Health Information Exchange: An Early Model for Value and Sustainability

Sue S. Feldman, RN, MEd, PhD
University of Alabama at Birmingham
Department of Health Services Administration
1716 9th Avenue South #590K
Birmingham, AL, 35294, USA
suefeldman1009@gmail.com, 661 618 8805

Keywords: Health Information Exchange, Medical Informatics, Information Systems, Value Proposition, Health Informatics
Health Information Exchange: An Early Model for Value and Sustainability

Abstract

Background:

The primary value relative to health information exchange has been seen in terms of cost savings relative to laboratory and radiology testing, emergency department expenditures, and admissions. However, models are needed to statistically quantify value and sustainability and to better understand the dependent and mediating factors that contribute to value and sustainability.

Objective:

The purpose of this study was to provide a basis for early model development for health information exchange value and sustainability.

Methods:

Twenty-one interviews were conducted across 10 organizations, all eHealth Exchange participants. Using a grounded theory approach, and 3.0 as a relative frequency threshold, five main categories and 16 sub-categories emerged.
Results:

This study identifies three core current perceived value propositions and five potential perceived value propositions—what interviewees expect will happen as health information exchanges evolve and has more participants. These value propositions were used as the foundation for early model development for sustainability of health information exchange.

Conclusions:

Using the value factors from the interviews, the study provides the basis for early model development for health information exchange value and sustainability. This basis include factors from the research: fostering consumer engagement; establishing a provider directory; quantifying usage, cost, and clinical outcomes; ensuring data integrity through patient matching; and increasing awareness, usefulness, interoperability, and sustainability of eHealth Exchange.

Keywords: Health Information Exchange, Medical Informatics, Information Systems, Value Proposition, Health Informatics

Introduction

The last decade has been one of understanding the contribution of health data exchange to healthcare’s “Triple Aim”: improved care, lowered costs, and increased patient satisfaction. To that end, eHealth Exchange (formerly NwHIN), was established in 2009. However, onboarding was slow, and the US government soon realized that internal electronic exchange within an organization was not enough. Motivated by incentive funding provided by the Health
Information Technology for Economic and Clinical Health (HITECH) Act, many states or regions have health information exchanges (HIEs), and many electronic medical record (EMR) vendors are capable of health data exchange with disparate organizations. For the purposes of this paper, HIE refers to a single organization or group of organizations facilitating electronic health data exchange.

While eHealth Exchange will not singlehandedly solve every health data exchange scenario, it is an excellent environment and critical component toward the ability to exchange records with any provider, at any time, for any patient. Isolated use cases and studies have tried to quantify the economic value of health data exchange across an HIE in general [1, 2] and eHealth Exchange more specifically [3, 4]; however, none have reported the value in terms of clinical outcomes, but rather cost savings in terms of laboratory and radiology testing, emergency department expenditures, and admissions [2, 5]. Additionally, models that consider both current value and perceived value are needed to help statistically quantify value and sustainability. However, value is not a singular focus. To that end, a method and model of statistically quantifying value that considers multiple factors is important.

The Sequoia Project
The Sequoia Project, who partially funded this study, is a non-profit, membership corporation whose goal is to improve the health and welfare of all Americans by supporting and advancing health data exchange that is trusted, that is scalable, and that enhances quality of care and health outcomes by supporting comprehensive longitudinal health records. The Sequoia Project seeks to expand trusted, secure, and interoperable exchange of health information across the nation by fostering cross-industry collaboration and consensus agreement among public and private organizations who wish to function as interconnected
networks. Current eHealth Exchange participation includes more than 100 organizations, representing about 33% of all US hospitals, over 17,000 medical groups, more than 8,200 pharmacies, more than 1,000 dialysis centers, and over 100 million patients.

Theoretical Orientation: Group Forming Networks

While many organizations now participate in eHealth Exchange, there are few regional clusters/networks within which medical information could be queried and retrieved. Having regional clusters/networks would facilitate the transportation of vital information needed to provide a comprehensive clinical picture, exponentially increasing the value of eHealth Exchange to all organizations. The Healthcare Information and Management Systems Society (HIMSS) [6] suggests that more needs to be done to show the business value of health data exchange and suggests value in terms of creating a healthcare data economy whereby:

- people are willing to pay for and to sell data,
- stakeholders could control data and exchange with others, and
- the surrounding ecosystem includes measures of interoperability that are meaningful to patients and providers.

This value equation has been seen in other “network of networks” configurations, described as Group Forming Networks, or Reed’s Law. Reed describes three types of networks: a “one-to-many” network, in which a central entity shares information with a large number of members (e.g., through a Web portal); a “one-to-one” network, where single members are connected to other individuals to conduct a number of transactions (e.g., email); and a “flexible” communication network, which renders it possible to connect not only pairs of participants, but groups as well [7].

Under Reed’s Law, value grows such that the whole network (eHealth Exchange) is greater than the sum of the individual participants or clusters/networks (statewide or vendor
HIE networks) [8]. This environment exponentially increases the number of health data
exchange transactions that can occur and broadens the geographical reach of the individual and
collective networks, thereby providing more accurate, current, and comprehensive information
at the point of care. Furthermore, the expansion of accountable care models and retail medical
clinics (e.g., CVS’ Minute Clinic or Walgreens’ Healthcare Clinic) present additional opportunities
for eHealth Exchange use and impact on clinical outcomes. The use of such a network of
networks could aid widespread achievement of the Triple Aim, widespread use of health
information exchange in general, and eHealth Exchange in particular, and increase the value of
individual and collective factors. The purpose of this study is to explore the various factors
associated with real and perceived value to provide a basis for early model development for
health information exchange value and sustainability.

Methods

The study design incorporated twenty-one 1-hour semi-structured phone interviews and
document analyses to understand the perceived current and potential value proposition of
eHealth Exchange participation. Each interview was recorded and transcribed. Transcriptions
were imported into ATLAS.ti for data organization and analysis. The findings from the interviews
were used to form the basis of an early model for health information exchange value and
sustainability.

Interviewees were recruited by way of email invitation and were purposefully selected
based on their participation in eHealth Exchange. All interviewees signed a consent and their
identity is kept confidential. Table 1 shows the distribution of interviewees across sector.
Table 1. Interviewee description.

<table>
<thead>
<tr>
<th>Interviewees (N)</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Hospital System</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Statewide HIE</td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Regional HIE</td>
</tr>
<tr>
<td>2</td>
<td>Vendor</td>
</tr>
<tr>
<td>3</td>
<td>Federal</td>
</tr>
<tr>
<td>6</td>
<td>Government</td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

- The following is an example of selected interview questions:
  - What technical advances will need to happen for more organizations to join eHealth Exchange?
  - What technical issues need to be solved to impact sustainability?
  - What are the current reasons for maintaining your participation in eHealth Exchange?
  - What needs to happen for HIE to impact improved care delivery, reduce costs, etc.?
  - What public policies need to happen for HIE to be a standard of care?

Using a grounded theory approach [9], 16 conceptual categories and 73 sub-categories emerged, with relative frequency (RF) counts ranging from 0.20 to 6.77. RF is the proportion of responses in the particular category. RF was computed by dividing the frequency of a response by the number of interviewees. Using 3.0 as a cut-off, five main categories and 16 sub-categories are described in the findings.

**Results**

The findings of this qualitative study reveal that a majority of eHealth Exchange participants have onboarded since 2014, even though eHealth Exchange originated in 2009 (as
NwHIN). Overall, interviewees demonstrated much confusion regarding vendor HIEs, regional HIEs, statewide HIEs, and eHealth Exchange. At times in the interview process, the interviewee needed to be “recentered” that the interview was specific to eHealth Exchange. When interviewees were asked about the alignment of policy to health data exchange initiatives, many commented that public policy and legislation need to catch up to the willingness of providers to exchange information and of consumers to have their information exchanged.

Using RF≥3.0 as a top-tier cutoff for data reporting, Table 2 and below show five conceptual categories and 16 sub-categories. To readily show the issues of greatest importance, Table 2 is organized in descending order (RF=6.77 to RF=3.00. To correspond to the narrative detail in this section, is organized with the sub-category data grouped by category.

Table 2. Findings in descending order (RF≥3.0).

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Category</th>
<th>Relative Frequency in Descending Order (only those &gt;3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Proposition</td>
<td>Value in better care</td>
<td>6.77</td>
</tr>
<tr>
<td>Usage</td>
<td>Increase eHealth Exchange usage</td>
<td>6.75</td>
</tr>
<tr>
<td>eHealth Exchange Concerns/Challenges</td>
<td>Interoperability</td>
<td>6.17</td>
</tr>
<tr>
<td>Technical</td>
<td>Technical standards</td>
<td>6.13</td>
</tr>
<tr>
<td>Technical</td>
<td>Patient matching</td>
<td>5.80</td>
</tr>
<tr>
<td>Value Proposition</td>
<td>Value in avoiding duplication</td>
<td>4.93</td>
</tr>
<tr>
<td>eHealth Exchange Concerns</td>
<td>Level of implementation</td>
<td>4.60</td>
</tr>
<tr>
<td>Value Proposition</td>
<td>Value in lowering costs</td>
<td>4.47</td>
</tr>
<tr>
<td>Technical</td>
<td>Data usability</td>
<td>4.37</td>
</tr>
<tr>
<td>Usage</td>
<td>Who is using eHealth Exchange</td>
<td>4.30</td>
</tr>
<tr>
<td>Technical</td>
<td>Data integrity</td>
<td>3.87</td>
</tr>
<tr>
<td>Value Proposition</td>
<td>Intangible value</td>
<td>3.53</td>
</tr>
<tr>
<td>Usage</td>
<td>Actual eHealth Exchange usage time</td>
<td>3.30</td>
</tr>
<tr>
<td>eHealth Exchange Concerns</td>
<td>Increase statewide HIE to eHealth Exchange connectivity</td>
<td>3.17</td>
</tr>
</tbody>
</table>
### Table 3. Findings by category (RF≥3.0).

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Category</th>
<th>Relative Frequency in Descending Order (only those &gt;3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>eHealth Exchange Concerns/Challenges</td>
<td>Interoperability</td>
<td>6.17</td>
</tr>
<tr>
<td></td>
<td>Level of implementation</td>
<td>4.60</td>
</tr>
<tr>
<td></td>
<td>Increase statewide/regional HIE to eHealth Exchange connectivity</td>
<td>3.17</td>
</tr>
<tr>
<td>Governance</td>
<td>DURSA</td>
<td>3.10</td>
</tr>
<tr>
<td>Technical</td>
<td>Technical standards</td>
<td>6.13</td>
</tr>
<tr>
<td></td>
<td>Patient matching</td>
<td>5.80</td>
</tr>
<tr>
<td></td>
<td>Data usability</td>
<td>4.37</td>
</tr>
<tr>
<td></td>
<td>Data integrity</td>
<td>3.87</td>
</tr>
<tr>
<td>Usage</td>
<td>Increase eHealth Exchange usage</td>
<td>6.75</td>
</tr>
<tr>
<td></td>
<td>eHealth Exchange Participants</td>
<td>4.30</td>
</tr>
<tr>
<td></td>
<td>Actual eHealth Exchange usage time</td>
<td>3.30</td>
</tr>
<tr>
<td></td>
<td>Number of records exchanged using eHealth Exchange</td>
<td>3.00</td>
</tr>
<tr>
<td>Value Proposition</td>
<td>Value in better care</td>
<td>6.77</td>
</tr>
<tr>
<td></td>
<td>Value in avoiding duplication</td>
<td>4.93</td>
</tr>
<tr>
<td></td>
<td>Value in lowering costs</td>
<td>4.47</td>
</tr>
<tr>
<td></td>
<td>SSA Disability Determination</td>
<td>3.53</td>
</tr>
</tbody>
</table>

**eHealth Exchange Concerns/Challenges**

The primary concerns expressed by interviewees related to interoperability (RF=6.17), level of implementation (RF=4.60), and increasing statewide/regional HIE to eHealth Exchange connectivity (RF=3.17).
Interoperability

Despite attention from policymakers and industry professionals, interoperability—the seamless exchange of health data among organizations for total patient care—remains elusive. When interviewees discussed reconciling technology and usability, they pointed out that eHealth Exchange is not “plug and play” and lamented the lack of direct communication from vendors about their system requirements. One interviewee summed up what many expressed: “Make it [eHealth Exchange] as interoperable as banking.” Even still, interoperability will require constant consensus building, improvement, and course corrections to keep pace with innovations. It also is important to understand that even with complete interoperability, there could still be a lack of complete medical information, leading to a lack of trust in any of the information.

Level of Implementation

Upon analysis, it was evident that few organizations are fully implemented, which would mean that they are performing queries, receiving and consuming into the EMR usable information, and are connected to federal partners. In terms of meaningful use, interviewees referred primarily to using eHealth Exchange as a vehicle for care transition summaries. Others described exchanging with federal partners as the level of implementation. When questioned further about implementation, many interviewees discussed other HIE networks used to exchange clinical data (e.g., regional HIEs, vendor HIEs, specialized practice HIEs, etc.). Whether or not these HIEs were eHealth Exchange participants, it was apparent that a majority of the interviewees have implemented eHealth Exchange at the federal partner level for SSA disability determination and/or Veterans Health Administration (VHA).
Increasing Statewide/Regional HIE to eHealth Exchange Connectivity

Most interviewees thought that increasing statewide/regional HIE to eHealth Exchange connectivity would depend on a less cumbersome process to gain more traction. Regardless of processes that need streamlining (e.g., testing and sign-in), it was felt that statewide/regional HIEs should be the first level of connection to eHealth Exchange, then organizations and health systems should connect to their statewide/regional HIE. One interviewee stated, “I would say 90% to 100% of the time it [data from the statewide HIE] impacts the way that I deal with every single patient. There's something on there that either changes the care that I would deliver... and because I'm aware of [a] clinical context, I'm just going to deal with that patient a little bit differently.” Such comments support the value of building a network of networks.

Governance

Many interviewees thought that the Data Use and Reciprocal Support Agreement (DURSA) was comprehensive and saved them significant legal counsel expenses (RF=3.10) to ensure that best practices, legislative regulations, and common sense are employed. While most interviewees agreed that legal counsel is typically a large budget item, many felt that the DURSA, put in place by the Office of the National Coordinator for Health IT (ONC) and carried forward by The Sequoia Project, saved their organizations human and fiscal resources. Regional or statewide HIEs reported spending very few resources on DURSA review, which may be partially due to previous familiarity with the agreement. Overall, many interviewees said that there is a certain level of understanding and confidence that “we are all playing by the same rules.”
**Technical**

The technical issues most often expressed by interviewees were technical standards (RF=6.13), patient matching (RF=5.80), data usability (RF=4.37), and data integrity (RF=3.87). Importantly, no one mentioned the technology as a barrier, but rather selective technical areas that can be viewed as a natural consequence of the growth process.

**Technical Standards**

In terms of technical standards, comments centered around forward and backward compatibility between the 2010, 2011, and 2014 specifications. While some organizations, such as SSA, support multiple versions, this is not widespread. Furthermore, organizations do not upgrade to the latest technical specifications in lock-step, so there will always be the need for forward and backward compatibility. For content standards, interviewees discussed the need for more granularity and more consistent interpretation of the standards. Two interviewees commented on the diversity of options for documenting data from the continuity of care document (CCD), although they acknowledged tighter specifications have resulted in improvements. Finally, some interviewees felt that vendors contribute to the lack of clarity with regard to standards—technical and content—and The Sequoia Project could help by setting universal standards and ensuring consistency in the interpretation and application of the standards between organizations and vendors.

**Patient Matching**

Accurate patient matching is a critical component to seamless health data exchange across eHealth Exchange. One interviewee stated the alternative very simply: “The fallout from inaccurate patient matching is too risky.” Interviewees linked patient matching to interoperability and data integrity. While organizations have made strides with patient matching
for internal exchange within their organization, this refers specifically to patient matching for external exchange across organizations (i.e., eHealth Exchange). One interviewee suggested adoption of a nationwide patient matching strategy with standardized and vendor agnostic patient demographic elements. Of those suggesting solutions, many mentioned a central patient list with a record locator and a unique health identifier (not the social security number).

Data Usability
Trust can be critical to how usable data are used. For example, if a clinician suspects that data may not be accurate for the patient (perhaps due to inaccurate patient matching), the data will be discounted and not perceived as useful. Additionally, while the data may be accurate, there may be no need for those particular data. Importantly, interviewees with more HIE experience (regional or statewide) expressed that they feel the data they get are usable and helpful.

Data Integrity
As one interviewee noted, "A fundamental and critical success factor for HIE is the ability to accurately link multiple records for the same patient across the disparate systems of the participating organizations." Another interviewee added that this becomes an issue of patient safety when data are incorrectly merged, sometimes between the wrong patients. The absence of accurate patient matching was seen by many interviewees as the root problem behind data integrity.

Usage
A majority of interviewee comments about usage had to do with increasing eHealth Exchange usage and usability (RF=6.75), understanding who is using eHealth Exchange
Increasing eHealth Exchange Usage

Many interviewees felt that their organization’s prior experience with data exchange had resulted in increased usage of eHealth Exchange; however, that usage was primarily for SSA disability determination. Many felt that SSA usage was high for two reasons: 1) it did not require initiation from the user, and 2) there was concrete revenue tied to its use. Other than SSA disability determination, some interviewees noted that their organization did not have any set primary purpose for eHealth Exchange and thought that might be a contributing factor to low usage.

One interviewee said that in their organization, it is possible that users are not even sure if they are using Epic or eHealth Exchange to query for records, as the query goes first to Epic and then to the eHealth Exchange without signaling the transition. This scenario, for this organization, runs about 8:1 Epic to Epic vs. eHealth Exchange; another organization cited a 10:1 Epic to Epic vs. eHealth Exchange ratio. In other words, Epic records are returned 8 or 10 times more frequently, respectively, than eHealth Exchange records.

Some interviewees suggested that if insurance companies became eHealth Exchange participants, usage would increase. Some organizations created their own connectivity with HIEs that existed prior to eHealth Exchange (or even NwHIN) and have not transitioned over. Other interviewees mentioned usability: “Asking for the data is one thing; getting usable information is quite another.”
**eHealth Exchange Participants**

Interview data suggest that, outside of SSA and VHA, users are organization-to-organization rather than organization-to-HIE (statewide or regional). Many interviewees suggested that the lack of a provider directory contributes to low usage. One interviewee stated, “Just knowing who your eHealth Exchange neighbors are might increase the propensity to initiate an eHealth Exchange query.”

**Actual eHealth Exchange Usage Time**

The organizations interviewed had been eHealth Exchange (or NwHIN) participants ranging from one to seven years. However, the length of eHealth Exchange (or NwHIN) participation did not necessarily reflect the length of time that organizations were electronically exchanging health data. Those that have been using eHealth Exchange the longest (some starting as NwHIN participants) commented that a majority of their exchanges are with SSA.

**Number of Records Exchanged Using eHealth Exchange**

Many interviewees commented that the number of records exchanged using eHealth Exchange would rapidly increase if legislation made querying records a standard of care. However, these interviewees were quick to point out that doing so should not limit queries to only eHealth Exchange, but from any HIE, including vendor systems such as Epic. Another issue brought up by several interviewees was enforcing data contribution: if an organization is an eHealth Exchange participant, they need to contribute data. Depending on the organization and regulations for sensitive data, this may be more complicated than it sounds.

In terms of actual records exchanged across eHealth Exchange, Table 4 lists, in ascending order, the average records transacted each month, as reported by the interviewee.

Table 4. Monthly eHealth Exchange transactions.
<table>
<thead>
<tr>
<th>Type of Organization</th>
<th>Region</th>
<th>Average records per month(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthcare System</td>
<td>Southwest</td>
<td>10</td>
</tr>
<tr>
<td>Hospital</td>
<td>Southwest</td>
<td>667</td>
</tr>
<tr>
<td>State HIE</td>
<td>Midwest</td>
<td>1400</td>
</tr>
<tr>
<td>Veterans Health Administration</td>
<td>Federal</td>
<td>2000</td>
</tr>
<tr>
<td>Regional HIE</td>
<td>South</td>
<td>4000</td>
</tr>
<tr>
<td>Social Security Administration</td>
<td>Federal</td>
<td>25,657(^b)</td>
</tr>
</tbody>
</table>

\(^a\) These are estimates given by interviewees and represent both inbound and outbound transactions.
\(^b\) Author’s analysis from SSA provided data

Value Proposition

While responses varied, it was apparent that all interviewees perceived value in being an eHealth Exchange participant. However, when queried for concrete value statements, interviewees mostly pointed to revenue generated from SSA participation. Most interviewees expressed that the primary perceived value was located in better care (RF=6.77), but others cited avoiding duplication of services (RF=4.93). Again, although mostly anecdotal evidence, many mentioned lower costs of care as one of the value propositions (RF=4.47). SSA disability determination (RF=3.53) was the only factor mentioned with concrete actual value (vs. perceived value). It is critical to note that many interviewees who have been conducting electronic exchange of records through regional HIEs anecdotally report better care, duplication avoidance, etc. These interviewees draw from these known experiences and perceive that this same value can and will happen at a national level with eHealth Exchange.

Value in Better Care

Several interviewees commented that although they think use of eHealth Exchange will result in better care, “its use must become the standard of care.” A network diagram constructed from interview data shows linkages to developing eHealth Exchange use as a standard of care. As shown in Figure 1, interviewees identified eight core contributors to making eHealth Exchange a standard of care:
• increased usage,
• increased marketing,
• solidified sustainability,
• ability to get accurate, current, and needed data,
• provider directory,
• increased statewide HIE connectivity,
• organizational leadership commitments, and
• consistent and clear standards.

**Figure 1. Ehealth exchange as a standard of care.**

**Value in Avoiding Duplication of Services**
Several interviewees commented that in order to avoid duplication of services, eHealth Exchange must get the patient matching right. One interviewee suggested that avoiding duplication of services could actually be motivated through a bottom up approach with “the patient say[ing] that they just had that test, can you please check eHealth Exchange?”

**Value in Lowering Costs**
Interviewees discussed the perceived value of eHealth Exchange in lowering overall costs of healthcare. Many factors can impact overall healthcare costs, and “while eHealth Exchange can play a strong role in lowering healthcare costs, we may not be able to attach causality to eHealth Exchange for a while,” one interviewee commented.


SSA Disability Determination

Many interviewees commented that even though they are not seeing actual quantifiable value in terms of clinical outcomes, “Being an eHealth Exchange participant is the right thing to do for medicine.” One interviewee commented: “Revenue is not directly tied to why we’re part of the eHealth Exchange. We view participation with the eHealth Exchange as it’s just a part of who we are, and what we want to do, and how we promote interoperability in the country. I have to say I have never been in a meeting where we’d say, 'Look, we’re making this amount of money from the SSA.'”

SSA disability determination was the only quantifiable value proposition mentioned by interviewees, and for many, the primary motivation for their organization’s eHealth Exchange participation. One interviewee summed up the comments of many: “Credit to SSA for figuring out that [eHealth Exchange] was possible and then figuring out how to do it so it is of value.”

Uncompensated care cost recovery is directly linked to SSA disability determination; if an SSA beneficiary gets approved for Social Security Disability Insurance (SSDI), they are more likely to pay the hospital bill and seek medical care before using expensive emergency care [4]. Most interviewees estimated the cost for eHealth Exchange onboarding $100,000 to $400,000 and very dependent of the existence of previous HIE participation. However, once onboarded, SSA participants estimated that the revenue generated from SSA queries largely off-sets eHealth Exchange participation costs.

Current and Perceived Value Propositions

The interview data revealed linkages to current and future perceived value propositions as shown in (Figure 2) and (Figure 3), respectively. As shown in Figure 2, interviewees identified three core current perceived value propositions:
• SSA disability determination (revenue and uncompensated care cost recovery) – this is the only value proposition to have been quantified,
• ease with which records are retrieved, and
• reduction of administrative burden for staff needing to request records.

In terms of the potential perceived value proposition—what interviewees expect will happen as eHealth Exchange evolves and has more participants—Figure 3 shows five core items:

• statewide HIE connectivity,
• avoiding test duplication,
• better care,
• ability to get accurate, current, and needed data, and
• decreased costs.

**Health Information Exchange Model Development**

The aforementioned factors that contribute to the current and potential perceived value propositions provide the basis for model development for health information exchange value and sustainability (Figure 4). The next step is statistical testing of this model to understand the contribution of each proposition in terms of dependent and mediating factors relative to value and sustainability.
Discussion

eHealth Exchange participants are not waiting for a perfect network, but rather are willing to participate for what they can achieve now and readily avail themselves to network advantages with incremental eHealth Exchange advances and maturity. This differs from those who are withholding eHealth Exchange onboarding until a tipping point of value propositions has been achieved. It is likely that those who are current participants will see much earlier and much greater return on their investment, and more importantly, will be able to quantify elements of the Triple Aim. In ways that may not yet be apparent, such positioning could offer a strategic advantage to providing healthcare to patients from anywhere in the US.

Limitations
This study is limited in that only current eHealth Exchange participants were interviewed.

Group Forming Networks
eHealth Exchange has demonstrated usefulness in facilitating the development of group forming networks, as it enables healthcare providers to connect not only to each other, but also to federal entities that have a vested interest in improving care quality (e.g., VHA).

**Value Proposition and Sustainability**

Additionally, there are several opportunities to enhance the value proposition, and thus the sustainability, of eHealth Exchange. The first is to improve consumer engagement by educating patients on the value of health data exchange through an HIE. Doing so will create a culture of patients who expect and demand health data sharing as a standard of care. Additionally, compiling a national provider directory or a similar mechanism for eHealth Exchange participants will enable care providers to readily identify with whom they can exchange information.

In a similar vein, interviewees expressed that increasing awareness and usefulness of eHealth Exchange would prove beneficial. While there is much anecdotal discussion around what participants feel is working, very little of it has been formalized with studies. Additionally, interviewees commented on the need for increased marketing endeavors. Exchangeability for current eHealth Exchange participants can be increased by focusing on onboarding statewide HIEs and organizations in states neighboring current participants.

Another method to increase the value of eHealth Exchange is to quantify usage cost and clinical outcomes through studies on well-established use cases for eHealth Exchange. Other benefits worth considering include decreased duplication for laboratory or radiology services and reduced admission rates from emergency department visits.

Ensuring data integrity and patient matching is a priority, with standardized processes to ensure overall data integrity, and thus confidence in the information presented at the point of
care. It is recommended that The Sequoia Project combine the findings from this study with public comments received from the recently released report entitled “A Framework for Cross-Organizational Patient Identity Management” (http://sequoiaproject.org/).

The need to advance interoperability was mentioned by nearly every interviewee. It is recommended to utilize policy and funding levers to create a business imperative and clinical demand for interoperability. This may require greater involvement of the federal government to align economic incentives, including but not limited to a stronger commitment from Centers for Medicare and Medicaid Services (CMS). A CMS commitment could take a multitude of forms but should start with something manageable, actionable, and measurable, such as requiring all emergency department visits with an ambulatory sensitive condition diagnosis to have an external HIE query.

**Model Development**
While the above enhancement opportunities provide guidance to eHealth Exchange, parallel discovery is needed in understanding the strength of the constructs that contribute to the model suggested in Figure 4. This study combines current and potential perceived value propositions to provide the basis for early model development for health information exchange value and sustainability. This model then needs to be statistically tested to determine the strength of each of the constructs and to what degree they are mediating or contributing factors.

**Acknowledgements**
This study was funded, in part, by The Sequoia Project.

**Conflicts of Interest**
None
References