of computerized systems in clinical practice; experience, satisfaction, and beliefs about e-prescribing; barriers and incentives to the implementation of these systems; and respondents’ demographics. Responses were either dichotomous (that is, yes or no) or on a Likert-style scale (with answers such as very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied).

We drew our sample of practicing physicians from a comprehensive list maintained by Surescripts, which operates the largest e-prescribing network in the United States. Surescripts lists all physicians enrolled in all US e-prescribing systems. We included only physicians affiliated with one of the fifteen largest e-prescribing vendors as of April 2009 (see the Technical Appendix for the list of vendors).<sup>15</sup>

We included a low-usage stratum to ensure that our sample had sufficient variance in technology use. We defined *low usage* as physicians who had used the e-prescribing system fewer than ten times per month in the three months prior to the selection of our sample. Our final list included 3,010 regular-use and 954 low-use physicians with accounts established more than three months prior to the sample’s selection.

From this list, we selected a random sample of 2,000 physicians practicing in outpatient settings from our two strata (1,540 regular users and 460 low users). We mailed the physicians a notification letter, followed by a survey packet containing a cover letter, the survey, a “frequently asked questions” sheet about our study, and a \$20 check as an incentive for participation. We mailed nonresponders two additional survey packets, and we attempted to reach by telephone all of the physicians who still did not respond. We conducted the survey between April and September 2009.

**INDEPENDENT VARIABLES** Our primary independent variable was the type of e-prescribing system used in the physician’s main practice site. To categorize the systems, we asked respondents: “Is the electronic prescribing system at your main practice site integrated with an electronic health record or a ‘stand-alone’ electronic prescribing system?” Other independent variables were respondents’ sex, race, ethnicity, specialty, number of years in practice, practice size,

3 clinical setting, location, and region of the country (Exhibit 1).

**DEPENDENT VARIABLES** We assessed ease of prescribing through a series of questions. We asked respondents about the effect of their e-prescribing system on taking care of prescription refill requests; having staff take care of refills; processing refill requests in batches; writing an initial prescription for a new patient; and prescribing within a patient's formulary. We also asked respondents to rate the effect of e-prescribing on the number of phone calls their practice received [from whom?] about formulary

errors and from patients about prescription refills.

We asked physicians to rate their level of satisfaction with their e-prescribing system overall and with certain aspects of it: reliability, flexibility, cost, number of available functions, amount of time it took to learn, quality of the medication database—or [please provide]—and perceived satisfaction of patients.

We examined the effect of e-prescribing on perceived prescribing safety through several questions. First, what effect did the e-prescribing system have on reconciling a patient's medica-

16 **EXHIBIT 1**

**Characteristics Of Responding Physicians With Electronic Prescribing Systems**

	Total		Integrated system		Stand-alone system	
	Number	Percent	Number	Percent	Number	Percent
<b>SEX</b>						
Male	664	66	363	64	252	68
Female	345	34	202	36	118	32
<b>RACE OR ETHNIC GROUP</b>						
Hispanic	53	5	24	4	22	6
Non-Hispanic	925	95	526	96	337	94
White	808	80	467	82	287	78
Black	33	3	17	3	14	4
Asian	108	11	58	10	38	10
Other	44	4	16	3	24	6
<b>MEDICAL SPECIALTY</b>						
Primary care	549	54	323	57	197	53
Non-primary care	462	46	243	43	173	47
<b>NUMBER OF YEARS IN PRACTICE</b>						
1-9	209	22	139	26	55	15
10-19	349	36	208	38	117	33
20-29	273	28	138	25	114	32
30 or more	138	14	58	11	69	19
<b>NUMBER OF PHYSICIANS IN PRACTICE</b>						
Solo practice	66	7	18	3	44	12
2-3	459	46	215	38	211	57
4-5	165	16	99	17	52	14
6-10	190	19	142	25	37	10
11-50	106	11	75	13	25	6
More than 50	19	2	17	3	1	< 1
<b>CLINICAL SETTING</b>						
Hospital or medical center	276	28	178	32	79	22
Office not attached to hospital or medical center	708	71	375	67	287	78
Other	8	1	8	1	0	0
<b>LOCATION</b>						
Urban	896	89	490	87	338	91
Rural	115	11	76	13	32	9
<b>REGION</b>						
Northeast	265	26	132	23	114	31
Midwest	218	22	137	24	71	19
South	379	38	192	34	150	41
West	146	14	103	18	34	9

17 **SOURCE** Authors' analysis of data from the National Survey of E-Prescribing Physicians. **NOTES** Integrated electronic prescribing systems are integrated with an electronic health record system; stand-alone systems are not. In our survey, 60 percent of the systems were integrated, and 39 percent were not. Not all percentages sum to 100 because of rounding.

tion list (made it much harder, or somewhat harder, made no difference, made it somewhat easier, or much easier)? What effect did the system have on the number of phone calls their practice received from pharmacies about prescribing errors? And had physicians avoided triggering a drug allergy or a potentially dangerous drug interaction because of a prompt from their e-prescribing system?

**ANALYSIS** We first examined bivariate relationships between the type of e-prescribing systems (stand-alone versus integrated), physician and practice characteristics, and our dependent variables. Finally, we applied a logistic regression model to examine associations between our dependent variables and type of system, after controlling for characteristics of physicians and their practices.

The exhibits show the bivariate results and the *p* values obtained from our model (see the Technical Appendix for the multivariable results).<sup>13</sup> *P* values of less than 0.05 indicate that these results are probably due to true variations between the two types of systems, rather than to chance alone.

**STUDY LIMITATIONS** Our study approach had several limitations. First, our sample included only physicians who were signed up with an e-prescribing service, so we cannot generalize our results to the entire population of physicians.

Second, although we adhered to the best practices of survey research—for example, sending incentive checks made out to the physicians—to ensure that the survey reached our intended respondents, we cannot verify that the survey was completed by the physicians themselves. It is possible that an office manager or other staff member filled out the survey.

Third, although we achieved a reasonable response rate for a physician survey, we cannot rule out the possibility that the physicians who responded were different from those who did not. To the extent that there are systematic, rather than random, differences between the two groups, nonresponse bias could exist.

Finally, we could not verify the accuracy of respondents' reports of e-prescribing or reductions in errors using survey methods.

## Study Results

**SURVEY RESPONDENTS** Of the 2,000 physicians in our sample, we excluded 53 because their addresses were unknown. Of the 1,947 eligible respondents, 1,011 completed the survey, which yielded a response rate of 52 percent. Response rates by survey strata were equivalent: 51 percent for physicians in the regular-use stratum and 53 percent in the low-use stratum.

Sixty percent of our respondents reported having an integrated e-prescribing system; the rest had a stand-alone system. Those with integrated systems were more likely than those with stand-alone systems to be primary care physicians, to practice in larger groups and in a hospital or medical center, and to have practiced for fewer years (Exhibit 1). They were also more likely to be regular users of e-prescribing (data not shown).

### CHARACTERISTICS OF E-PRESCRIBING SYSTEMS

Nearly all respondents (97 percent) reported that they were able to send prescriptions electronically; 87 percent had e-prescribing systems that included drug warnings or contraindications and the ability to manage refill authorizations. Fewer physicians, although still a majority, reported that their system included access to patients' drug history (62 percent) and formulary (60 percent). Physicians using an integrated e-prescribing system were significantly more likely than those using a stand-alone system to report having the following functionalities: access to patients' drug history, warnings of drug interactions or contraindications, and refill authorizations. The results for all functionalities are shown in the Technical Appendix.<sup>13</sup>

**USE OF THE E-PRESCRIBING SYSTEM** Physicians with integrated systems were significantly more likely than those with stand-alone systems to report writing prescriptions electronically most or all of the time (Exhibit 2). Regardless of the type of system used, the majority of physicians who wrote prescriptions electronically most or all of the time also sent prescriptions to the pharmacy electronically (data not shown). However, those with integrated systems were significantly more likely than those with stand-alone systems to report using this function.

Overall, only 56 percent of physicians said that they checked a patient's drug history most or all of the time. Those with integrated systems were significantly more likely than their counterparts with stand-alone systems to report doing this. We found a similar pattern for checking patients' formulary information, although far fewer physicians reported using this functionality.

**EASE OF PRESCRIBING** We asked physicians about the effect of their e-prescribing system on ease of prescribing (Exhibit 3). At least half said that their use of e-prescribing made it easier for them to take care of prescription refills themselves, have staff take care of refills, batch-process refills, write an initial prescription for a new patient, and prescribe within a patient's formulary.

Physicians with an integrated system were significantly more likely than those with a stand-alone system were to report that e-prescribing

19 **EXHIBIT 2**

9  
10 **Physicians' Use Of Integrated And Stand-Alone E-Prescribing Systems, 2009**

	Total		Integrated system		Stand-alone system		p value
	Number	Percent	Number	Percent	Number	Percent	
<b>USE SYSTEM TO WRITE PRESCRIPTIONS</b>							
Not at all/some of the time	281	30	124	22	151	41	< 0.001
Most or all of the time	655	70	437	78	212	58	
<b>USE SYSTEM TO SEND PRESCRIPTIONS ELECTRONICALLY TO PHARMACY</b>							
Not at all/some of the time	223	24	112	20	103	28	0.015
Most or all of the time	713	76	448	80	260	71	
<b>USE SYSTEM TO CHECK FORMULARY INFORMATION FOR A PATIENT</b>							
Not at all/some of the time	534	57	277	50	248	69	0.001
Most or all of the time	314	34	218	39	93	26	
<b>USE SYSTEM TO CHECK DRUG HISTORY FOR A PATIENT</b>							
Not at all/some of the time	377	40	148	27	224	62	< 0.001
Most or all of the time	522	56	389	70	126	35	

**SOURCE** Authors' analyses of data from the National Survey of E-Prescribing Physicians. **NOTES** Survey questions asked physicians about e-prescribing systems used at their main practice site. Integrated electronic prescribing systems are integrated with an electronic health record system; stand-alone systems are not. Not all percentages sum to 100 because of missing data. P values were obtained from a logistic regression model adjusting for physician specialty, years in practice, practice size, clinical setting, urbanicity, and US region in which the physician practices.

made it somewhat or much easier to take care of refill requests themselves, have staff take care of refill requests, and write an initial prescription for a new patient. There were no significant differences between the two groups on the other measures (see the Technical Appendix).<sup>13</sup>

Approximately one-third of physicians re-

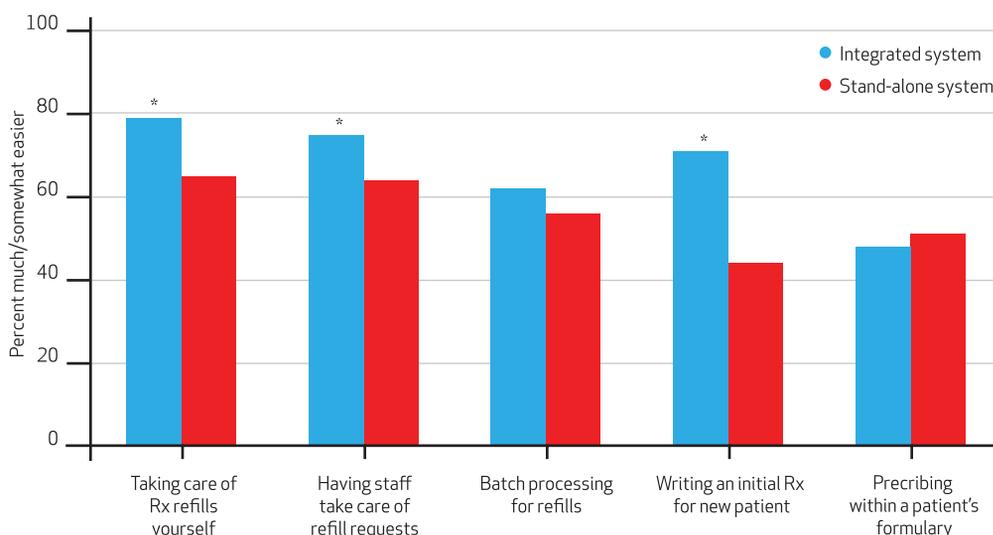
ported reductions in calls from [please provide] about formulary issues, and nearly half reported fewer calls from patients about prescription refills (Exhibit 4). There were no significant differences on these measures between system types.

**SATISFACTION WITH E-PRESCRIBING** The majority of physicians (88 percent) were satisfied with

11

**EXHIBIT 3**

**Effect Of E-Prescribing On Physicians' Prescribing Practices, 2009**



**SOURCE** Authors' analysis of data from the National Survey of E-Prescribing Physicians. **NOTES** An asterisk denotes significant difference between physicians with an integrated system and those with a stand-alone system. Adjusted odds ratios were obtained from a logistic regression model adjusting for physician's specialty, years in practice, practice size, clinical setting, urbanicity, and region of the United States in which the physician practices.

21

their e-prescribing system overall. Physicians with integrated systems were significantly more likely than those with stand-alone systems to be satisfied (see the Technical Appendix).<sup>13</sup>

When asked about specific aspects of their systems, physicians reported high levels of satisfaction on average. At least three-quarters of physicians were satisfied with all of the specific aspects of e-prescribing included in the survey.

There were no significant differences between physicians with stand-alone as compared to integrated systems, with one exception: Physicians with stand-alone systems were significantly more likely to be satisfied with the cost of the system. This is probably because [please provide].

**EFFECT ON PRESCRIBING SAFETY** Overall, physicians reported that their use of e-prescribing had a positive effect on the safety of their prescribing practices. Sixty-eight percent of physicians reported that their system made it easier to reconcile a patient's medication list, and 57 percent reported a reduction in the number of calls the practice received from pharmacies about prescribing errors. Physicians with an integrated system were significantly more likely than those with a stand-alone system to report these benefits (Exhibit 5).

Half of physicians reported avoiding a drug allergy or a potentially dangerous medication interaction as the result of a prompt from their e-prescribing system. Approximately one-third credited their system with preventing one of these two problems in the six months prior to the survey. Physicians with integrated systems were significantly more likely than those with stand-alone systems to report avoiding a drug allergy or a dangerous medication interaction.

## Discussion

We found important differences between the use of a stand-alone e-prescribing system and the use of one integrated into an electronic health record. First, our results suggest that there are significant differences in the characteristics of physicians using the two different types of systems. Others have found that physicians who adopt health IT more broadly tend to be younger and practice in larger group settings.<sup>9</sup> Our findings echo this earlier work.

Greater adoption of integrated systems by younger physicians could be an effect of technology leapfrogging. E-prescribing systems available in the 1980s and 1990s tended to be stand-alone, while newer systems are more integrated with other health IT applications. However, our findings also suggest that stand-alone systems may be preferred by older physicians and those in small practices. This may be because of their lower cost and the smaller chance that implementation will result in major disruptions to the work flow.

**EFFECTS OF SYSTEM TYPE** Our findings suggest that physicians' use of e-prescribing differs by type of system in three important ways: extent of use; depth of use; and value-added use. We found that physicians with an integrated system used their e-prescribing system more extensively than did those with a stand-alone system; used more of the functionality offered by the system; and used the system in a way that maximized the efficiency of office practices and minimized drug costs. Collectively, these results suggest the importance of integrated systems that may support learning and knowledge transfer across different health IT applications.

Many physicians and practices are actively considering adopting e-prescribing or other health IT and are asking if the additional expense

### EXHIBIT 4

Effect Of E-Prescribing On Phone Calls To Physicians' Practices, 2009

	Total		Integrated system		Stand-alone system		p value
	Number	Percent	Number	Percent	Number	Percent	
<b>EFFECT ON THE NUMBER OF CALLS FROM [PLEASE PROVIDE] ABOUT FORMULARY ISSUES</b>							
Significantly/somewhat reduced	302	33	177	32	121	34	0.538
No effect	559	61	336	61	214	60	
Significantly/somewhat increased	58	6	35	6	22	6	
<b>EFFECT ON THE NUMBER OF CALLS FROM PATIENTS ABOUT PRESCRIPTION REFILLS</b>							
Significantly/somewhat reduced	452	49	282	51	169	47	0.283
No effect	380	41	220	40	152	42	
Significantly/somewhat increased	92	10	50	9	38	11	

**SOURCE** Authors' analysis of data from the National Survey of E-Prescribing Physicians. **NOTES** Integrated electronic prescribing systems are integrated with an electronic health record system; stand-alone systems are not. *P* values were obtained from a logistic regression model adjusting for physician's specialty, years in practice, practice size, clinical setting, urbanicity, and US region in which the physician practices.


**Physicians' Perceptions Of Effect Of E-Prescribing On Quality And Safety, 2009**

	Total		Integrated system		Stand-alone system		p value
	No.	%	No.	%	No.	%	
<b>EFFECT ON RECONCILING A PATIENT'S MEDICATION LIST</b>							
Much/somewhat harder	67	7	27	5	36	10	< 0.001
No difference	157	17	61	11	94	26	
Much/somewhat easier	631	68	443	80	180	50	
<b>EFFECT ON NUMBER OF CALLS FROM PHARMACIES ABOUT PRESCRIBING ERRORS</b>							
Significantly/somewhat reduced	527	57	341	62	182	51	0.005
No effect	313	34	154	28	155	43	
Significantly/somewhat increased	86	9	59	11	22	6	
<b>AVOIDED A DRUG ALLERGY BECAUSE OF WARNING FROM E-PRESCRIBING SYSTEM</b>							
Yes, in past 6 months	331	36	240	45	83	23	< 0.001
Yes, but more than 6 months ago	126	14	87	16	38	11	
No	409	45	192	36	212	59	
<b>AVOIDED A POTENTIALLY DANGEROUS DRUG INTERACTION BECAUSE OF PROMPT FROM E-PRESCRIBING SYSTEM</b>							
Yes, in past 6 months	306	34	207	39	93	26	< 0.001
Yes, but more than 6 months ago	149	16	102	19	45	13	
No	406	45	206	38	195	55	

**SOURCE** Authors' analysis of data from the National Survey of E-Prescribing Physicians. **NOTES** Integrated electronic prescribing systems are integrated with an electronic health record system; stand-alone systems are not. Not all percentages sum to 100 because of rounding. *P* values were obtained from a logistic regression model adjusting for physician specialty, years in practice, practice size, clinical setting, urbanicity, and US region in which the physician practices.

of moving to an integrated system would be offset by the system's benefits, compared to a stand-alone system. Our data allowed us to examine areas in which physicians might expect to see benefits in daily practice. It could help clarify the potential impact of different types of systems.

**EFFICIENCY GAINS** E-prescribing advocates cite increased efficiency as one of the greatest benefits of adopting the technology.<sup>2,15</sup> Our results suggest that physicians who use either an integrated or a stand-alone system do realize this benefit in terms of fewer phone calls and greater ease of prescribing. Our results also suggest that the use of e-prescribing generally results in a perception of greater efficiency.

However, there appears to be little added benefit to moving from a stand-alone system to one that is integrated into an electronic health record. Because the efficiency of office procedures represents a potential direct gain for a practice, the lack of impact here may decrease physicians' enthusiasm for moving to an integrated system.

Prescribing within patients' formulary should reduce patients' overall drug costs and improve prescribing efficiency. A majority of physicians reported that their system could check a patient's formulary and that their system made conducting this check easier than in the past. However, far fewer reported consistent use of this functionality. Prior work suggests that this may be due in part to clinicians' perceptions that

these are administrative duties that disrupt their traditional work flow.<sup>14</sup>

Although physicians with an integrated system report checking formularies more often, it is still not a majority of this group. This suggests that, overall, physicians are not taking advantage of the efficiency gains and potential cost savings for patients that e-prescribing technology could offer. The regional extension centers of the Office of the National Coordinator for Health Information Technology, created to provide technical assistance to physicians and hospitals as they move toward meaningful use, could help motivate physicians to implement and use this technology by demonstrating and quantifying real gains in efficiency.

**SAFETY** One area where our findings suggest that integrated systems offer a considerable advantage over stand-alone systems is in prescribing safety. Users of integrated systems consistently reported a larger effect than those with stand-alone systems. Although these are perceptions of benefits, and we were not able to confirm the reduction in errors, any real difference between the types of systems in this area would be important clinically. They would also be relevant to the quality improvement efforts encouraged by the American Recovery and Reinvestment Act, although they might not produce direct gains in productivity or reimbursement for physicians or practices.

14

## Policy Implications

**MEANINGFUL USE** Our findings have direct implications for the implementation of CMS's meaningful-use provisions and incentive payments. To be eligible for the incentive payments, providers will have to demonstrate their use of an electronic system that includes drug-drug interaction, drug allergy, and possibly drug formulary checks; has the capability to generate and transmit prescriptions electronically; and can maintain an active patient medication list in an electronic format.<sup>16</sup> Because many stand-alone systems cannot support these functions, we will probably continue to see a shift away from the use of stand-alone systems toward those that are integrated within an electronic health record.

Our data suggest that physicians who already have systems with the required functionalities might not be using them to the extent required by the meaningful-use criteria. This provides further evidence that adoption of technology alone is not enough. Simply transferring functions from paper to an electronic system is not likely to result in substantial improvements in care. Clinicians will need to make changes to their work flow in order to capture the full benefits of the technology. Whether the meaningful-use incentives are enough to encourage physicians to make these changes is not yet clear.

This question is particularly salient in areas with direct financial gains for physicians (efficiency) and payers (formulary checks). Here we did not find a large return on the additional investment that integrated systems require. However, we did see substantial benefits in the area of

prescribing safety. If these benefits can be confirmed, and if the financial incentives available to physicians are enough to offset the additional investment in an integrated system, that would strongly support the policy case for incentives to move prescribers toward adoption of integrated systems.

**CHANGES IN PRACTICE SIZE** Our findings have further policy implications beyond the current debate over meaningful use. The model of provider organizations may be shifting from one dominated by solo or very small practices to one of consolidation of these practices into larger groups.<sup>17</sup> This change in practice size may alleviate some of the cost concerns involved in the use of health IT. Furthermore, earlier studies have found that the perceived and actual benefits of the technology accrue primarily to larger practices. This suggests that more physicians may begin to realize the intended benefits of e-prescribing as the average practice size increases.

**CONCLUSION** In summary, we found that integrated e-prescribing systems offered incremental benefits over stand-alone systems. Whether these benefits and the meaningful-use incentives offered by the federal government will be sufficient to overcome the cost of moving to an integrated system will be a critical factor in whether the technology is widely adopted. If the incentives function in their intended manner, it is likely that stand-alone e-prescribing systems will become obsolete, replaced by those that can be used to conform to the meaningful-use criteria. ■

This work was supported by a grant from the Agency for Healthcare Research and Quality and by the Center for Improving Medication Management. The center was founded by the American Academy of Family Physicians,

Blue Cross Blue Shield Association, Humana, Intel, Medical Group Management Association, and Surescripts. Its focus is to leverage health information technology to improve the outcomes of medication

management through collaborative initiatives among physician practices, payers, pharmacies, and patients. The authors gratefully acknowledge the assistance of Paola Miralles in completing this research.

## NOTES

- 1 Tierney WM, Miller ME, Overhage JM, McDonald CJ. Physician inpatient order writing on microcomputer workstations: effects on resource utilization. *JAMA*. 1993; 269(3):379-83.
- 2 Hollingworth W, Devine EB, Hansen RN, Lawless NM, Comstock BA, Wilson-Norton JL, et al. The impact of e-prescribing on prescriber and staff time in ambulatory care clinics: a time motion study. *J Am Med Inform Assoc*. 2007;14(6):722-30.
- 3 Fischer MA, Vogeli C, Stedman M, Ferris T, Brookhart MA, Weissman JS. Effect of electronic prescribing with formulary decision support on medication use and cost. *Arch Intern Med*. 2008;168(22):2433-9.
- 4 Crosson JC, Isaacson N, Lancaster D, McDonald EA, Schueth AJ, DiCiccio-Bloom B, et al. Variation in electronic prescribing implementation among twelve ambulatory practices. *J Gen Intern Med*. 2008;23(4):364-71.
- 5 Wang CJ, Patel MH, Schueth AJ, Bradley M, Wu S, Crosson JC, et al. Perceptions of standards-based electronic prescribing systems as implemented in outpatient primary care: a physician survey. *J Am Med Inform Assoc*. 2009;16(4):493-502.
- 6 Weingart SN, Simchowit B, Padolsky H, Isaac T, Seger AC, Massagli M, et al. An empirical model to estimate the potential impact of medication safety alerts on patient safety, health care utilization, and cost in ambulatory care. *Arch Intern Med*. 2009;169(16):1465-73.
- 7 Weingart SN, Simchowit B, Shiman L, Brouillard D, Cyrulik A, Davis RB, et al. Clinicians' assessments of electronic medication safety alerts in ambulatory care. *Arch Intern Med*. 2009;169(17):1627-32.
- 8 Devine EB, Hollingworth W, Hansen RN, Lawless NM, Wilson-Norton JL, Martin DP, et al. Electronic prescribing at the point of care: a time-motion study in the primary care setting. *Health Serv Res*. 2010;

- 45(1):152–71.
- 9** DesRoches CM, Campbell EG, Rao SR, Donelan K, Ferris TG, Jha A, et al. Electronic health records in ambulatory care—a national survey of physicians. *N Engl J Med*. 2008;359(1):50–60.
- 10** Blumenthal D. Stimulating the adoption of health information technology. *N Engl J Med*. 2009; 360(15):1477–9.
- 11** American Recovery and Reinvestment Act, Pub. L. No.: 111-5; 2009. Title IV, Subtitle B, sec. 4101 (a).
- 12** As noted in the text, please provide source of quote here.
- 13** To access the Technical Appendix, click on the Technical Appendix link in the box to the right of the article online.
- 14** Agarwal R, Angst CM, DesRoches CM, Fischer MA. Technological viewpoints (frames) about electronic prescribing in physician practices. *J Am Med Inform Assoc*. 2010;17(4): 425–31.
- 15** Grossman JM, Gerland A, Reed MC, Fahlman C. Physicians' experiences using commercial e-prescribing systems. *Health Aff (Millwood)*. 2007; 26(3):w393–404. DOI: 10.1377/hlthaff.26.3.w393
- 16** Centers for Medicare and Medicaid Services. Medicare and Medicaid programs; electronic health record incentive program; final rule. *Fed Regist*. 2010;75(144):44314–518.
- 17** Lohr S. Electronic patient records will force consolidation in health care. *New York Times*. 2009 May 28.

## ABOUT THE AUTHORS: CATHERINE M. DESROCHES, RITU AGARWAL, COREY M. ANGST & MICHAEL A. FISCHER



**Catherine M. DesRoches** is an assistant professor at the Mongan Institute, Partners Healthcare.

Catherine DesRoches, Ritu Agarwal, Corey Angst, and Michael Fischer report on a survey of doctors about their use of e-prescribing in outpatient services. They found significant differences between those physicians using a stand-alone e-prescribing system and those using one integrated into an electronic health record—and concluded that the differences posed challenges for meeting “meaningful use” requirements that will go into effect next year. On the other hand, the authors also say that the survey offered surprising evidence that physicians’ adoption of integrated systems is moving faster than they previously expected.

DesRoches is an assistant professor of medicine at the Mongan Institute, Partners Healthcare, and a member of the adjunct faculty at Vanderbilt University. She serves on the Harvard School of Public Health’s Joint Committee on the Status of Women and is editor of the *Journal*

*of Electronic Health*. DesRoches received Massachusetts General Hospital’s 2009 award for Excellence in Clinical Research. She received a doctoral degree in public health from Columbia University.



**Ritu Agarwal** is a professor at the University of Maryland.

Agarwal is a professor and the Robert H. Smith Dean’s Chair of Information Systems in the University of Maryland’s School of Business. She also serves as director for the business school’s Center for Health Information and Decision Systems, and next year she will be editor-in-chief of *Information Systems Research*, where she is now senior editor. Agarwal, who won that publication’s best paper award in 2009, received a doctorate in management information systems from Syracuse University.



**Corey M. Angst** is an assistant professor at the University of Notre Dame.

Angst is an assistant professor in the Management Department at the University of Notre Dame’s Mendoza College of Business. He served as associate director of the University of Maryland’s Center for Health Information and Decision Systems from 2005 to 2007. He received a doctorate in information systems from Maryland.



**Michael A. Fischer** is a health services researcher and primary care physician at Brigham and Women’s Hospital.

Fischer is a colleague of DesRoches at Harvard, where he is an assistant professor of medicine and an associate physician in Brigham and Women’s Hospital’s Division of Pharmacoepidemiology and Pharmacoeconomics. He studies the impact of electronic

prescribing, prescription drug reimbursement policy; medication adherence; the appropriate use of

prescription drugs; and the assessment of complications of prescription drug therapy,

especially among the elderly. Fischer earned his medical degree from the Yale School of Medicine.