Where Are We on the Diffusion Curve? Trends and Drivers of Primary Care Physicians' Use of Health Information Technology

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Objective. To describe trends in primary care physicians' use of health information technology (HIT) between 2009 and 2012, examine practice characteristics associated with greater HIT capacity in 2012, and explore factors such as delivery system and payment reforms that may affect adoption and functionality.

Data. We used data from the 2012 and 2009 Commonwealth Fund International Health Policy Surveys of Primary Care Physicians. The data were collected in both years by postal mail between March and July among a nationally representative sample of primary care physicians in the United States.

Study Design. We compared primary care physicians' HIT capacity in 2009 and 2012. We employed multivariable logistic regression to analyze whether participating in an integrated delivery system, sharing resources and support with other practices, and being eligible for financial incentives were associated with greater HIT capacity in 2012.

Principal Findings. Primary care physicians' HIT capacity has significantly expanded since 2009, although solo practices continue to lag. Practices that are part of an integrated delivery system or share resources with other practices have higher rates of electronic medical record (EMR) adoption, multifunctional HIT, electronic information exchange, and electronic access for patients. Receiving or being eligible for financial incentives is associated with greater adoption of EMRs and information exchange.

Conclusions. Federal efforts to increase adoption have coincided with a rapid increase in HIT capacity. Delivery system and payment reforms and federally funded extension programs could offer promising pathways for further diffusion.

Key Words. EMR adoption, primary care physicians, shared resources, financial incentives, health information exchange, small physician practices

National trends in physicians' use of health information technology (HIT) are clear: in 2001, 18 percent of office-based physicians had implemented either a partial or full electronic medical record (EMR), 48 percent had done so in

2009, and 72 percent in 2012 (Hsiao and Hing 2012). Less is known about the nature of the progress in areas such as computerized physician ordering or clinical decision support. Furthermore, little is known about how external factors such as shared technical assistance programs and delivery system and payment reforms are impacting adoption. Studies have described significant variation in EMR adoption by physician practice size, setting, and physician age (Decker, Jamoom, and Sisk 2012). Documented barriers include costs, the lack of expertise, and technical support infrastructure (Audet et al. 2004; DesRoches et al. 2008; Boonstra and Broekhuis 2010; Patel et al. 2013).

The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 injected unprecedented resources to build the national HIT infrastructure. Those resources support several programs, including the “Meaningful Use” incentives, technical assistance through regional extension centers, and the creation of health information exchange communities. In addition, the Patient Protection and Affordable Care Act (ACA) of 2010 fostered payment and delivery system reforms, such as an increased focus on the patient-centered medical home model and accountable care organizations (ACOs). These initiatives aim to create and support an environment and infrastructure where all primary care practices can provide advanced primary care, regardless of their size or setting.

In this study, we use results from two international surveys of primary care physicians—the first conducted in 2009, before the ACA and in the very early stages of deployment of HITECH funds, and the second in 2012—to describe trends in adoption of HIT functionalities. While HIT adoption in a cross-national context has been reported elsewhere (Schoen et al. 2009, 2012), this study further explores the factors that may facilitate or hinder HIT adoption and functionality in the United States.

DATA AND METHODS

Data

This study primarily uses data from the 2012 Commonwealth Fund International Health Policy Survey of Primary Care Physicians, conducted in 11

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countries (Schoen et al. 2012), and restricts the analysis to U.S. respondents. The survey was conducted by Harris Interactive by postal mail between March and July; the response rate was 35 percent. The sample consisted of 1,012 primary care physicians—39 percent in family practice, 36 percent in internal medicine, 22 percent in pediatrics, and 3 percent in general practice—randomly drawn from the AMA Masterfile. Responses are weighted by gender, age, region, and specialty. We compared unweighted respondents and nonrespondents by region, years in practice, and type of practice (i.e., solo, group) and found similar proportions in both groups, suggesting that our sample is representative of the physicians in the AMA Masterfile. However, the low response rate does introduce potential bias.

Data from the 2009 Commonwealth Fund International Health Policy Survey of Primary Care Physicians (Schoen et al. 2009) are also used to explore changes in HIT adoption over time. Both survey instruments are available in the online Appendix. The 2009 survey was conducted following the same methodology as in 2012; the response rate in 2009 was 39 percent.

HIT Functionality

Respondents were asked whether they use electronic patient medical records in their practice. They were also asked about several electronic HIT functions. Using the same methodology as Schoen et al. (2012), we grouped 15 HIT questions into four domains related to (1) *generating patient information*; (2) *generating patient registry and panel information*; (3) *electronic order entry*, and (4) *electronic decision support* (Table 1 includes a list of questions under each domain). Respondents who reported using electronic medical records and two or more functions within each of the four domains were considered to have “multifunctional” *HIT capacity*. Physicians with *electronic exchange capacity* reported having at least two of the following: the ability to electronically exchange clinical summaries or laboratory test results with doctors outside their practice, or to receive hospital discharge reports via remote access. Practices providing *electronic access for patients* offered patients two or more of the following: the option to request appointments or referrals online, email about a medical question, request online prescription refills, or view test results on a secure website.

Integrated Delivery System and Sharing Resources

We characterized respondents by whether they reported being part of an integrated system such as Kaiser or the V.A. In addition, the survey asked

Table 1: Health Information Technology (HIT) Capacity among U.S. Primary Care Physicians 2009 and 2012

	2009 (N = 1,442), %	2012 (N = 1,012), %
Uses electronic patient medical records	46	69***
Computerized ability to generate patient information		
List medications taken by an individual patient, including those prescribed by other doctors	30	45***
List lab results for an individual patient, including those ordered by other doctors		43
Can provide patients with clinical summaries for each visit		43
<i>Can electronically generate patient information: 2 + of above 3 functions</i>		44
Computerized ability to generate patient registry and panel information		
List patients by diagnosis	42	50***
List patients due/overdue for tests or preventive care	29	42***
List all patients taking a particular medication		37
List patients by lab result	29	42***
<i>Can electronically generate patient registry and panel information: 2 + of above 4 functions</i>		46
Computerized order entry management: routinely...		
Order laboratory tests electronically	38	54***
Prescribe medication electronically	40	64***
Able to electronically send prescriptions to the pharmacy [†]	34	66***
Electronically track all laboratory tests until results reach clinicians	28	41***
<i>Routinely uses computerized order entry management: 2 + of above 4 functions</i>		68
Computerized decision support: routinely...		
Receive electronic alert/prompt about potential drug dose/interaction problems	37	58***
Receive computerized reminder for guideline-based intervention/screening tests	20	33***
Receive computerized alert/prompt to provide patients with test results	22	35***
Send patients reminders for preventive/follow-up care through computerized system	18	22***
<i>Routinely uses computerized decision support: At least 2 of the above 4 functions</i>		45
Multifunctional HIT capacity: <i>Uses EMRs and at least two electronic functions for generating patient information, generating panel information, order entry management, and routine decision support</i>		27
Electronic information exchange		
Can electronically exchange clinical summaries with doctors outside practice		33

continued

Table 1. *Continued*

	2009 (N = 1,442), %	2012 (N = 1,012), %
Can electronically exchange laboratory/diagnostic tests with doctors outside practice		35
Usually receive hospital discharge reports through remote access		12
<i>Able to electronically exchange information: 2 + of above 3 functions</i>		32
Electronic access for patients: Practice allows patients to...		
Request appointments or referrals online		30
Email about a medical question or concern		34
Request refills for prescriptions online		36
View test results on a secure website		28
<i>Electronic patient engagement: 2 + of above 4 functions</i>		35

Statistically different: * $p < .05$, ** $p < .01$; *** $p < .001$.

[†]Only asked of those who report occasionally or routinely electronically prescribing medication.

Source. 2009 and 2012 Commonwealth Fund International Health Policy Surveys of Primary Care Physicians.

respondents whether they have formal arrangements with external organizations to share technical support for clinical information systems or quality improvement consultants or support. Those that reported either or both arrangements were characterized as sharing resources.

Financial Incentives

Our analysis characterized respondents by whether they received or had the potential to receive financial support for any of the following: managing patients with chronic disease or complex needs; providing enhanced preventive care activities; adding nonphysician staff to their practice team; having non-face-to-face interactions with patients; or making home visits.

Practice Size

Practice size was categorized into four groups: solo, 2 to fewer than 10 physicians, 10 to fewer than 20 physicians, and 20 or more physicians.

Analysis

Trends between 2009 and 2012 in the percentage of physicians reporting various HIT functions were examined (Table 1). Bivariate analyses and

multivariable logistic regression of the 2012 data examined the association of HIT capacity with practice size, participation in an integrated delivery system, sharing resources, and eligibility for financial incentives, controlling for physician age, gender, urbanicity, and census region (Tables 2

Table 2: Practice Characteristics and HIT Capacity, U.S. Primary Care Physicians (2012)

	<i>Unweighted N</i>	<i>Uses Electronic Patient Medical Records</i>	<i>Multifunctional HIT Capacity[†]</i>	<i>Can Electronically Exchange Information with Other Providers[‡]</i>	<i>Electronic Access for Patients[§]</i>
U.S. total	1,012	69%	27%	32%	35%
Formal arrangements with other practices/groups to share technical support for clinical information systems, and/or quality improvement consultants or support					
Yes	376	83***	38***	49***	47***
No	580	59	20	21	27
Part of integrated system (e.g., Kaiser, the V.A.)					
Yes	276	87***	41***	51***	56***
No	721	63	22	24	27
Receives or eligible for targeted financial incentives [¶]					
Yes	342	76***	31*	39***	40**
No	653	65	25	27	32
Practice size ^{††}					
Solo	238	49	11	19	23
2 to <10	485	70***	29***	32***	32*
11 to <20	99	84***	32***	41***	38**
20 or more	145	90***	45***	45***	61***

Statistically different: * $p < .05$; ** $p < .01$; *** $p < .001$.

[†]Uses EMR, and has at least two electronic functions for: generating patient information, generating panel information, order entry management, and routine clinical decision support. See Table 1 for further details.

[‡]At least two of three functions: can electronically exchange records with other doctors, test results with other doctors, or usually receives hospital discharge reports through remote access. See Table 1 for further details.

[§]At least two of four functions: practice allows patients to request appointments/referrals online, email about a medical question, request online prescription refills, or view test results on a secure website. See Table 1 for further details.

[¶]Receives or has the potential to receive targeted financial support for managing patients with chronic disease or complex needs; providing enhanced preventive care activities; adding nonphysician staff to your practice team; having non-face-to-face interactions with patients; or making home visits.

^{††}Asterisks indicate statistical difference from practices with fewer than two FTE physicians.

Source. 2012 Commonwealth Fund International Health Policy Survey of Primary Care Physicians.

Table 3: Factors Associated with HIT Capacity among U.S. Primary Care Practices: Shared Resources, Integrated Delivery System, Financial Incentives, and Practice Size, Based on Logistic Regression (2012)

	Uses Electronic Patient Medical Records		Multifunctional HIT Capacity [†]		Can Electronically Exchange Information with Other Providers [‡]		Electronic Access for Patients [§]	
	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value	Odds Ratio	p-value
Shares technical support for clinical information systems and/or quality improvement consultants or support (reference = no)	1.83	.001	1.54	.006	2.49	<.001	1.56	.004
Part of an integrated delivery system (reference = no)	2.30	<.001	1.54	.009	2.15	<.001	2.32	<.001
Receives or eligible for targeted financial incentives [¶] (reference = no)	1.42	.034	1.25	.146	1.49	.009	1.28	.100
Practice size (reference = solo)								
2 to <10	1.74	.001	2.33	<.001	1.44	.080	1.16	.433
10 to <20	3.22	<.001	2.18	.011	1.53	.141	1.19	.531
20 or more	5.57	<.001	3.73	<.001	1.67	.052	2.56	<.001

Model adjusted for physician age, gender, practice location (urban/rural mix), and census region.

[†]Uses EMR, and has at least two electronic functions for: generating patient information, generating panel information, order entry management, and routine clinical decision support. See Table 1 for further details.

[‡]At least two of three functions: can electronically exchange records with other doctors, test results with other doctors, or usually receives hospital discharge reports through remote access. See Table 1 for further details.

[§]At least two of four functions: Practice allows patients to request appointments/referrals online, email about a medical question, request online prescription refills, or view test results on a secure website. See Table 1 for further details.

[¶]Receives or has the potential to receive targeted financial support for managing patients with chronic disease or complex needs; providing enhanced preventive care activities; adding nonphysician staff to your practice team; having non-face-to-face interactions with patients; or making home visits.

Source. 2012 Commonwealth Fund International Health Policy Survey of Primary Care Physicians.

and 3). Missing data were not excluded from the denominator, and the percentage of missing respondents ranged from 1 to 7 percent. We found no evidence of multicollinearity in our models. All analyses were conducted using Stata (version 12).

RESULTS

Trends in Adoption of EMRs among Primary Care Physicians, 2009–2012

Between 2009 and 2012, U.S. primary care physicians' adoption of EMRs rose 50 percent, from 46 to 69 percent (Table 1). The use of HIT increased in all areas, but relatively more so in order entry management: the proportion of physicians able to send prescriptions electronically to the pharmacy nearly doubled from 34 to 66 percent; electronic prescribing increased from 40 to 64 percent; and electronic ordering of laboratory tests from 38 to 54 percent.

Although the use of HIT for decision support generally lags behind other domains, progress has been made. In 2012, one-third of physicians received electronic prompts to provide patients with test results (35 percent) and reminders for guideline-based interventions or screening tests (33 percent), up from one-fifth in 2009. The ability to receive electronic alerts or prompts about drug dosing or potential interaction problems increased from 37 to 58 percent between 2009 and 2012. Twenty-two percent of physicians report that their practices send patient reminders for preventive or follow-up care—an increase of 4 percentage points since 2009.

Less than half of physicians in 2012 can use HIT to generate information about each patient, although these functions have become more common since 2009. Physicians' ability to generate information about their panel electronically has also increased since 2009, including being able to list patients by diagnosis (50 vs. 42 percent), those overdue for preventive care (42 vs. 29 percent), or by specific laboratory results (42 vs. 29 percent).

Multifunctional HIT Capacity, 2012

In 2012, 44 percent of physicians can generate *patient information* and 46 percent can generate *patient registry and panel information* using at least two HIT functions; 45 percent use at least two *electronic decision support* functionalities; and 68 percent use at least two HIT functions for *order entry management* (Table 1). Slightly over a quarter (27 percent) of physicians are “multifunctional” users of EMRs, meaning they use an EMR and have at least two electronic

functions for generating patient information, panel information, order entry management, and routine decision support.

Electronic Information Exchange, 2012

Thirty-three percent of primary care physicians report the ability to exchange clinical summaries with other doctors, and 35 percent can share laboratory or diagnostic tests with doctors outside their practice (Table 1). Even fewer physicians (12 percent) indicate that when their patients are discharged from a hospital they usually receive information about the admission through a remote server. In total, 32 percent of physicians have at least two HIT functions that allow them to electronically exchange or acquire information outside their practice.

Electronic Access for Patients, 2012

Roughly one-third or fewer of physicians offer electronic access to their patients so they can view test results on a secure website (28 percent), request an appointment or a referral online (30 percent), email them about a medical concern (34 percent), or refill prescriptions online (36 percent) (Table 1). In total, 35 percent of doctors offer their patients at least two of these forms of electronic access.

Factors Associated with Adoption of HIT

Based on bivariate analysis, physicians who are part of an integrated delivery system, who have formal arrangements with other practices to share resources, or who are eligible for financial incentives have higher rates of HIT adoption (Table 2). They are significantly more likely than physicians without these characteristics to use EMRs; to have multifunctional HIT capacity; to be able to electronically exchange information with other providers; and to offer patients electronic access to information, appointments, or prescription refills.

Practice size is also a major determinant of physicians' use of EMRs and HIT capacity, including exchanging patient information electronically and providing electronic access to their patients. Half of physicians in solo practices report using EMRs, compared to 90 percent of those in practices with 20 or more physicians; likewise, there is a 4-fold difference between solo and large practices in achieving multifunctional HIT capacity (11 vs. 45 percent).

Table 3 shows the net effects of practice size, sharing resources, being part of an integrated delivery system, and receiving or being eligible for financial incentives, also controlling for physician location, census region, age, and gender. Practice size remains an important determinant of HIT capacity even after controlling for all other covariates. Sharing resources is strongly associated with EMR use (OR = 1.83, $p = .001$), multifunctional HIT capacity (OR = 1.54, $p = .006$), electronically exchanging patient information (OR = 2.49, $p \leq .001$), and electronic access for patients (OR = 1.56, $p = .004$). Participating in an integrated delivery system also has an independent effect on EMR adoption and HIT capacity, holding all other covariates constant. Physicians who receive or are eligible for financial incentives are more likely to use EMRs (OR = 1.42, $p = .034$) and be able to electronically exchange patient information with physicians outside of their practice (OR = 1.49, $p = .009$) than those not eligible for incentives.

DISCUSSION

Given the public and private investment in building the national HIT infrastructure, it is important to track the adoption of HIT as well as explore factors that can accelerate or hinder the pace of adoption among all practices, regardless of their size or setting. Our analysis of national surveys of primary care physicians conducted in 2009 and 2012 demonstrates that HIT adoption is increasing but some HIT functionalities are more prevalent than others. With one exception (drug alerts) electronic decision supports are used only by at most one-third of physicians. Physicians' ability to electronically access clinical data and use it to manage individual patients or a panel of patients is progressing, although less than half of physicians have reached that level of functionality.

Two of the functions least adopted—electronic patient access and health information exchange—have been prioritized in the second stage of Meaningful Use. Success in this case will depend on physicians forging different types of partnerships with their patients and with the other service providers to whom they refer. The number of models and tools that include HIT as a way to engage patients continues to grow (Delbanco et al. 2010; Wasson et al. 2012). On the other hand, electronic exchange of clinical information will likely remain a significant challenge for some time—one that goes beyond technical and financing solutions and requires new relational approaches that address issues of trust, competition, autonomy, privacy, and security (Wright et al. 2010).

Integrated delivery systems have the financial capacity to invest in HIT and quality infrastructures that can benefit physicians who are part of such networks (Shih et al. 2008). In our study, twice as many physicians in an integrated delivery system reported high HIT functionality. However, only one-fourth of physicians said they practice in such a setting and these structural characteristics are hard to change. On the other hand, results suggest that financial incentives and technical assistance, which are more flexible and potentially applicable to large numbers of physicians, have the potential to enable practices, regardless of size and setting, to achieve high levels of HIT proficiency.

Our study finds that only 39 percent of physicians surveyed said they had formal arrangements to share technical support or quality improvement consultation. Yet physicians who said they share technical support were significantly more likely to use EMRs and have multifunctional HIT capacity than physicians who did not share these resources. Shared technical assistance programs were also associated with the ability to exchange health information with other providers.

These results suggest that attention should be placed on technical assistance programs that can effectively outreach to practices in a variety of settings, such as the Office of the National Coordinator's Regional Extension Center program deployed nationwide through federal funding (Grumbach and Mold 2009; Mostashari, Tripathi, and Kendall 2009; Abrams, Schor, and Schoenbaum 2010; Ryan et al. 2013). States' Medicaid agencies could also purchase or create incentives for practices to invest in such programs (Highsmith and Berenson 2011). Independent practice associations, which were originally created to help practices negotiate complex risk-based managed care contracts, are now also evolving as organizations that can provide infrastructure support to networks of practices (Lake, Higgins, and Ginsburg 2011). Delivery system models being tested and implemented through health care reform such as ACOs also hold promise for physicians, who could benefit from economies of scale if the ACO invests in HIT and quality improvement infrastructure.

Incentives were not significantly associated with multifunctional HIT capacity or patient electronic access but were associated with EMR use and electronic exchange of information. Payment reforms that reward value over volume will make investment in quality infrastructure more sustainable than in the past. For example, incentives for managing more complex patients, shared savings, capitation, and global budgeting create a business case for investing in the tools that are necessary to deliver high-quality and efficient care.

The strength of this study is that both surveys were conducted among a nationally representative sample of primary care physicians and contained many of the same questions, allowing us to trend adoption of a rich set of HIT functions. However, some limitations are noted. First, self-reported data collected through surveys are subject to social desirability bias. Second, our response rate is 35 percent and it is hard to predict the direction of any potential bias. Physicians with higher levels of adoption might be more willing to respond to the survey or physicians who are challenged with adoption might be more willing to voice their concerns. However, our estimate of EMR adoption in 2012 (69 percent) among primary care physicians (PCPs) is within range of other national studies that have reported EMR adoption among PCPs (58 percent using 2011 CDC/NCHS Physician Workflow Study; 75 percent using 2012 National Electronic Health Record Survey) (Jamoom et al. 2012; Office of the National Coordinator for Health Information Technology 2013).

CONCLUSION

The adoption of EMRs and more advanced HIT functionalities continues to increase. Although the gap in HIT capacity between solo and larger practices persists, study findings suggest that new strategies to narrow this gap—such as delivery system reforms, payment reforms, and extension programs that provide resources such as staff and technical support to networks of practices—are promising. To further accelerate HIT adoption, investments will need to be made in research, development, and knowledge translation, so that learning can be disseminated to practices of all kinds across the country. Continued federal investment in HIT can play a pivotal role in ensuring that all practices, regardless of their size or setting, have the necessary tools and resources available to take full advantage of the power of health information technology.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

- Appendix SA1: 2009 International Survey of Primary Care Doctors.
- Appendix SA2: 2012 International Survey of Primary Care Doctors.
- Appendix SA3: Author Matrix.