HEALTH CARE REFORM

Health Information Exchange

Participation by Minnesota Primary Care Practices

Patricia Fontaine, MD, MS; Therese Zink, MD, MPH; Raymond G. Boyle, PhD, MPH; John Kralewski, PhD

Background: The American Recovery and Reinvestment Act of 2009 will provide $36 billion to promote electronic health records and the formation of regional centers that foster community-wide electronic health information exchange (HIE) with the ultimate goal of a nationwide health information network. Minnesota's e-Health Law, passed in 2007, mandates electronic health record and HIE participation by all clinics and hospitals. To achieve these goals, small primary care practices must participate. Factors that motivate or prevent them from doing so are examined.

Methods: From November 10, 2008, through February 20, 2009, we gathered data (through questionnaires and interviews) from 9 primary care practices in Minnesota with fewer than 20 physicians and with varying degrees of electronic health records and HIE involvement.

Results: No practice was fully involved in a regional HIE, and HIE was not part of most practices' short-term strategic plans. External motivators for HIE included state and federal mandates, payer incentives, and increasing expectations for quality reporting. Internal motivators were anticipated cost savings, quality, patient safety, and efficiency. The most frequently cited barriers were lack of interoperability, cost, lack of buy-in for a shared HIE vision, security and privacy, and limited technical infrastructure and support.

Conclusions: Currently, small practices do not have the means or motivation to fully participate in regional HIEs, but many are exchanging health data in piecemeal arrangements with stakeholders with whom they are not directly competing for patients. To achieve more comprehensive HIE, regional health information organizations must provide leadership and financial incentives for community-wide meaningful use of interoperable electronic health records.

Arch Intern Med. 2010;170(7):622-629

T HE HEALTH INFORMATION Technology for Economic and Clinical Health Act (HITECH)[1] contained within the American Recovery and Reinvestment Act of 2009 will provide $36 billion to promote electronic health records (EHRs) and the formation of regional centers to foster community-wide electronic health information exchange (HIE). The ultimate goal is a nationwide health information network that will improve patient care and efficiency and garner cost savings.[2-4]

See Invited Commentary at end of article

The term *HIE* is defined by the Office of the National Coordinator for Health Information Technology as "the electronic movement of health-related information among organizations according to nationally recognized standards."[5] **Table 1** provides definitions of selected health information technology (IT) terms.[6] Self-contained networks that use a proprietary product to exchange information without using nationally recognized interoperability standards are not involved in HIE by Office of the National Coordinator for Health Information Technology definitions.[7]

At the state level, there has been significant interest in interoperable health IT and HIE.[8] The Minnesota Department of Health coordinates health IT activities through the Minnesota e-Health Initiative, a public-private collaboration created in 2004 "to accelerate the adoption and use of health IT to improve healthcare quality, increase patient safety, reduce healthcare costs, and enable individuals and communities to make the best possible health decisions."[9] This collaboration has distributed almost $15 million in e-Health grants and loans for planning, purchasing, and implementing EHRs.

Author Affiliations:
Department of Family Medicine and Community Health, Medical School, University of Minnesota, Minneapolis.

Table 1. Definitions of Information Technology Terms[a]

Term	Definition
Electronic health record	An electronic record of health-related information for an individual that conforms to nationally recognized interoperability standards and can be created, managed, and consulted by authorized physicians and staff across more than 1 health care organization
Personal health record	An electronic record of health-related information for an individual that conforms to nationally recognized interoperability standards and can be drawn from multiple sources while being managed, shared, and controlled by the individual
Health information exchange	The electronic movement of health-related information among organizations, according to nationally recognized standards
Health information organization	An organization that oversees and governs the exchange of health-related information among organizations, according to nationally recognized standards
Regional health information organization	A health information organization that brings together health care stakeholders within a defined geographic area and governs health information exchange among them for the purpose of improving health and care in that community

[a] Adapted from the National Alliance for Health Information Technology.[6]

Minnesota set the stage for HIE in 2007 with the passage of the e-Health Law, which mandated electronic claims submission by 2009, e-prescribing by 2011, and interoperable EHRs for all hospitals and health care professionals by 2015.[10]

Nationwide, larger health care systems have been the first to be involved with interoperable HIE, and the lessons learned are emerging.[11,12] Rudin et al,[13] who studied 3 HIEs in Massachusetts, identified trust, considering the strategic interests of the providers (ie, physicians, nurse practitioners, and physician assistants) and medical community, and quality measures as critical ingredients. Beyond this, little is known about the participation of independent primary care practices in community-wide HIEs. Because small primary care practices must participate to achieve long-term success, we examined the factors that motivated or prevented small Minnesota primary care practices from participating in interoperable HIE.

METHODS

SELECTION OF PRACTICES

We consulted with an 8-member advisory board composed of health IT experts from public and private organizations to identify 3 Minnesota HIE initiatives with potentially eligible practices. The initiatives included the following: (1) a 10-year-old Health Information Organization that promotes HIE across northern Minnesota and coordinates a statewide immunization registry, (2) a network of independent metropolitan community clinics that received Minnesota e-Health grant funding to implement EHRs, and (3) an initiative to develop an electronic personal health record among patients with congestive heart failure in a micropolitan community. We purposively selected practices in geographic proximity to these 3 HIE initiatives that had fewer than 20 providers and demonstrated varying degrees of clinical data–sharing activity.[14] Practices received a $2000 stipend for their time. The University of Minnesota Committee for the Protection of Human Subjects approved the project.

ORGANIZATIONAL QUESTIONNAIRE

We collected organizational information that included characteristics of the practice, EHR capacity, and the degree of HIE.

The degree of HIE was assessed across a broad range of stakeholders, such as hospitals, other health service providers, public health agencies, and patients. The questionnaire was developed from surveys conducted previously in Minnesota and nationally[15,16] and was reviewed by the advisory board and piloted by 2 nonparticipating practice administrators. The final instrument included 21 questions.

An Internet link to the questionnaire (Checkbox Survey Solutions Inc, Watertown, Massachusetts) was e-mailed to each practice before the site visit. If the questionnaire was not completed by the administrator or medical director within 2 weeks, a second e-mail was sent followed by personal contact. Responses were reviewed and clarified during the site visit.

SITE VISITS

All of us conducted site visits; each site was visited by 2 of us. These visits involved a tour of the facilities, a demonstration of the EHR, and interviews with key informants using a semistructured script with questions about EHR and HIE planning and implementation. The practice contact person identified a minimum of 3 informants from among those most knowledgeable and responsible for the practice's IT system, including practice administrators, medical directors, IT staff, physician champions, and nurse managers.

DATA ANALYSIS

Organizational Questionnaire

Responses were compiled, cross-checked, and updated from interview transcripts. They were then analyzed using simple descriptive statistics.

Site Visits

Thirty-nine individuals participated in key informant discussions. Audiotaped content was transcribed, proofread, compared with survey responses, and then deidentified. Using an immersion crystallization approach,[17] the researchers independently read transcripts in detail and recorded summary comments and possible themes. During several sessions, the 4 researchers met to compare observations for each site and come to consensus on the major themes from the data. Two researchers (T.Z. and P.F.) coded the transcripts using qualitative data analysis software (NVivo 8.0; QSR International Pty Ltd, Don-

Table 2. Demographic and Background Information From Participating Minnesota Primary Care Practices

	Practices Grouped by Region								
	NE 1	NE 2	NE 3	Metro 1	Metro 2	Metro 3	SW 1	SW 2	SW 3
Location[a]	Rural	Rural	Rural	Metro	Metro	Metro	Rural	Rural	Micro
Ownership	Community board	Health care system	Health care system	Community board	University/ community	Community board	Hospital	Hospital	Physicians
Physicians, No.									
Family medicine	6	4	3	6	4	6.5	8	5	8.5
Other	1	0	3	0	2	1	2	0	0
Total	**7**	**4**	**6**	**6**	**6**	**7.5**	**10**	**5**	**8.5**
EHR system									
Practice EHR	Centricity	NextGen On-Base	EpicCare	Centricity[b]	Electronic Health Systems	Mysys	MEDITECH	MS Access[c]	NextGen
Hospital EHR[d]	MEDITECH[e]	MEDITECH On-Base	MEDITECH	Epic	Allscripts	Epic	MEDITECH		Affinity

Abbreviations: EHR, electronic health record; MEDITECH, MEDITECH Medical Information Technologies Inc; Metro, metropolitan; Micro, micropolitan; MS, Microsoft; NE, Northeast; SW, Southwest.

[a] On the basis of US Office of Management and Budget definitions, a micropolitan area contains an urban core with 10 000 but fewer than 50 000 people. We designated any town smaller than a micropolitan area as rural.

[b] Centricity was the preferred option; in the process of being purchased but not yet implemented.

[c] Designed and built their own medical record based on a relational database.

[d] Hospital, either affiliated or unaffiliated, where most patients received care.

[e] Practice and local hospital use: a practice management system to share records.

Table 3. Electronic Data Sharing Between Practices and Other Potential HIE Participants

	Practices Grouped by Region								
	NE 1	NE 2	NE 3	Metro 1	Metro 2	Metro 3	SW 1	SW 2	SW 3
Hospital	Neither	Both	Neither	Neither	Neither	Neither	Neither	Neither	Neither
Laboratory	Receive	Both	Both	Both	Both	Both	Both	Neither	Both
Radiology	Neither	Both	Both	Neither	Neither	Both	Receive	Neither	Neither
Payer	Neither	Neither	Both	Send	Neither	Neither	Both	Neither	Both
Pharmacy	Neither	Neither	Send	Neither	Neither	Neither	Both	Send	Both
PBM	Neither	Neither	Send	Neither	Neither	Neither	Neither	Neither	Neither
Public health	Send	Send	Send	Send	Send	Send	Send	Send	Send
Patient health record	Neither	Neither	Both	Neither	Neither	Neither	Neither	Neither	Neither
Other physicians	Neither	Neither	Neither	Neither	Neither	Neither	Neither	Neither	Neither

Abbreviations: HIE, health information exchange; Metro, metropolitan; NE, Northeast; PBM, pharmacy benefit manager; SW, Southwest.

caster, Victoria, Australia) and completed searches on the key themes and subthemes relating to the implementation of EHR and HIE, including the motivators (perceived or realized benefits), barriers, and strategies to overcome barriers. The coded transcript segments were examined to ensure that all outliers were represented and quotes illustrating the key concepts were chosen.

RESULTS

DESCRIPTION OF PARTICIPATING PRACTICES

As indicated in **Table 2**, the 9 practices represented a mix of location, size, and ownership. Most (n=5) were located in rural areas. The practices consisted of 4 to 10 physicians, and all employed nurse practitioners or physician assistants. Only 1 practice was totally owned by the physicians. In 2 practices, physicians were organized as a professional limited partnership, but the hospital owned the clinic building and employed the practice staff. In 2 others, physicians were employed by a health care organization that owned the hospital and clinic. The 4 remaining practices were federally qualified health centers of not-for-profit corporations governed by community boards.

EXTENT OF EHR AND HIE IMPLEMENTATION

Of the 9 practices, 8 were using EHRs; 7 had purchased a proprietary EHR system and 1 group had developed its own system. The sole practice without an EHR system had selected one but had not yet obtained funding for the purchase. With regard to HIE, **Table 3** presents a summary of the types of entities with which practices were electronically sharing information (sending, receiving, or sharing in both directions).

All nine practices shared data with the Minnesota Department of Health through the successful and widely disseminated Minnesota Immunization Information Connection, a secure and comprehensive Web-based immunization registry, supported by state and federal funding and accessible to health care clinics, schools, and child care workers.[18] The Minnesota Immunization Informa-

Table 4. Factors Motivating Small Minnesota Primary Care Practices to Participate in HIE

Motivator	Corresponding Benefits Cited by Key Informants
External motivators	
State and federal mandates	Compliance with mandates (eg, e-prescribing)
Public or private payers	e-Billing mandates
	Pay-for-performance incentives
Quality reporting requirements	Time savings from direct electronic reporting compared with manual data abstraction and reporting
	Increased reimbursements if certain quality goals are achieved
Population health management	Cost savings to public and private health plans
Quality initiatives (eg, Minnesota Community Measures)	Altruistic goal to improve public health
Internal motivators	
Cost savings linking practice's existing EHR to other nonaffiliated organizations' EHRs	Potential systemwide savings from improved process efficiencies and chronic disease prevention and management
	Savings from improved coding and direct links to payers for billing
	Potential savings from more efficient staff workflow in handling test ordering and results tracking
Quality of care and patient safety	Patient data available from locations outside the practice (ie, from hospital, emergency department, and/or consultants) at time of visit
Efficiency	Fewer paper "work-arounds" and more efficient workflow for ancillary staff (eg, when HIE allows hospital discharge summaries or laboratory or radiology results to be sent directly to patient's practice EHR)

Abbreviations: EHR, electronic health record; HIE, health information exchange.

tion Connection's Web-based interface does not connect directly with any practice's EHR; however, such interoperability is planned for the future.

Laboratory information was the next most commonly shared type of information, reported by 8 practices. Several practices were receiving information from non–hospital-based commercial laboratories through direct electronic imports to the EHR. One practice had programmed an interface between their EHR system and the hospital laboratory information system. Other HIE functions were present in 7 or fewer practices, and none reported electronic data sharing with nonaffiliated practices (eg, competing primary care groups or independent consultants).

MOTIVATING FACTORS AND PERCEIVED BENEFITS RELATED TO DATA SHARING

Key informants could easily describe the motivation and anticipated benefits for the practice's decision to adopt an EHR, and many could envision the benefits of HIE participation, although benefits currently accruing to practices were scarce. **Table 4** summarizes the motivating factors identified for HIE participation and categorized as originating externally or from within the practice.

Among external motivations, Minnesota's e-Health Law,[10] which requires interoperable EHRs by 2015, was a factor recognized by most practices. Practices that faced financial challenges and lagged behind others in EHR implementation tended to view the legislation negatively. One participant described it as "the legislation breathing down your neck, telling you what you need to do." The most electronically advanced practices, in contrast, had begun the process of planning for EHRs more than 10 years earlier and believed they were well positioned to meet current mandates.

Practices were aware of Medicare's 2% e-prescribing incentive[19] that took effect in 2009. For some, e-prescribing was used as a first step toward broader use of electronic data sharing "to get staff and providers comfortable" in an effort that "could precede full implementation." E-prescribing typically involved generating prescriptions from the EHR and faxing, although one practice's health care system was working with a pharmacy benefits manager and local pharmacy to create direct, interoperable interfaces.

Quality reporting has expanded in Minnesota during the past decade. All the dominant payers use health outcome data in "pay-for-performance" incentives for practices, and the public can compare practice outcomes through Minnesota Community Measurement, a statewide nonprofit quality reporting organization.[5] More than half our sites were involved in quality reporting initiatives, which were a frequently mentioned motivation for establishing HIE. One informant characterized it as a "driving force . . . We were trying to do reporting manually, so having the electronic capability is huge."

Internal motivators included anticipated cost savings from linking to other nonaffiliated organizations. Although this linking was not quantified, it was said to create efficiencies in workflow and time savings. Examples included laboratory results going directly into the EHR and prescriptions sent by electronic fax to the pharmacy, saving paper and staff time. For quality reporting requirements, replacing labor-intensive medical record reviews with an electronic process also had significant cost implications. One quality manager told us, "We do 2000 hand audits a year. With our paper charts, that's 20 minutes per chart. Do the math."

Immediate access to outside records improved the quality and safety of patient care, as well as saving staff the time spent requesting old records, waiting for them to arrive, and scanning them into the EHR system. Without the prior records, providers might repeat tests that were already performed or make decisions with incomplete knowledge of the patient's medications or problems.

Table 5. Barriers and Potential Solutions to HIE Participation in Small Minnesota Primary Care Practices

Barrier	Corresponding Strategies Used by Key Informants
Lack of interoperability	
Lack of common standards (eg, CCR)	Anticipate federal standards development and requirements for certified EHRs
Lack of common language (eg, LOINC)	Make use of other secure solutions for data access: VPN access, internal single vendor networks, secure Web portals
Vendors promise interoperability features that are not yet functional	Create secure PHRs with essential patient care information
Lack of buy-in for the vision and goals of the HIE	Consider future interoperability for HIE when planning EHR purchase (ie, purchasing a higher-cost EHR already used by another organization in the community may avoid costly future "work-arounds" to bridge incompatible systems)
	Develop regional collaboratives to facilitate HIE
	Clearly define the roles for each organization in the collaboration before initiation
	Provide context, stress significance of national priorities and incentives
	Focus initial sharing efforts on data that are important for clinical care and have high value to stakeholders
Competition	Anticipate federal guidelines
Security and privacy concerns	Anticipate federal policy guidelines
HIPAA may appear to conflict with HIE	
Practices are reluctant to share patient progress notes	
Patients are reluctant to share sensitive data	
Costs	Bring pressure to bear on vendors to consolidate or discount licensing fees for HIE
Licenses and fees	Develop open source software alternatives and platforms that are less expensive and require less service
Creating a sustainable business model	Use and expand on components of HIE that are already operational
Limited success and large time investment to develop business agreements	Build enough time into the development phase of the project and set realistic expectations
Limited technical support at the sites	Work with collaborative group or network

Abbreviations: CCR, continuity of care record (http://www.astm.org/Standards/E2369.htm; accessed January 15, 2010); EHR, electronic health record; HIE, health information exchange; HIPAA, Health Insurance Portability and Accountability Act; LOINC, Logical Observation Identifiers Names and Codes (http://loinc.org; accessed January 15, 2010); PHR, personal health record; VPN, virtual private network.

BARRIERS RELATED TO HIE

Barriers to HIE participation and the key informants' strategies for resolving them are presented in **Table 5**. Lack of interoperability was considered a barrier by all the practices. Most were mired in EHR implementation and frustrated with efforts to collaborate with larger, nonaffiliated health care organizations that provided referral care for their patients. Informants with IT backgrounds observed that interoperability was not technically difficult; however, they noted limited political willpower to bring appropriate resources to that goal. Vendors were noted to have proprietary interests in producing EHRs that did not "talk to" competitors' products, and they sometimes promised interoperability that was not yet functional. Some smaller practices felt ignored by the EHR vendors and large health care systems in the state: "HIE probably is not going to happen until 2015 because you've got all these big guys playing with this, and we're going to be the last people let into this system." Key informants generally believed that the development of federal standards and requirements for certified EHRs were necessary to address the lack of common standards and language: "Someone needs to say, 'Do it!'"

Practices sought various ways around the interoperability barrier. Two had created access to records through a virtual private network. For example, physicians from competing practices in one town could each access their patient records via a virtual private network link at the hospital, although neither could access the other's patient records. Secure Web portals on selected hospital or clinic computers were a typical way to access records from one location when working at another. One practice favored the alternative of a personal health record and was developing a 512-MB card that included the patient's list of concerns, medical and surgical history, medication list, and basic laboratory work. The patient "would hand carry it anywhere he or she wanted to go…pop it in a computer."

Cost was a formidable barrier to HIE that overlapped the problems with interoperability. A medical director in a community where 2 independent practices shared a community hospital described it as follows: "One of the struggles is that our system is different than [practice C's] which is different from the hospital's, and nobody wants to pay the cost of doing the integration." In particular, systems that are more technically advanced have a financial disincentive to create HIE programs that could benefit competitors. In one setting, for example, [hospital A] had little incentive to participate in HIE because the records were already in their system. One informant thought that patient care was not well served: '[Hospital A] doesn't want to pay to play if not everybody else is playing…but the smaller hospital that sees a complicated patient who is also cared for at [A]…needs to know what happened at [A].'

Funding EHRs was usually the first cost hurdle, but ongoing license fees and IT support also limited implementation of HIE, especially in settings where resources were scarce. The clinic administrator at an urban federally qualified health center practice explained: "We don't

have the money to participate in [the HIE] right now. . . . It was going to be about $6000 a year and then it had additional startup fees." This contrasted with the financial view expressed by a key informant representing the larger health care system affiliated with one practice: 'We believe there's a tipping point happening, and that everybody's going to have to do this. It's become a cost of doing business, and we don't really look on a return on investment. Like an electrical system that's reliable so that power doesn't go out when somebody's doing an operative procedure. It's infrastructure.'

Regional cooperatives that created economies of scale helped to address some of these hurdles for small rural practices. In rural areas, the adequacy of high-speed T1 lines (fiber-optic lines that can carry roughly 60 times more data than a normal residential modem) was a particular challenge. This was important for data warehousing for the EHR and HIE. One physician champion lamented, "I've got one T1 line coming into [my small town], one source of Internet access. If my [EHR] data is housed in Minneapolis and somebody cuts the T1 line east of town, I'm done."

For 8 of the 9 practices, clinical data exchange with their associated hospitals was an unrealized goal. Even among practices that were part of larger systems that also owned the local hospitals, only 1 could access patient information from throughout the system; another had recently purchased a compatible EHR. Hospitals and practices did not typically envision community-wide HIE when they planned for and purchased their EHR systems. One physician described how the hospital had purchased a different EHR system from the practice: "[D]espite our encouragement to get one that would interface with ours, they chose to get something that was much cheaper." A small practice was unable to purchase the EHR system that is widely used by large group practices and hospitals because the vendor "won't give [a clinic this small] the time of day." A federally qualified health center bought an EHR that was tailored for federal reporting requirements, despite its incompatibility with that of every hospital in the area.

All practices recognized the challenges of security and data privacy. Some thought that the Health Insurance Portability and Accountability Act was not widely understood and could be used as an excuse to avoid data exchange. A practice in the metropolitan area was experiencing frustration when they tried to negotiate bidirectional sharing of emergency, hospital, and ambulatory records with their referral hospital: "From a quality perspective, it just makes absolute sense to do this. After 2 years we thought we had an in, then they threw up [the Health Insurance Portability and Accountability Act]."

One medical director summarized the importance of security from the practice perspective: "Any time you get into electronic availability of data, the security protections have to be in place to make sure that you don't have people accessing data that shouldn't be there." Some shared "bad experiences," where employees inappropriately accessed confidential health data, stating, "We can track what was done, but we still don't know how to stop it on the front end." Patients' concerns about data sharing were acknowledged by a medical director who re-flected, "I think patients are afraid because their data get released to insurance companies and then something gets denied or misinterpreted." Overall, data security and privacy were acknowledged as challenging issues that warranted federal guidelines.

Faced with barriers to HIE, practices responded with varying degrees of success. As an important incremental step toward HIE, practices in the northeast region of the state worked with a regional health information organization to create a patient record locator service. "The service would help you determine where a patient's records exist," so although not all parties are electronically linked, at least "you know where a patient has been and could then request the records in the traditional way." Strong leadership, a strategic plan, and physician involvement from the beginning of the EHR selection process seemed to promote HIE success. Overall, however, no practice was engaged in the community-wide HIE that is envisioned as the foundation for the national health information network.

COMMENT

Many states, including Minnesota, have set ambitious goals to achieve community-wide HIE within the next 5 years. Although this result is technically possible, progress is slow. In this sample, we discovered many examples of clinical data sharing. However, none of the practices achieved HIE with a broad range of community partners that would meet the Office of the National Coordinator for Health Information Technology standard of "electronic movement of health-related information among independent organizations according to nationally recognized standards." For practices, being owned by a health care system clearly mitigated the financial barriers to EHR purchase and implementation but did not facilitate HIE with stakeholders outside the system or even ensure that the practice and hospital shared interoperable health IT systems.

Previous studies[2,20-22] have shown that quality, patient safety, and efficiency were motivating factors for participation in an HIE. These were internal motivators for our practices, but external motivators facilitated by the state health department and statewide quality initiatives were important as well. The most frequently cited barriers to participation in an HIE included lack of interoperability, cost, competition or lack of a shared HIE vision, and security and privacy concerns. A 2007 survey of regional health information organizations reached similar conclusions.[23] Security and privacy concerns are real[24-26]; however, our key informants expressed concerns for a consistent application of Health Insurance Portability and Accountability Act rules so that this act does not become a barrier to HIE that benefits patients.

There are limitations to the generalizability of our findings. Minnesota e-Health grants have provided funding for planning, assessment, and implementation of EHR and HIE initiatives, and several of our practices were recipients.[7] Minnesota has higher rates of EHR implementation than the national average, with 42% of primary care practices having fully implemented EHRs in 2007 com-

pared with 4% nationally.[20,27] Motivations, barriers, and strategies could be different in settings where EHRs are less prevalent. In addition, our study was conducted before the American Recovery and Reinvestment Act was finalized in early 2009, so we were unable to assess concepts of "meaningful use" or to ask whether the practices intended to seek American Recovery and Reinvestment Act funding. Finally, not all practices had IT experts for key informants, so in some cases we were unable to clarify details of HIE technical architecture (centralized vs peer to peer).[13]

At this time, small practices do not have the means or motivation to fully participate in regional health data exchanges, but many are exchanging health data in piecemeal arrangements with stakeholders with whom they are not directly competing for patients. The data-sharing patterns described in this study portend significant exchange of clinical information among stakeholders during the next decade. To achieve more comprehensive HIE and ultimately a national health information network, regional health information organizations need to provide leadership and financial incentives for community-wide meaningful use of interoperable EHRs.

The HITECH Act incentives provide money to purchase and adopt EHRs for meaningful use. Experts express concern that the proposed timeline and definition of "meaningful use" may put eligibility for HITECH Act incentives out of the reach of many providers, especially smaller and rural practices, and cause others to compromise the essential planning and workforce development that are necessary to implement their EHRs effectively.[28] This study of Minnesota primary care practices highlights the importance of appropriate planning before EHR adoption, the feasibility of including small rural practices, and the need to make community-wide HIE a high priority in the planning process.

Correspondence: Therese Zink, MD, MPH, Department of Family Medicine and Community Health, Medical School, University of Minnesota, MMC 81, 420 Delaware St SE, Minneapolis, MN 55455 (zink0003@umn.edu).
Author Contributions: *Study concept and design:* Fontaine, Boyle, and Kralewski. *Acquisition of data:* Fontaine, Zink, Boyle, and Kralewski. *Analysis and interpretation of data:* Fontaine, Zink, Boyle, and Kralewski. *Drafting of the manuscript:* Fontaine, Zink, and Boyle. *Critical revision of the manuscript for important intellectual content:* Fontaine, Zink, Boyle, and Kralewski. *Statistical analysis:* Zink. *Obtained funding:* Fontaine and Boyle. *Administrative, technical, and material support:* Boyle. *Study supervision:* Fontaine.

REFERENCES

1. American Recovery and Reinvestment Act of 2009. Open Congress for the 111th United States Congress Web site. http://www.opencongress.org/bill/111-h1/show. Accessed January 4, 2010.

2. Grossman JM, Kushner KL, November EA. Creating sustainable local health information exchanges: can barriers to stakeholder participation be overcome? *Res Briefs*. 2008;2(2):1-12.

3. McGowan JJ, Jordan C, Sims T, Overhage JM. Rural RHIOs: common issues in the development of two state-wide health information networks. *AMIA Annu Symp Proc*. 2007;10(11):528-532.

4. Solomon MR. Regional health information organizations: a vehicle for transforming health care delivery? *J Med Syst*. 2007;31(1):35-47.

5. Measuring and reporting health care quality in Minnesota. Minnesota Community Measurement Web site. http://www.mncm.org/site/?p=home. Accessed January 15, 2010.

6. The National Alliance for Health Information Technology. *The National Alliance for Health Information Technology Report to the Office of the National Coordinator for Health Information Technology on Defining Key Health Information Technology Terms*. Washington, DC: United States Dept of Health and Human Services; 2008.

7. Defining key health information technology terms. Department of Health and Human Services Web site. http://healthit.hhs.gov/portal/server.pt/gateway/PTARGS_0_10741_848133_0_0_18/10_2_hit_terms.pdf. Accessed January 4, 2010.

8. Rosenfeld S, Koss S, Caruth K, Fuller G. *Evolution of State Health Information Exchange*. Rockville, MD: Agency for Healthcare Research and Quality; 2006. AHRQ publication 06-0057.

9. Minnesota Department of Health, Office of the Commissioner. Minnesota e-Health Initiative: Report to the Minnesota Legislature 2009. Minnesota Department of Health Web site. http://www.health.state.mn.us/e-health/legrpt2009.html. Accessed October 5, 2009.

10. Health information and technology infrastructure: 2007. Office of the Revisor of Statutes of the State of Minnesota Web site. https://www.revisor.leg.state.mn.us/bin/getpub.php?pubtype=STAT_CHAP_SEC&year=current&section=62J.495&image.x=12&image.y=9. Accessed January 4, 2010.

11. Holmquest DL. Another lesson from Santa Barbara. *Health Aff (Millwood)*. 2007; 26(5):w592-w594.

12. Hripcsak G, Kaushal R, Johnson KB, et al. The United Hospital Fund meeting on evaluating health information exchange. *J Biomed Inform*. 2007;40(6)(suppl): S3-S10.

13. Rudin RS, Simon SR, Volk LA, Tripathi M, Bates D. Understanding the decisions and values of stakeholders in health information exchanges: experiences from Massachusetts. *Am J Public Health*. 2009;99(5):950-955.

14. Glaser BG, Strauss AL. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago, IL: Aldine Publishing Co; 1967.

15. Kralewski JE, Dowd BE, Cole-Adeniyi T, Gans D, Malakar L, Elson B. Factors influencing physician use of clinical electronic information technologies after adoption by their medical group practices. *Health Care Manage Rev*. 2008;33(4): 361-367.

16. Kralewski J, Dowd BE, Kaissi A, Curoe A, Rockwood T. Measuring the culture of medical group practices. *Health Care Manage Rev*. 2005;30(3):184-193.

17. Borkan J. Immersion/crystallization. In: Crabtree B, Miller W, eds. *Doing Qualitative Research*. 2nd ed. Thousand Oaks, CA: SAGE Publications; 1999:179-194.

18. Electronic medical records and immunization registries: the benefits of exchanging data. Minnesota Department of Health Web site. http://www.health.state.mn.us/divs/idepc/immunize/registry/hp/emedrecords.html. Accessed January 4, 2010.

19. Electronic prescribing incentive fact sheet. Centers for Medicare and Medicaid Services/United States Department of Health and Human Services Web site. http://cms.hhs.gov/pqri/downloads/pqrieprescribingfactsheet.pdf. Accessed January 30, 2010.

20. DesRoches CM, Campbell EG, Rao SR, et al. Electronic health records in ambulatory care: a national survey of physicians. *N Engl J Med*. 2008;359(1): 50-60.

21. Frisse ME, Holmes RL. Estimated financial savings associated with health information exchange and ambulatory care referral. *J Biomedical Informatics*. 2007; 40(6)(suppl):S27-S32.

22. Walker J, Pan E, Johnston D, Adler-Milstein J, Bates DW, Middleton B. The value of health care information exchange and interoperability. *Health Aff (Millwood)*. 2005; Jan-Jun(suppl):WS-10–WS-18.

23. Adler-Milstein J, McAfee AP, Bates DW, Jha AK. The state of regional health information organizations: current activities and financing. *Health Aff (Millwood)*. 2008;27(1):w60-w69.

24. Carter P, Lemery C, Mikels D, Bowen R, Hjort B. Privacy and security in health information exchange. *J AHIMA*. 2006;77(10):64A-64C.

25. Diamond C, Ricciardi L. Building consumer trust into health information exchange. *J AHIMA*. 2006;77(10):36-38.

26. Halamka J, Overhage JM, Ricciardi L, Rishel W, Shirky C, Diamond C. Exchanging health information: local distribution, national coordination. *Health Aff (Millwood)*. 2005;24(5):1170-1179.

27. Electronic health care record landscape assessment: Minnesota's primary care clinics. Stratis Health Web site. http://www.stratishealth.org/documents/ClinicEHRLandscapeAssessment0807.pdf. Accessed January 4, 2010.

28. Health Information Technology Policy Committee Meaningful Use Comments. Minnesota Department of Health Web site. http://www.health.state.mn.us/e-health/hitech/ht062609meaningful.pdf. Accessed January 4, 2010.

INVITED COMMENTARY

The Litmus Test for Health Information Exchange Success

Will Small Practices Participate?

The movement to establish widespread health information exchange (HIE) in the United States has thus far shown mixed results.[1] Although the number of sustainable HIEs is increasing, it appears that few of them encompass a large enough portion of health care providers and patients to significantly affect the provision of care. Even long-standing and eminently successful HIEs have been slow to gather clinical data from independent office-based practices,[2] which account for most health care use in the United States.[3] In addition, not much is known about the extent to which existing HIEs organize clinical data as patient-centric, longitudinal records accessible to all health care providers caring for a patient. Many HIEs achieve sustainability by automating the provision of test results[1] rather than offering more robust data-exchange functionality in which physicians can actually view a wide array of clinical data generated by other physicians, formatted as a unified record for each patient. Understanding why physicians, especially those who are office based, do or do not participate in HIE has become more urgent now to inform the ways the American Recovery and Reinvestment Act's payments for meaningful use of HIE can be effectively targeted.

In this issue of the *Archives*, Fontaine et al explore HIE from the perspectives of small primary care practices in Minnesota. Because small primary care practices provide a large portion of care in many regions, they represent critical stakeholders to HIEs as sources of clinical information for use by other health care providers and as consumers of other health care providers' clinical data to inform and coordinate their patients' care. These stakeholders, however, may be the hardest group to engage in HIEs because of their difficult financial situations and large patient loads.[4] In addition, with the shortage of primary care physicians in the United States, few will think to use HIE as a competitive weapon to attract new patients because many already have full panels.[5,6] The fact that small primary care practices are essential for HIE success and difficult to engage makes their perspective an important one to examine.

The authors' findings reveal a diversity of information-sharing activities among 9 small primary care practices, selected for their close geographic proximity to HIE initiatives and varying degrees of clinical data–sharing activities. The practices seem well integrated electronically with laboratories, which is an encouraging finding. Less encouraging is that only 1 in 9 are sharing data electronically with hospitals, and, very troubling, not a single practice was found to be electronically sharing clinical data with another nonaffiliated physician practice. In addition, "no practice was fully involved in a regional HIE, and HIE was not part of most practices' short-term strategic plans." If physicians with small primary care practices are not engaged in robust clinical information sharing in Minnesota, a state with a relatively high degree of health information technology penetration, it can reasonably be assumed that few primary care physicians, other than those in large integrated health care systems, are exchanging clinical data with other physicians electronically, and HIE has a long way to go to realize its potential value.[7]

What is preventing small primary care practices from joining HIEs? What could motivate them to participate? Through extensive interviews, Fontaine et al begin to answer these questions and provide a window into the incentive structures in which these critical stakeholders operate. They describe a complex array of forces at work, but perhaps the most potentially powerful one is absent: patients demanding that their records be shared electronically among their caregivers. Patients appear to not yet be aware that HIEs exist or of their potential to improve care and reduce costs.[7] It may be that patient demand for HIE will not grow until patients come to expect access to their own health data in an organized electronic form, namely, patient portals that allow them to view and manipulate data from their physicians and clearly see which physicians are participating and which are not. If the intent of the American Recovery and Reinvestment Act's meaningful-use payments is to stimulate HIE to the point of sustainability, the payments may need to advance HIE to the point where patients can access their clinical data so that market forces, in the form of patients' expectations, become strong enough to bring physicians toward HIEs.

However, in today's health care market, patient demand for HIE may only motivate a small portion of primary care physicians to take part in HIE. The shortage of primary care physicians suggests that few will need to compete for patients, and they will be especially reluctant to join an HIE if the membership fee further strains their finances.