Development and Adoption
Of a
Health Information Network

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For Course:
Managing Networked Businesses
Harvard Business School
Executive Summary

A new frontier is being explored in the creation and delivery of healthcare information. The advent of a nationwide Health Information Network (HIN) infrastructure will bring electronic medical records and consumer portals, e-prescribing, real-time consumer/provider communication, and more efficient provider/payer communication – all facilitated over a ubiquitous, interoperable, and secure network. This new frontier will empower individuals to control and allocate their personal health information in a more personalized and involved way and will bring about massive changes in the way consumers, providers, and payers of healthcare products, services, and information interact.

With the health care industry representing 14% of the United States Gross Domestic Product, the benefits to a comprehensive “e-health connectivity system” far outweigh the costs. Utilization of Electronic Medical Records is estimated to save $112 Billion annually in ambulatory settings, including $34 Billion in office efficiencies and $78 billion from efficiencies derived from interoperability. Lastly, and most importantly, Electronic Medical Records would eliminate of up to 98,000 annual deaths from information-based errors.

Yet with all this need, the adoption of health information network (or network of networks) has been slow across the United States. There is a true “chicken and egg” challenge in this sector as there are powerful benefits on both sides of the network yet a critical mass needs to be reached in order to spur adoption. On the consumer side of the network (healthcare patients), the benefits to a higher level of control of their health care information and an enhanced level of planning based on their personal health trend and context makes the market for Personal Health Information Portals (PHIP) compelling, yet there are few examples of consumer friendly applications for
interacting with the network. On the provider side of the network (hospitals, clinics, and payers/insurance companies) the cost savings and increased efficiency derived from the network are substantial and must be exploited, yet technology complexity and lack of a network-wide business model has slowed adoption. The market research conducted for this paper focused on anecdotal evidence of new technologies for the consumer side of the network and a survey on the provider side – the point at which the largest barriers intersect. The research illuminated the four primary challenges to adopting Health Information Technologies (HIT) and the deployment of a comprehensive Health Information Network (HIN):

1. Lack of a network sponsor and platform provider – to develop a truly nationwide network, a primary sponsor has to gel the market. This sponsor has to devise a business model which clearly sets the role of a platform provider or multiple regional providers. And although the US Department of Health and Human Services has taken a lead role over the past year, the lack of common understanding and cooperation among network stakeholders currently slows the growth of industry wide and region wide planning and development.

2. Lack of network-wide standards – the healthcare provider community is resistant to investing in Health Information Technology because of fragmentation in the market and lack of a long term technology solution set. The providers that invest in technological infrastructure run a high risk of being stranded once standards are developed.

3. Lack of consumer focused technologies – the sector has not developed a compelling set of “tools” for the consumer to interface with the network. These tools could be a web based interface to their personal health information combined with monitoring and
diagnostic technologies that would enable an individual to control their personal health context.

4. Complexities of business model and cost/benefit allocation – in the current marketplace, the costs associated with adoption of new technologies are not aligned equitably among stakeholders. The benefits are distributed yet the costs are concentrated on the provider side.

These barriers mirror the issues paramount in most complex networked business models and initiatives, namely; conceptualizing, building, and managing a solution which results in equitable shifts of structures, processes, and economic costs and benefits. This paper does not focus on what technology to implement, but rather provides a strategic framework and cross-boundary business model to accelerate the development and adoption of a Health Information Network.

In the proposed model, growth of HIT solutions and HIN(s) will be driven by regional (state or local) public/private partnerships. This partnership will act as the local platform sponsor and provider. Through an attached state or local agency, the organization will raise capital through the issuance of revenue or general obligation bonds. This capital will then be allocated to the cooperative development of a public/private “limited open-source” HIT solution set. This technology will then be distributed to participating consumers, providers, payers, and affiliates in the organizational network. In return, the network “subscribers” will pay dues with pricing that is set by the partnership to meet Equivalent Annual Costs (cash flow required to cover capital investment), reinvest earnings in the HIN model, and retire debt. In the early years this model will be capital intensive but over time will become self sustaining from increasing returns to scale.
This business model accelerates the development, deployment, and adoption of a regional health information infrastructure. Over time, as regions and communities replicate this model, a national “network of networks” will emerge. There are three strategic development areas to the model:

1. Establishment of a cross-boundary governance structure and platform sponsor. To bring multiple stakeholders to the table in a collaborative, consistent, and long-term way, an inclusive governance structure must be built that will give a policy and management voice to providers, payers, government, and consumers.

2. Establishment of a Health Information Network Cooperative. To drive down technology development and maintenance costs, accelerate development of standards and interoperability, and spur adoption and growth, a HIT cooperative should be implemented to develop a “Limited Open-Source” technology solution set.

3. Establishment of a network wide business model and operating model. To bring down financial barriers and create an efficient and equitable distribution of costs and benefits, innovative financing and pricing is required.

**Health Information Technology Overview**

Health Information Technology has been evolving rapidly over the past decade. As technology blossomed in the 1990s and the Internet showed its ability to handle mass data flow, technology companies raced to develop software suites for streamlining healthcare data management. Early players in this market were mostly larger data warehousing companies but by the mid 1990s many small and mid-sized companies engaged the market by introducing medical office flow
product suites. Recently, companies have offered integrated packages that merge Electronic Medical Records with back-office accounting and data transfer. The immediate challenge in the market is the lack of industry standards and interoperability which has been driven in part by vendor’s proprietary product offerings.

Health Information Technology is generally defined as: “The application of information processing involving both computer hardware and software that deals with storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making.” There are four general components in the HIT solution set. First, an Electronic Medical Record (EMR) is established for a consumer which contains past records of treatment, medications, and physician directions. An EMR is generally maintained by the healthcare provider but is increasingly being maintained in dual direction with consumer access and content control. The second component is a physician order entry system (POES) which enables physicians to electronically order treatment and prescribe medication. The third general component is an integration application which connects remote data systems with a provider’s general network infrastructure. The fourth component is a community wide network for the transfer of information. Historically this data transfer has been accomplished through direct leased lines or Virtual Private Networks (VPN) but increasingly is being migrated to secure internet-based connections. Healthcare organizations spend an estimated $17 to $42 Billion per year on Health Information Technology depending on how you factor in maintenance, new systems, and upgrades. Growth estimates range from 5% to 17% per year.

The current climate is one of change and innovation. With consumers, providers, payers, corporations, and government realizing the potential benefits of a comprehensive HIT system, the sectors are now strategizing new ways to develop and govern a National Health Information
Network (NHIN). This network would represent the platform in which all the HIT components along with consumer interfaces would be enveloped.

During a speech in April of 2004, President Bush called for widespread adoption of interoperable electronic health information records (EHR) within the next ten years. To bring this commitment to fruition the Federal Department of Health and Human Services under the Office of the National Coordinator for Health Information Technology (ONCHIT) is charged with the production of a strategic health information technology (HIT) strategic plan. 

"Within ten years, every American must have a personal electronic health record."
President George W. Bush
April 26, 2004

Success in this endeavor will be found within a complex and challenging set of circumstances, institutions, politics, and organizational dynamics – each of which requiring thoughtful analysis and planning. The research, thought, and strategy laid out in this paper are meant to further the discussion on the future of the Health Information Technology and Network Infrastructure landscape.

Consumers Side Factors in Determining Business Model

This frontier is bringing the opportunity for a new form of personal health information management. This new environment will enable an individual to utilize miniaturized sensor networks and computing tools that proactively monitor the individuals “health context” and seamlessly load that information into a personal web based “health information portal.” The personal health information portal (PHIP) will act as a repository for critical information and will sync that information with health care providers, content providers, peers, and personal networks. This optimized personal health environment will enable an individual to control all facets of their
personal health spectrum – from diagnosing their performance during a training run, to
downloading a personally tailored training plan, to swapping nutrition plans with a peer of like
ability, to setting appointments with their doctor and managing their prescriptions, to monitoring
vital signs during a time of illness.

The PHIP would enable an individual to store, access, manage and modify their personal health
information on their own – enabled by advanced sensor and computing technology and in concert
with their medical and personal health providers. And while select healthcare providers have built
limited interfaces for their subscribers to connect with their care network to facilitate access and
decision making, there is a decided gap in the marketplace for a robust personal health
information portal (PHIP) service that enables an individual to proactively manage their entire
personal health spectrum.

**Market Drivers and Intersecting Trends**

Demographic trends provide a compelling environment for the
launch of a PHIP as well. On one end of the market is the “baby
boom” generation which is driving a new market for personal health
optimization and products and services that keep a person vital into
their mature years. On the other end of the market is a younger
demographic whose members are embracing information
technologies for compiling their personal information and sharing it
with select peers and social networks. Across this demographic
spectrum is the trend towards personalization of service, increased
control of personal information and transactional information (online

<table>
<thead>
<tr>
<th>Intersecting Trends</th>
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<tr>
<td>National health information networks</td>
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<tr>
<td>Government Regulation</td>
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<tr>
<td>Demographic Shifts &amp; New Preferences</td>
</tr>
<tr>
<td>Sensing Technologies &amp; Miniaturization</td>
</tr>
<tr>
<td>Ubiquitous Networking &amp; Diagnosis</td>
</tr>
<tr>
<td>Social Networking &amp; Customized Content</td>
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</table>
portfolios, online banking, social networking sites, personal blogs, etc), and sharing of personalized online lifestyle planning tools through opt-in and pass enabled networks.

On the technological side, advances are being made at an astounding rate in sensing technologies and the ubiquitous networks that can transfer information to electronic tools that can run analysis and generate optimizing feedback in real-time. On one end of the technological spectrum is “environmental sensing technology” that can be embedded in an “environment” such as a workout room, bedroom, or medical care setting in order to collect personal health metrics in real-time and seamlessly upload the data into portable computers or a central network. On the other end of the spectrum is wearable computing technology that people can carry at all times, wherever they go. This provides the opportunity to be able to constantly and intimately monitor all the relevant contextual information of an individual and well as provide instantaneous feedback and interaction. By harnessing key technologies along

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**Case in Point: MIT Media Lab and the “LiveNet” System**

LiveNet is a powerful mobile system capable of significant local sensing, real-time processing, distributed data streaming, and interaction. All while relying on off-body resources for wireless infrastructure, long-term data logging and storage, visualization and display, complex sensing, and computational-intensive processing.

This multi-functional mobile healthcare infrastructure is at the same time a personal health monitor, social network support enabler and communicator, context-aware agent, and multimodal feedback interface. Key attributes include:

- Wireless capability with data streaming
- Flexible and unobtrusive
- Capable of monitoring and storing long-term contextual information
- Real-time classification/analysis and feedback of data that can promote and enforce healthy behavior
- Trending analysis to characterize long-term behavior
- Enables new forms of social interaction and communication for community-based support by peers and establishing stronger social ties
this spectrum and integrating them into a PHIP infrastructure, a contextually driven and personalized service could be developed to optimize an individual’s or community’s proactive health management. A strong HIN would drive market demand for a PHIP service. This network exhibits strong network effects as the more participant there are on each side of the network the more valuable the network becomes. As health care providers deploy increasingly sophisticated networks they will want more connectivity and interaction with their customers in order to increase revenues, decrease transaction costs, and leverage overall network effects. Thus, market demand for a PHIN infrastructure and service line will be on both sides of the network – the consumer side and the provider side.

**Personal Health Information Portal and Value Chain**

![Diagram of Personal Health Information Portal and Value Chain](image-url)
Provider Side Factors in Determining Business Model

Market research was conducted on small, midsize, and large healthcare providers in the United States. The research was survey based with the goal of determining the key barriers to adoption of HIT and the key financial factors that influence decision making on HIN investments. (To view survey questions see appendix.) From these research findings this paper recommends model of collaboration and new organizational structures. Ultimately, models of collaboration and organization will be developed that will enable community wide decision making, methods of development will arise that will address adoption barriers, and forms of financing will be devised that will generate economic incentives and align costs equitably. Below is a synopsis of the market research:

General Demographic and Financial Information

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Avg. Small Provider</th>
<th>Avg. Medium Provider</th>
<th>Avg. Large Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate annual billings</td>
<td>&lt; $25M</td>
<td>$25M – $75M</td>
<td>&gt; $75M</td>
</tr>
<tr>
<td>Approximate number of payer connections per month</td>
<td>4</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Approximate annual cost of HIT data transfer</td>
<td>$27,000</td>
<td>$58,000</td>
<td>$237,000</td>
</tr>
<tr>
<td>Approximate savings if member of HIT network partnership (data transfer &amp; error reduction)</td>
<td>$34,500</td>
<td>$110,000</td>
<td>$473,000</td>
</tr>
<tr>
<td>Approximate amount willing to pay annually for membership in HIT network</td>
<td>$30,000</td>
<td>$59,000</td>
<td>$356,000</td>
</tr>
</tbody>
</table>
For the next set of questions providers assumed that the general definition of “health information network” is: A system which provides an electronic medical record (EMR), electronic prescription transfer, and electronic eligibility/billing. All components are integrated and connected via a secure network to all your trading partners (payers, other providers, public health officials). The providers were then asked the question: “If your practice has not implemented a comprehensive e-health solution (as defined above) how would you rate the influence of the following factors in your decision?” Results are averaged below:

### Factors that Influence the Adoption of Health Information Technology

<table>
<thead>
<tr>
<th>Factor</th>
<th>AFI* Small Provider</th>
<th>AFI Medium Provider</th>
<th>AFI Large Provider</th>
<th>AFI Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>No recognized standards (immaturity of technology)</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2.3</td>
</tr>
<tr>
<td>Lack of cooperation, common understanding, and goals among trading partners</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4.3</td>
</tr>
<tr>
<td>Complexity of/number of technological options</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2.6</td>
</tr>
<tr>
<td>Inadequate trading partner compatibility/interoperability</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2.6</td>
</tr>
<tr>
<td>Cost of deployment, training, and maintenance</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4.6</td>
</tr>
</tbody>
</table>

*Average Factor Influence (Scale of 1 – 5. With 1 being least influential and 5 being most influential.)
Key Findings

1. Providers find the cost of deployment, training, and maintenance as the primary barrier to adoption of Health Information Technology. The second most influential barrier is a lack of cooperation, common understanding, and goals among trading partners.

2. Providers would be willing to pay for a membership to a “HIT Network” that provided a full suite of solutions. From the average amount willing to pay we can infer that an acceptable price point would be midway between their current HIT network costs and the amount they would save as part of a collective membership.

Aligning the technologies on the consumer side and provider side of the network will enable a full solution to come to market. Over time, regional health information networks will evolve into a fully interoperable and ubiquitous national health information network exhibiting strong network effects.

Health Information Network Effects
Governance and Management Model

To address the market failure currently affecting the development and deployment of a HIN around the nation, this paper recommends a public/private governance and platform sponsorship structure that recognizes the interests and abilities of policy makers, providers, payers, and consumers. This structure is a composition of stakeholders that jointly articulate the vision, set the policy, raise capital, allocate resources, manage the procedural levers, and take responsibility for the health information network.

At this stage of design and adoption of a national HIN, a cross-boundary collaborative is the most effective and equitable way to address the complex and intertwined issues around conceptualizing, building, and managing a solution. This model would also build a sense of trust and commitment to goals in the community. The model looks at governance from a regional network point of view. This allows for situational, legal, financial, and cultural variations to be accounted for. This regional view will ultimately provide the foundation for a national “network of networks.”

Organizational Process and Business Model Flow

In the new model of governance and finance, growth of HIN solutions will be driven by regional (state or local) public/private partnerships.

1. The public/private partnership will be governed by a cross-boundary board composed of representatives from key stakeholder groups.

2. Through an attached state or local agency, the organization will raise capital through the issuance of revenue or general obligation bonds.
3. This capital will then be allocated to the cooperative development of a public/private “limited open-source” HIN solution set.

4. This technology will then be distributed to participating providers, payers, and affiliates in the organizational network.

5. In return, the network “subscribers” will pay annual dues to the Joint Powers Organization which will meet Equivalent Annual Costs (cash flow required to cover capital investment), reinvest earnings in the HIN and retire debt.

The Health Information Network Cooperative

An overarching barrier to the development and growth of health information networks is the cost structure of developing, deploying and managing the platform. The key drivers of this cost structure are proprietary technology lock-in and lack of common standards, lack of interoperability, and lack of a forecasted long term technology cycle. Providers are hesitant to purchase infrastructure that will be outdated or displaced before their internal payoff or rate of return cycle. In addition, many providers would like to be involved in the ongoing development of features and abilities of the solution set. The cost curves of HIT must be brought down to spur investment.

To address this large barrier the HIN community should bring together technologists from providers, payers, consumer organizations, and private partners to create a “Health Information Network Cooperative.” This sub-organization to the public/private partnership would develop
common standards and architecture and build code and applications for the e-health solution set. The code and applications would be classified as “limited open source” in that code sharing, enhancements, and maintenance would be limited to the cooperative community which is defined as the partners, network members, and private partners of the organization.

This cooperative limited open-source model generates substantial economic incentives and innovative network growth through direct cost savings, reduction of the economic loss associated with proprietary and non-interoperable commercial applications, access to source code for network growth and diffusion, large-scale interoperability, active engagement and buy-in within the cross-boundary e-health community, and partnership with private industry.

**Cost Savings**

The most obvious savings is in the elimination of expensive licensing fees charged to providers by proprietary technology vendors. In the case of an e-health “network of networks,” re-using and sharing the overall code multiplies this effect. These savings will accrue as the Health Information Network Cooperative adds partner networks and network users around the nation and realizes scale economies. The model also reduces the losses associated with the health community purchasing commercial off-the-shelf systems which are proprietary, not easily interoperable, and high in maintenance costs. These cost saving are passed on to the entire HIN which brings down total cost of development and ownership.

**Network Innovation, Interoperability, and Growth**

The cooperative open-source model accelerates innovation and network growth through faster, easier and less expensive diffusion of technology in the e-health network. As enhancements are developed they can be “pushed” to the network members in real time. The development allows for faster review and testing and interoperability is addressed and extended as the members of the
cooperative community generate common standards and protocols together. As the cooperative progresses through development sessions the core elements functionality is built as a “solution” rather than “software” and the solution becomes what the community wants. The speed to deployment of these types of solutions is often faster than proprietary models that have to be continuously retrofitted.

**Capital Investment and Finance Model**

The development of a regional, state, or national Capital Investment Plan (CIP) is critical for advancing the development of large scale Health Information Technologies and Networks. This paper takes the position that a national health information network should be viewed as a critical infrastructure and that the requisite financial tools should be utilized to build out this infrastructure.

As a component of the business model, this paper recommends that the HIN partnership develop a CIP that taps the capital markets for funding. Through an attached state or local agency, the organization will raise capital through the issuance of revenue or general obligation bonds. This capital will then be allocated to the cooperative development of the HIT solution set. This technology will then be distributed to participating providers, payers, and affiliates in the organizational network. In return, the network “subscribers” will pay annual dues to the Joint Powers Organization which will reinvest earnings in the HIT solution set and retire the debt.

**Network Pricing on Provider Side**

The business model outlined is based on a “network membership” model in which participating providers, payers, and affiliates pay an annual fee to the Joint Powers Organization in exchange for being part of the Limited Open-Source Cooperative and receiving the HIT network infrastructure as a complete package. The “network pricing” would be set by the regional JPO.
and would consider the factors of debt covenants, Equivalent Annual Costs (cash flow required to cover capital investment), total membership size, individual member size as it relates to fee structure, state or regional reimbursements, development and maintenance, and debt retirement.

**Network Pricing on the Consumer Side**

On the consumer side, revenues could be generated through subscription fees to the online portion of the PHIP. Additional revenues could be generated as the consumer adds modules to their PHIP via peripheral equipment like sensors and portable devices that synchronize with the PHIP. Finally, revenues could be derived from the network linkages built into the system – such as a Linked-In type community for runners or golfers.

The network effects inherent in the HIN would also enable revenue generation as providers want more consumers on the network – and thus may subsidize the consumer side by licensing a provider branded PHIP infrastructure for their consumers.

Content partners would also be a source of revenues as they would look to the PHIP network as a targeted advertising and sales medium. Integrated cross-selling relationships could be developed with consumer lifestyle companies such as sporting goods manufacturers, supplement and health food companies, pharmaceutical firms, etc.
Conclusion

This paper has provided a strategic framework and cross-boundary business model to accelerate the development and adoption of a Health Information Technology Network.

The paper recommended a public/private governance and management structure that would recognize the interests and abilities of all network users and stakeholders. The composition allows for building trust and equity in a long term vision by enabling collective articulation of vision, policy, financing and managing a health information network.

In this new model of governance and finance a regional or national public/private partnership would be created to sponsor the development of a HIN collaborative. Through an attached public entity, the organization would raise capital through the issuance of revenue or general obligation bonds. This capital would be allocated to the cooperative development of a HIT solution set, and the solution would then be distributed to participating providers, payers, and affiliates in the organizational network. In return, the network “subscribers” would pay dues with pricing that is set by the partnership/cooperative to meet Equivalent Annual Costs (cash flow required to cover capital investment), reinvest earnings in the HIN, and retire debt.

Based on findings from market research, it is believed that this new model would effectively alleviate barriers to HIT adoption by accelerating the development, deployment, and adoption of health information infrastructure. Over time, as regions and communities replicate this model, a national “network of networks” will emerge. This will ultimately result in a system of electronic medical records and consumer portals, e-prescribing, real-time consumer/provider.
communication, and more efficient provider/payer communication – all facilitated over a ubiquitous, interoperable, and secure network.

This new reality will empower individuals to control and allocate their personal health information in a more personalized and involved way and will bring about massive changes in the way consumers, providers, and payers of healthcare products, services, and information interact.
Appendix: Provider E-Health Survey

HIN Survey

This survey is intended to gather information for a student research report on electronic infrastructure in healthcare at Harvard’s John F. Kennedy School of Government. The research report will provide strategic ideas on the governance, finance, and development of health information networks. Information collected will be aggregated and averaged before presented and respondents will remain anonymous.

Instructions: Please respond to questions by entering your answers in grid, re-save and send document to Antonio_oftelie@ksg05.harvard.edu.

Thank you in advance for your participation.

General Questions and Information

1) How many physicians are in your practice/care group?

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<tr>
<th>Number</th>
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2) Approximate annual billings?

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<th>Amount</th>
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3) Approximate number of payers you connect with (bill) on a monthly basis?

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<th>Number</th>
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4) Approximate annual cost of transferring data/information with your trading partners (providers, payers, government agencies)?

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<thead>
<tr>
<th>Cost</th>
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For the next sets of questions assume that the general definition of “health information network” is: A system which provides an electronic medical record (EMR), electronic prescription transfer, and electronic eligibility/billing. All
components are integrated and connected via a secure network to all your trading partners (payers, other providers, public health officials).

5) If your practice has not implemented a comprehensive e-health solution (as defined above) how would you rate the influence of the following factors in your decision?

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<tr>
<td>Cost of deployment, training, and maintenance:</td>
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</table>

For the next set of questions, assume all the components of an e-health infrastructure and network (EMR, e-prescribing, eligibility/billing, hardware, software, secure connections and maintenance) were provided for your practice via a regional e-health partnership and the majority of your trading partners were connected to the network.

6) Would your practice participate in the regional e-health partnership? (Yes/No)

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<th>Yes/No</th>
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7) If your practice joined the e-health partnership/network, approximately how much would your practice save in annual data transaction costs (including reduction in errors)?

<table>
<thead>
<tr>
<th>Approx. Amount</th>
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8) If there were an annual membership fee for participation, how much would your practice be willing to pay?

<table>
<thead>
<tr>
<th>Approx. Amount</th>
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9) Open and Optional Response: Any other considerations/comments on e-health networks from your perspective?

Comment:

Thank you for participating in this survey!
Citations and General References

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iv Chin, T, Hospitals are Laying the Groundwork for EMR’s, American Medical News, 2004.