

# The value of health information exchange

Joshua E Richardson  
Erika L Abramson  
Rainu Kaushal

Center for Healthcare Informatics  
and Policy, Weill Cornell Medical  
College, New York, NY, USA

**Abstract:** Health information exchange (HIE) is a key component of health care reform that enables clinical data sharing between providers, patients, and health care organizations. The value of HIE rests in the promise that more efficient and effective access to clinical data will improve patients' condition-specific outcomes relative to the costs. For example, improvements in outcomes may result from fewer medical errors and improved adherence to evidence-based recommendations, whereas reductions in costs may result from fewer duplicate tests and improved care coordination. However, even though health care reform efforts promote HIE as a way to improve care and curb costs, few studies demonstrate these results. We have organized the available evidence at national and regional levels to report on costs and benefits associated with HIE, and identify potential areas of future research.

**Keywords:** health information exchange, interoperable systems, health information technology, economic assessment, evaluation

## Introduction

Health information exchange (HIE) is considered a key component of health care reform efforts to improve health care quality and contain health care costs. HIE may be operationalized through a variety of clinical systems, such as electronic health records (EHRs), that enable the sharing of patient data among patients, providers, and organizations,<sup>1</sup> thereby potentially improving care coordination, quality, efficiency, and safety. Achieving HIE in the United States requires a multi-pronged effort to develop industry-wide technical standards, align economic incentives among stakeholders, and effectively integrate HIE within clinical workflow.<sup>2,3</sup> Beginning in 2011, provisions in the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 took effect, and providers may earn as much as US\$63,750 if they can demonstrate "meaningful use" of a certified interoperable EHR.<sup>4</sup> Meaningful use refers to the concept of utilizing an EHR with demonstrable improvements in various aspects of care as measured by specified criteria. These criteria currently include aspects of HIE, namely that providers use EHRs to share patient information with other providers. With EHRs in place, HIE will be the electronic circulatory system throughout the United States that enables patient information to flow.<sup>5</sup>

These efforts are being carried out to address a vicious cycle of uncoordinated patient care that results in fragmented patient data and poor outcomes – a problem that has long burdened health care. Traditionally, practices, pharmacies, and hospitals have used paper-based records to document, store, and share clinical data. As a result, patient information remains in institutional silos, thereby making it difficult to develop

Correspondence: Joshua E Richardson  
402 East 67th Street, Mailbox 75,  
New York, NY 10065, USA  
Tel +1 646 962 8069  
Fax +1 646 962 0281  
Email jor2032@med.cornell.edu

a complete picture of a patient's medical history and current health status.<sup>6</sup> Even among hospitals and providers that have adopted EHRs, there is often limited ability to share data. For example, one hospital could electronically share data across departments because its EHR exchanges a particular type of data (laboratory results), using a particular standard (Health Level 7, or HL7), using a common software platform (Epic EHR or Siemens EHR). However, that hospital most likely could not share those same laboratory data with surrounding community practices because each uses different EHRs (Epic EHR vs eClinicalWorks EHR) that employ different standards (HL7 vs Clinical Care Record, or CCR).

Fragmented and incomplete patient records have broad implications for providers, patients, and payers. These types of records increase the potential for medical errors, such as improperly ordering a medication that results in a drug–drug interaction.<sup>7</sup> The lack of comprehensive records hinder patients' and providers' abilities to track medical conditions, receive timely reminders when routine screenings and check-ups are due, and be alerted when duplicate procedures or tests are being ordered.<sup>8</sup> This fragmentation causes providers and patients to spend additional time and effort navigating the health care system, which ultimately increases health care costs. Sharing information electronically could be cheaper and faster than by paper, but health information technology (HIT) has lacked industry-wide protocols and standards.

Since 2004, the federal government through the Office of the National Coordinator for Health Information Technology (ONC) has been partnering with states, regions, and communities to develop the means for HIE.<sup>9,10</sup> ONC has been offering resources to develop capacity through technological, organizational, and business structures such as non-profit regional health information organizations (RHIOs) that facilitate information exchange among health care institutions.<sup>1</sup> The number of RHIOs nationwide has been growing and as of July 2011 there were 255 RHIOs, 85 of which had the service capability to perform at least one meaningful use requirement.<sup>11</sup> Although there have been RHIO success stories (most notably the Indiana Network for Patient Care (INPC)), most have struggled to demonstrate financial sustainability or generate sufficient adoption to change how most Americans receive their care. Models such as the Community Health Information Network (CHIN) and the Santa Barbara County Care Data Exchange (SBCCDE) were unsustainable for various reasons.<sup>12–14</sup> Research has documented challenges associated with developing and supporting RHIOs that include competitiveness and misaligned incentives<sup>12</sup> and fostering trust among health care organizations that

traditionally view one another as competitors.<sup>15–19</sup> A variety of RHIO business cases have been, and are being, weighed to promote long-term sustainability through federal and state incentives.<sup>20</sup>

More recently, the ONC has been focusing its efforts on two initiatives that promote HIE: The Direct Project,<sup>21</sup> and the State Health Information Exchange (State HIE) Cooperative Agreement Program.<sup>10</sup> The Direct Project funds efforts to enable direct transport of clinical data between two trusted sources, such as two physicians' EHRs. The State HIE Cooperative Agreement Program is awarding over US\$500 million to states and territories to support their HIE efforts, and an addition US\$16 million was awarded to ten sites to develop innovative technical, organizational, and governance solutions to building HIE.<sup>22</sup> The results from these efforts may fundamentally alter how providers, patients, and health care organizations share information with one another, thereby improving patient care and cost efficiency.

Mechanisms with which to capture and exchange clinical data will provide opportunities to reduce fragmentation and inefficiencies and provide more accurate and actionable patient information than what is currently available. However, potential pitfalls to HIE remain concerning the development of optimal means for securing data,<sup>23</sup> as well as providing appropriately patient-centered mechanisms for controlling what personal data are and are not exchanged.<sup>24</sup>

Advocates believe that the benefits that accrue from HIE will be self-evident and that improved quality, lower costs, and overall value will be attained after providing clinicians with electronically available information to guide decisions. However, to date it has been difficult to demonstrate that capturing and sharing clinical data will provide significant financial and clinical value.<sup>25</sup> Researchers are just beginning to produce empirical results that demonstrate the economic implications of HIE.

The purpose of this paper is to describe the value of HIE in terms of financial costs and benefits that are detailed in published literature. We will review the nascent evidence demonstrating HIE's value to different stakeholders within particular geographic regions (national and regional) and then comment on future directions of research.

## Investigating the costs and benefits of health information exchange

To understand any projected financial costs and benefits of health information exchange we sought published literature in the PubMed, Academic Business Premier, and Google

Scholar databases. Searches were limited to English language manuscripts that were published within the last 10 years, and were found using search terms such as “health information exchange,” “electronic health records/economics,” “interoperab\*[ility],” and “regional health information organization” or “RHIO.” Additional articles were individually selected based on our knowledge of the field and literature.

We found that HIEs are most often operationalized by stakeholders such as payers, providers, and government agencies within specified geographic boundaries,<sup>26</sup> and so we organized our findings at the national and regional levels accordingly (Table 1).

## National level costs and benefits

Research regarding HIE at the national level offers estimates of HIE’s financial costs and benefits. In addition, a national-level literature review reports inconclusive results as to HIE’s financial and clinical benefits to primary care practices.

In one study, Walker et al developed the Center for Information Technology Leadership (CITL) model to estimate financial costs and benefits of HIE among providers and “independent laboratories, radiology centers, pharmacies, payers, and public health departments.”<sup>27</sup> The CITL model accounted for four “levels” of HIE mechanisms that ranged from basic phone calls (Level 1) to robustly electronic (Level 4). The authors hypothesized that the United States would achieve Level 4 HIE at a cost of US\$276 billion over 10 years. Furthermore, through eliminating waste and inefficiencies such as duplicate tests, screenings, and shipping paper records across medical practices, an immediate benefit of US\$613 billion would be realized over 10 years. Subsequent to the 10-year investment, the United States would attain an annual US\$77.8 billion net benefit (US\$94.3 billion in benefits vs US\$16.5 billion in costs), or roughly 5% of all 2003 health care expenditures. However, concerns have been raised about the model’s basic assumptions, particularly regarding labor and resource costs.<sup>28,29</sup>

Also in 2005, Hillestad et al addressed the costs and benefits of nationwide HIE within the context of EHR systems. EHRs that rely on communication mechanisms such as “electronic messaging” to “communicat[e] between multiple specialists and patients” could improve safety and

efficiency – enough to save an estimated US\$513 billion over 15 years (2004–2018).<sup>30</sup> However, the authors did not explicitly distinguish the costs and benefits of EHRs from the costs and benefits of HIE.

Later that same year, Kaushal et al estimated the costs for developing a national-level HIE infrastructure that would enable universal functionalities such as clinical results viewing in interoperable EHRs.<sup>31</sup> They estimated that it would require US\$156 billion in capital costs and US\$48 billion in operational costs over 5 years, an average of US\$40.8 billion a year, with approximately two-thirds of this going toward functionalities such as EHRs and one-third toward HIE. Most of HIE’s costs would be incurred at the physician practice level (US\$31 billion).

Considering that the HITECH Act allocates US\$27 billion for EHR implementation incentives and US\$2 billion for infrastructure development,<sup>32</sup> the scale of transformation is brought into stark relief. Given traditional misaligned financial incentives, it will be difficult to fill the gaps to achieve HIE. Payers traditionally benefit from HIE due to efficiencies in paperwork and patient care, yet the costs of HIT mostly falls on health care providers and taxpayers.<sup>33</sup>

More recently, Fontaine et al conducted a literature review to seek HIE “value” in primary care practices across the United States and found that there are numerous costs but few financial or clinical benefits.<sup>34</sup> Costs were associated with EHR implementations and maintenance, such as software updates and ongoing security updates. Yet it was “unclear” that practices experience any savings from improved workflow efficiencies or staff reduction. In addition, the authors were unable to find convincing clinical benefits via improved patient outcomes, and that most reported improvements come from small, self-reported studies.<sup>34</sup> Instead, the authors stated, payers attain the greatest benefit from HIE through more efficient reporting. The authors argued that technical, organizational, and cultural barriers need to be overcome before broader determinations of cost savings and improved outcomes could be more fully demonstrated.

## Regional costs and benefits

There is emerging evidence that HIE at the regional level has an impact on clinical outcomes in addition to financial costs and benefits. Kern et al conducted a study among primary care practices across New York’s Hudson Valley to determine whether any clinical benefits result from HIE. The authors compared 54 providers with access to an Internet patient website (“portal”) with 114 providers who did not, and examined whether the former group performed better than

**Table 1** Level and description of findings

Level	Description
National	National level populations
Regional	States, counties, and cities

the latter on eight quality measures.<sup>35</sup> The authors found that accessing labs through the Internet portal was independently associated with higher scores on these quality measures. Interestingly, they found that having an EHR was not associated with higher quality measures, although the subsample had only 17 providers.

Frisse and others have conducted numerous studies in the tri-county area around Memphis, TN, to determine HIE's costs and benefits. Frisse and Holmes developed an economic model to determine HIE's impact on costs among eleven emergency departments (EDs) and referring ambulatory care practices, and reported that EDs would potentially save US\$6 million over 5 years from reduced duplicate labs and radiology orders, as well reductions in hospitalizations.<sup>36</sup> In a 2011 publication, Frisse et al reported that twelve emergency departments that used HIE for 6.8% of their admitted patients generated US\$1.9 million of savings as a result of a reduction in hospital admissions, imaging orders, and lab orders.<sup>37</sup>

Important financial as well as clinical costs and benefits have been demonstrated at local levels to multiple stakeholders. As stated earlier, payers often reap the greatest rewards from HIE while contributing relatively little to its development and support. However, Humana researchers in Wisconsin sought to demonstrate how HIE could reduce the costs associated with ED visits, and thereby make a business case for payers to invest in HIE.<sup>38</sup> The researchers determined that its members who had their HIE patient data accessed while in the ED cost on average US\$29 less than members who did not have their HIE data accessed. Innovative payer-based approaches such as paying providers to view HIE data could provide business cases for sustainability.<sup>38</sup>

Researchers at the Riegenstrief Institute (Indianapolis, IN) are well known for their studies investigating HIE's impact at the local level through the Indiana Network for Patient Care (INPC). Overhage et al conducted a randomized controlled trial to measure any impact on costs of HIE between two community hospital EDs. As in the previous study, the authors reported a reduction of US\$26.52 in costs per ED encounter in one of the two settings.<sup>39</sup> With regards to the second setting, a follow-up review found that HIE's poor integration into clinical workflow limited the potential financial and clinical benefits. These findings highlight the importance for HIE to be closely aligned within existing clinical workflow.

After working on HIE with community-based physicians, Overhage et al have questioned HIE's clinical and financial benefits depending on the environments in which patient data are used. For example, Overhage et al reported that the

apparent benefits of HIE in EDs and public health do not carry over well into ambulatory care. Their work with primary care providers revealed that some providers found HIE data of "marginal" value, and that making data available through HIE did not mean that providers could effectively translate those data into improved patient care.<sup>40</sup> Furthermore, the authors caution that the financial benefits as reported at the national level may not translate to the local level. For example, the CITL model estimates savings from fewer paper charts being moved between practices. However, Overhage et al note that in reality fewer providers exchange paper charts than may be estimated in the CITL model.

Overhage et al also conducted research across the entire Indianapolis population, and on the implementation of an automated electronic laboratory results reporting system. The authors reported significant benefits on population reporting with reduced effort. Using an automated reporting system, the authors identified over four times more reportable conditions than its paper-based process, and on average did so faster (instantly vs 7.9 days).<sup>41</sup> Although financial costs or benefits were not reported, the improvements were nonetheless impressive and the authors argued that expanded efforts could reduce morbidity and mortality due to select conditions such as sexually transmitted infections. Lastly, the authors were able to show that a technical reporting solution that relies on HIE may be scalable to a large urban area.

## Areas of current and future HIE research

As HIE develops, there will be many opportunities to demonstrate its value.<sup>42</sup> We propose addressing technical, organizational, and policy matters to evaluate the value of HIE as the field progresses.

One important area of inquiry will be seeking evidence-based solutions for providing secure and reliable means to access patient data. There currently exist a wide variety of privacy and security policies across states,<sup>43</sup> but many are considering procedures that have patients opt-in rather than opt-out of HIE.<sup>44</sup> However, this will likely restrict the availability of patient data through HIE, and so McDonald supports a two-tier approach that would legally give localities easier access to health data and national entities more difficult access to health data.<sup>45</sup> This would reduce barriers and encourage regional HIE participation while better ensuring that large-scale security breaches are minimized. Brown, though, echoes McGraw et al's<sup>46</sup> concern and argues that the Health Information Portability Accountability Act (HIPAA) is currently not robust enough to address the multiple consents that patients would require should an HIE want

to use clinical data for research purposes.<sup>47</sup> He also notes that “consent validation systems” are being developed that enable patient granular permissions whereby patients can determine who can see exactly what data, unlike a “macro” approach whereby opting in is an all or nothing proposition.<sup>48</sup> We encourage informatics research that further identifies technical solutions to existing security challenges, and evaluates the impact those solutions may have on patient and provider participation in HIE.

Research has begun to consider HIE within different organization types and clinical environments. Some of the work we refer to in this paper took place in EDs. Although EDs would intuitively seem to be the most appropriate environments to target medication errors and address information needs, other environments such as inpatient and ambulatory practices require additional study. Regardless of the clinical environments to be studied in the future, we believe that all will face challenges associated with adapting HIE to dynamic workflows, and further study will be required before anyone can demonstrate robust cost reductions or outcome improvements.

The aforementioned economic impact studies are important works that have and continue to inform the development of the HIT infrastructure across the United States. However, as we look to see how HIE may reduce costs, there may be assumptions built into economic models that may not be fully accounted for. As Overhage et al discussed, economic models may be factoring “shadow costs” such as mailing patient charts for every specialist referral,<sup>40</sup> when in reality there are few costs to begin with because most practices mail only a limited number of patient charts. Additional efforts must be made to align economic models with how medical care is carried out day-to-day in practices across the United States.

Finally, we expect that researchers will need to be open to new research questions as HIE undergoes technical, organizational, and economic changes resulting from new federal and state policies. We believe that potential areas for study include gauging the ways in which IT may rapidly adapt as new mandates are rolled out, such as requiring tiered patient consent or ensuring secure storage of patients’ legacy clinical data. Accordingly, HIEs as well as health care organizations will require agile means guided by evidence to rapidly adapt in ways that optimally respond to new policies. Any changes will have profound economic impacts that could promote or threaten their long-term financial sustainability.

## Conclusion

The United States is investing heavily in HIE to improve health care quality and cost effectiveness. As was shown

through our framing of available evidence, considerable effort and investments are made at national and regional levels. Each level reports some financial benefit relative to cost, yet when making these investments there must be evidence as to who benefits, to what degrees those benefits manifest themselves, and over what period of time. In addition, research may be improved through further syntheses of the levels so that macroeconomic models most appropriately account for micro considerations, and vice versa. Insights into these issues will greatly inform policies in the coming years.

Additional efforts also need to further reveal HIE’s clinical benefits relative to current standards of practice. As HIE becomes more robust we expect more studies to be published that empirically demonstrate improved physician performance on quality measures associated with the use of a patient portal. However, further research is required to understand the ways in which HIE is or is not effectively integrated into care practices.

We encourage future research that addresses HIE technical barriers that currently exist, such as security, improved end user data displays, and patient-centered HIE mechanisms. Furthermore, research must continue to help develop new business models that promote HIE utilization and improve organizational sustainability. Our growing understanding of HIE-related costs and benefits will provide an important means to determining financial and clinical value.

## Disclosure

The authors report no conflicts of interest in this work.

## References

1. Office of the National Coordinator for Health Information Technology, US Department of Health and Human Services. *Supplemental Funding Opportunity to the State Health Information Exchange Cooperative Agreement Program: Funding Opportunity Announcement*. Available at: [http://healthit.hhs.gov/portal/server.pt/gateway/PTARGS\\_0\\_11673\\_949197\\_0\\_0\\_18/State\\_HIE\\_Challenge\\_Funding\\_Opportunity\\_Announcement\\_12-12-2010\\_FINALw-508.pdf](http://healthit.hhs.gov/portal/server.pt/gateway/PTARGS_0_11673_949197_0_0_18/State_HIE_Challenge_Funding_Opportunity_Announcement_12-12-2010_FINALw-508.pdf). Accessed July 10, 2011.
2. Rudin R, Volk L, Simon S, Bates D. What affects clinicians’ usage of health information exchange? *Applied Clinical Informatics*. 2011;2(3): 250–262.
3. Balfour DC 3rd, Evans S, Januska J, et al. Health information technology – results from a roundtable discussion. *J Manag Care Pharm*. 2009;15(1 Suppl A):10–17.
4. Blumenthal D, Tavenner M. The “meaningful use” regulation for electronic health records. *N Engl J Med*. 2010;363(6):501–504.
5. Blumenthal D. Launching HITECH. *N Engl J Med*. 2010;362(5): 382–385.
6. Anderson G, Horvath J. The growing burden of chronic disease in America. *Public Health Rep*. 2004;119(3):263–270.
7. Kohn L, Corrigan JM, Donaldson MS, editors. *To Err is Human*. Washington, DC: National Academy Press; 2000.

8. Stewart BA, Fernandes S, Rodriguez-Huertas E, Landzberg M. A preliminary look at duplicate testing associated with lack of electronic health record interoperability for transferred patients. *J Am Med Inform Assoc.* 2010;17(3):341–344.
9. The Office of the National Coordinator for Health Information Technology, US Department of Health and Human Services. *Nationwide Health Information Network: Overview.* Available at: [http://healthit.hhs.gov/portal/server.pt/community/healthit\\_hhs\\_gov\\_nationwide\\_health\\_information\\_network/1142](http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov_nationwide_health_information_network/1142). Accessed August 18, 2011.
10. The Office of the National Coordinator for Health Information Technology, US Department of Health and Human Services. *Nationwide Health Information Network (NHIN): Trial Implementations.* Available at: [http://healthit.hhs.gov/portal/server.pt?open=512&objID=1191&parentname=CommunityPage&parentid=9&mode=2&in\\_hi\\_userid=10732&cached=true](http://healthit.hhs.gov/portal/server.pt?open=512&objID=1191&parentname=CommunityPage&parentid=9&mode=2&in_hi_userid=10732&cached=true). Accessed August 18, 2011.
11. Mosquera M. *HIEs expand to 255 to meet health system changes.* Available at: <http://govhealthit.com/news/hies-expand-255-meet-health-system-changes>. Accessed February 1, 2012.
12. Frohlich J, Karp S, Smith MD, Sujansky W. Retrospective: lessons learned from the Santa Barbara project and their implications for health information exchange. *Health Aff (Millwood).* 2007;26(5):w589–w591.
13. Adler-Milstein J, Landefeld J, Jha AK. Characteristics associated with regional health information organization viability. *J Am Med Inform Assoc.* 2010;17(1):61–65.
14. 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.
15. Frisse ME. Health information exchange in Memphis: impact on the physician-patient relationship. *J Law Med Ethics.* 2010;38(1):50–57.
16. Grossman JM, Kushner KL, November EA. Creating sustainable local health information exchanges: can barriers to stakeholder participation be overcome? *Res Briefs.* 2008;(2):1–12.
17. Nocella KC, Horowitz KJ, Young JJ. Against all odds: designing and implementing a grassroots, community-designed RHIO in a rural region. *J Health Inf Manag.* 2008;22(2):34–41.
18. Frisse ME, King JK, Rice WB, et al. A regional health information exchange: architecture and implementation. *AMIA Annu Symp Proc.* 2008:212–216.
19. Hessler BJ, Soper P, Bondy J, Hanes P, Davidson A. Assessing the relationship between health information exchanges and public health agencies. *J Public Health Manag Pract.* 2009;15(5):416–424.
20. NORC at the University of Chicago. *Health Information Exchange Economic Sustainability Panel: Final Report.* 2009:59. Available at: [http://healthit.hhs.gov/portal/server.pt/gateway/PTARGS\\_0\\_10731\\_865324\\_0\\_0\\_18/HIE%20Sustainability%20Paper%20-%20Final%20-22.pdf](http://healthit.hhs.gov/portal/server.pt/gateway/PTARGS_0_10731_865324_0_0_18/HIE%20Sustainability%20Paper%20-%20Final%20-22.pdf). Accessed July 13, 2011.
21. Department of Health and Human Services' Office of the National Coordinator for Health Information Technology. *The Direct Project Overview.* 2010. Available at: <http://wiki.directproject.org/file/view/DirectProjectOverview.pdf>.
22. The Office of the National Coordinator for Health Information Technology, US Department of Health and Human Services. *Health Information Exchange Challenge Grant Program.* Available at: <http://healthit.hhs.gov/portal/server.pt?open=512&mode=2&objID=3378>. Accessed October 18, 2011.
23. van der Linden H, Kalra D, Hasman A, Talmon J. Inter-organizational future proof EHR systems: A review of the security and privacy related issues. *Int J Med Inform.* 2009;78(3):141–160.
24. Goldstein MM, Rein AL. *Consumer Consent Options for Electronic Health Information Exchange: Policy Considerations and Analysis.* Washington, DC: Office of Policy and Planning Office of the National Coordinator for Health Information Technology; 2010. Available at: [http://healthit.hhs.gov/portal/server.pt/gateway/PTARGS\\_0\\_11673\\_911197\\_0\\_0\\_18/ChoiceModelFinal032610.pdf](http://healthit.hhs.gov/portal/server.pt/gateway/PTARGS_0_11673_911197_0_0_18/ChoiceModelFinal032610.pdf). Accessed February 23, 2012.
25. Hripscak G, Kaushal R, Johnson KB, et al. The United Hospital Fund meeting on evaluating health information exchange. *J Biomed Inform.* 2007;40(Suppl 6):S3–S10.
26. Blumenthal D, Glaser JP. Information technology comes to medicine. *N Engl J Med.* 2007;356(24):2527–2534.
27. 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;Suppl Web Exclusives:W5-10-W5-18.
28. Baker LC. Benefits of interoperability: a closer look at the estimates. *Health Affairs.* 2005. Available at: <http://content.healthaffairs.org/content/early/2005/01/19/hlthaff.w5.22.short>. Accessed February 23, 2012.
29. Basch P. Will Interoperable HIT Lead To A Net Gain Or To A Net Loss For Physicians? (2/23/2005). 2005. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=18281982&site=ehost-live>.
30. Hillestad R, Bigelow J, Bower A, et al. Can electronic medical record systems transform health care? Potential health benefits, savings, and costs. *Health Aff (Millwood).* 2005;24(5):1103–1117.
31. Kaushal R, Blumenthal D, Poon EG, et al. The costs of a national health information network. *Ann Intern Med.* 2005;143(3):165–173.
32. Blumenthal D. *The Age of Meaningful Use.* 2011. Available at: <http://healthit.hhs.gov/portal/server.pt?open=512&mode=2&objID=3541>. Accessed December 1, 2011.
33. Kaushal R, Landrigan C, Bates DW. Improving patient safety in Massachusetts. In: Moore RT, editor. *Massachusetts Memos to the Governor.* Bloomington, IN; 2003: 98–113.
34. Fontaine P, Ross SE, Zink T, Schilling LM. Systematic review of health information exchange in primary care practices. *J Am Board Fam Med.* 2010;23(5):655–670.
35. Kern LM, Barrón Y, Blair AJ, et al. Electronic result viewing and quality of care in small group practices. *J Gen Intern Med.* 2008;23(4):405–410.
36. Frisse ME, Holmes RL. Estimated financial savings associated with health information exchange and ambulatory care referral. *J Biomed Inform.* 2007;40(Suppl 6):S27–S32.
37. Frisse ME, Johnson KB, Nian H, et al. The financial impact of health information exchange on emergency department care. *J Am Med Inform Assoc.* 2011. Available at: <http://jamia.bmj.com/cgi/doi/10.1136/amiajnl-2011-000394>. Accessed December 2, 2011.
38. Tzeel A, Lawnicki V, Pemble KR. The business case for payer support of a community-based health information exchange: a Humana pilot evaluating its effectiveness in cost control for plan members seeking emergency department care. *Am Health Drug Benefits.* 2011;4(4):207–216.
39. Overhage JM, Dexter PR, Perkins SM, et al. A randomized, controlled trial of clinical information shared from another institution. *Ann Emerg Med.* 2002;39(1):14–23.
40. Overhage JM, Middleton B. *Value of Health Information Exchange in Ambulatory Care.* Indiana University School of Medicine and Regenstrief Institute; 2010. Grant final report R01 HS 015409. Available from: [http://healthit.hhs.gov/portal/server.pt/document/948763/15409overhagefinal102910comp\\_pdf](http://healthit.hhs.gov/portal/server.pt/document/948763/15409overhagefinal102910comp_pdf). Accessed April 3, 2012.
41. Overhage JM, Grannis S, McDonald CJ. A comparison of the completeness and timeliness of automated electronic laboratory reporting and spontaneous reporting of notifiable conditions. *Am J Public Health.* 2008;98(2):344–350.
42. Vest JR, Jaspersen J. What should we measure? Conceptualizing usage in health information exchange. *J Am Med Inform Assoc.* 2010;17(3):302–307.
43. Dimitropoulos L, Rizk S. A state-based approach to privacy and security for interoperable health information exchange. *Health Aff (Millwood).* 2009;28(2):428–434.
44. Tripathi M, Delano D, Lund B, Rudolph L. Engaging patients for health information exchange. *Health Aff (Millwood).* 2009;28(2):435–443.

45. McDonald C. Protecting patients in health information exchange: a defense of the HIPAA privacy rule. *Health Aff (Millwood)*. 2009;28(2): 447–449.
46. McGraw D, Dempsey JX, Harris L, Goldman J. Privacy as an enabler, not an impediment: building trust into health information exchange. *Health Aff (Millwood)*. 2009;28(2):416–427.
47. Brown B. HIEs are using and disclosing PHI in ways that may not have been anticipated by HIPAA. *Journal of Health Care Compliance*. 2010;12(2):43–72.
48. Brown B. Protecting the confidentiality of medical records in an interconnected environment. *Journal of Health Care Compliance*. 2010; 12(6):35–38.

### Journal of Healthcare Leadership

Dovepress

## Publish your work in this journal

The Journal of Healthcare Leadership is an international, peer-reviewed, open access journal focusing on leadership for the health profession. The journal is committed to the rapid publication of research focusing on but not limited to: Healthcare policy and law; Theoretical and practical aspects healthcare delivery; Interactions between healthcare and society and evidence-based practices;

Interdisciplinary decision-making; Philosophical and ethical issues; Hazard management; Research and opinion for health leadership; Leadership assessment. The manuscript management system is completely online and includes a very quick and fair peer-review system. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <http://www.dovepress.com/journal-of-healthcare-leadership-journal>