

Characteristics associated with Regional Health Information Organization viability

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ABSTRACT

Objective Regional Health Information Organizations (RHIOs) will likely play a key role in our nation's effort to catalyze health information exchange. Yet we know little about why some efforts succeed while others fail. We sought to identify factors associated with RHIO viability.

Design Using data from a national survey of RHIOs that we conducted in mid-2008, we examined factors associated with becoming operational and factors associated with financial viability. We used multivariate logistic regression models to identify unique predictors.

Measurements We classified RHIOs actively facilitating data exchange as operational and measured financial viability as the percent of operating costs covered by revenue from participants in data exchange (0–24%, 25–74%, 75–100%). Predictors included breadth of participants, breadth of data exchanged, whether the RHIO focused on a specific population, whether RHIO participants had a history of collaborating, and sources of revenue during the planning phase.

Results Exchanging a narrow set of data and involving a broad group of stakeholders were independently associated with a higher likelihood of being operational. Involving hospitals and ambulatory physicians, and securing early funding from participants were associated with a higher likelihood of financial viability, while early grant funding seemed to diminish the likelihood.

Conclusion Finding ways to help RHIOs become operational and self-sustaining will bolster the current approach to nationwide health information exchange. Our work suggests that convening a broad coalition of stakeholders to focus on a narrow set of data is an important step in helping RHIOs become operational. Convincing stakeholders to financially commit early in the process may help RHIOs become self-sustaining.

Fragmentation within the US healthcare delivery system leaves patients' medical histories trapped in the paper charts or electronic systems of multiple organizations. Health information exchange (HIE) that allows patients' clinical data to electronically follow them between care delivery settings has the potential to improve the quality and reduce the cost of care.^{1 2} Most policymakers have focused on Regional Health Information Organizations (RHIOs) as the primary model to drive HIE. These efforts typically bring together unaffiliated local stakeholders with clinical data (eg, physician practices, labs, hospitals) and set up the infrastructure for HIE. Substantial sums of private and public funding have been directed toward RHIOs and the recently signed American Recovery and Reinvestment Act of 2009 allocates an additional US\$300 million to further support HIE efforts.³

Early empirical evidence suggests that efforts to support RHIOs have had mixed results.^{4 5} While the number of operational RHIOs has grown, RHIOs continue to experience a high failure rate and those that are operational do not exchange comprehensive patient data.⁵ Efforts and policies to expand HIE through RHIOs have been hampered by a lack of empirical data on why some RHIOs succeed while others fail. Prior studies have found that operational RHIOs may have an easier time finding a sustainable business model compared to RHIOs still in the planning phase⁶ and early-stage RHIOs are more likely to be grant-dependent.⁷ However, we are unaware of any systematic effort to identify features of RHIOs that might improve the prospect of success. Identifying these features would guide RHIO leaders in how to structure their efforts and policymakers as they design policies to spur HIE. We completed our second national survey of all RHIOs in the US in mid-2008. We used data from this survey to answer two questions: which characteristics of RHIOs are associated with becoming operational? Which characteristics are associated with becoming financially viable?

METHODS

Data

We conducted a survey of all known RHIOs in the US in mid-2008. The details of our survey development, administration, and response rate have been described elsewhere.⁸ Briefly, we defined RHIOs as entities providing a technical infrastructure to support clinical data exchange between independent entities in a geographic region. This definition excluded efforts focused solely on administrative data exchange as well as those working on issues related to HIE but not directly enabling exchange to take place. We identified potential RHIOs using the comprehensive list compiled by the eHealth Initiative⁹ and supplemented it with efforts identified by health information technology (HIT) experts. We administered a web-based survey that asked the director of the RHIO to report their organization's demographics, level of progress in facilitating HIE at two points (January 1, 2007 and June 1, 2008), types of data exchanged and functionalities supported, funding sources and financial viability, and barriers to development.

Outcomes measures

We examined two main outcome measures: (1) whether the RHIO was operational (ie, actively facilitating clinical data exchange between independent entities); and (2) the percent of operating costs covered by revenue from participants in data

exchange. The first outcome measure grouped RHIOs according to whether or not they reported facilitating exchange of clinical data between independent entities as of June 1, 2008. Three types of organizations were classified as not operational: those that were planning for clinical data exchange but had not yet started exchanging data; those that had planned for clinical data exchange in the past but had stopped pursuing it; and those that had facilitated clinical data exchange in the past but no longer did so as of June 1, 2008.

The second outcome measure focused on financial viability. We asked RHIOs to report the percent of operating costs and the percent of capital costs covered by participants in data exchange (ie, those sending or receiving data for operational RHIOs) or expected participants (ie, those that are/were expected to send or receive data for planning and defunct RHIOs). Funding from grants or government contracts is unlikely to create long-term financial sustainability. Therefore, our question focused on proportion of revenue that came from participants directly engaged in data exchange. Given the large, upfront capital costs typical of technology implementations or expansions, we opted for a lenient measure of financial viability by focusing solely on operating costs. We then grouped RHIOs into three buckets: those covering 0–24% of operating costs with revenue from participating entities, those covering 25–74% and those covering 75%–100%.

Predictors of success

We chose a series of organizational characteristics that we expected a priori to be associated with a RHIO being operational or financially viable. These included the number and types of entities participating (or committed to participating) in clinical data exchange through the RHIO, the number of types of data being exchanged, whether the RHIO was focused on exchanging data for a specific population (eg, just Medicaid patients), whether the participants had a history of collaborating prior to their RHIO effort, and the sources of revenue during the planning phase.

We expected that more types of stakeholders participating in clinical data exchange may add complexity to the planning process from a technical perspective (different systems, different data) as well as from a governance perspective (different set of concerns). In contrast, having more types of participants increases the number of customer types served by the RHIO and paying for data exchange, which could increase the likelihood of becoming operational and financially viable. To measure the number of unique types of entities participating (or committed to participating) in the data exchange, we summed the unique types of entities that RHIOs reported as receiving or providing data. To ensure comparability with operational RHIOs, defunct RHIOs or those in the planning stage were asked to differentiate between committed and expected participants, and we focused solely on the ‘committed’ participant types.

We also examined whether the participation of specific types of entities was particularly important. We focused on ambulatory physicians and hospitals as receivers of clinical data, primarily because a large portion of the hypothesized value of HIE is driven by the use of exchanged clinical data at the point-of-care.² We focused on labs and imaging centers as data providers because the most tangible savings from HIE may be realized from electronic delivery of test results to providers.^{2–10} Finally, we asked respondents whether participants had collaborated on another effort prior to the RHIO, hypothesizing that a history of collaboration may increase the odds of successfully navigating the challenges associated with HIE.

To assess whether breadth of RHIO activity was associated with becoming operational or financially viable, we examined both the breadth of data types exchanged and patients populations included. We hypothesized that RHIOs exchanging a narrow set of data or focusing data exchange on a particular population would have fewer barriers to becoming operational, but may also be limited in the number of participants providing support. We summed the number of types of data exchanged or planned for exchange, and created a dichotomous variable to capture whether the RHIO focused data exchange on a specific population.

Finally, we were interested in determining whether the type of early funding received was associated with either the likelihood of becoming operational or financially viable. Receiving support from participants before data exchange is operational is likely a signal that participants are committed to HIE and believe they will benefit from it. Alternatively, receiving significant grant funding in the planning stage may be a catalyst that allows RHIOs to move forward toward clinical data exchange without having to go through the difficult process of getting full support of participants. In turn, the RHIO may build functionalities that participants do not want to support on an ongoing basis. Thus, we focused on two measures of revenue source during the planning phase: grants, contracts, or appropriations from public or private sources (referred to as ‘grants’ in the remainder of the paper); and fees from data exchange participants. We asked operational RHIOs to report which types of funding were either a substantial or moderate source of support while planning for data exchange. Planning and defunct RHIOs were asked the same question about their current (for planning RHIOs) or prior (for defunct RHIOs) forms of support.

Analysis

We first examined the bivariate relationships between our outcome measures and hypothesized predictors of success. We subsequently ran a multivariable logistic regression model with robust standard errors to investigate the independent associations between each characteristic and the odds of a RHIO becoming operational. We used an ordered logistic regression model with robust standard errors to investigate the characteristics associated with being in a higher category of financial viability. For the ordered logistic model, we performed a Brant test to ensure that the parallel regression assumption was not violated. To increase generalizability, we limited the dataset to RHIOs that were focused on exchanging data for at least 5000 potential patients. This was consistent with previous work and the cut-off was based on the notion that a typical primary care physician may care for 1500–2500 patients; therefore our cut-off excludes only the smallest RHIOs that were unlikely to serve as national models.

Sensitivity analyses

We were concerned that RHIOs that plan for a longer period have the opportunity to attract more types of participants, add types of data to be exchanged, and gain more sources of support. However, a RHIO may lose momentum over the course of the planning process and participants may decrease their level of support if they feel progress is slow. Thus, we re-ran the multivariable models with a measure of length of time planning for clinical data exchange and present results in an appendix (see online Appendix). This variable was defined as elapsed months from when the RHIO began pursuing clinical data exchange to the time it became operational, defunct, or, for RHIOs still in

the planning phase, the number of months it had been planning until June 1, 2008.

RESULTS

We received responses from 83% of the 207 organizations that we identified as involved in HIE and we determined that 131 of the 172 responding organizations met our definition of a RHIO. When we limited the sample to those exchanging data or planning to exchange data for more than our minimum threshold of 5000 potential patients, we were left with 81 efforts. We report results for this subset of organizations in the remainder of the paper. Forty-three were operational (actively exchanging clinical data as of June 1, 2008), 27 were planning for clinical data exchange and the remaining 11 had pursued clinical data exchange in the past but were no longer pursuing it as of June 1, 2008 (table 1).

RHIOs were fairly evenly spread across the country and usually had city/county-level coverage (69%) compared to a statewide focus (30%). RHIOs most often exchanged (or planned to exchange) test results (in 88% of RHIOs), followed by inpatient data, medication history, and outpatient data

(table 1). Ambulatory physicians, hospitals, labs, and imaging centers were the most frequent participants in data exchange. A minority of RHIOs focused data exchange on a particular type of patient population, with Medicaid being the most common (22% of RHIOs). Sources of moderate or substantial support for RHIOs while planning for data exchange came from time/in-kind resources (eg, volunteer personnel, donated equipment) in 80% of RHIOs, followed by grants in 60% of RHIOs.

In our bivariate analyses, we found four characteristics that differentiated operational and non-operational RHIOs. Operational RHIOs had 4.8 types of participants on average compared with 3.6 for non-operational RHIOs ($p=0.025$, table 2). Operational RHIOs exchanged 3.0 types of data on average while non-operational RHIOs expected to exchange 3.8 types ($p=0.008$). Twenty-eight percent of operational RHIOs exchanged data for a specific population compared to 50% of non-operational RHIOs ($p=0.041$). Finally, operational RHIOs planned for data exchange for an average of 16 months compared to 36 months for non-operational RHIOs ($p<0.001$). We found no other statistically significant differences between the two groups (table 2).

In the multivariate analysis, two characteristics were associated with higher likelihood of being operational: having more types of participants (OR: 1.90, 95% CI: 1.33 to 2.71, $p<0.001$) and fewer types of data exchanged (or planned for exchange) (OR: 0.29, CI: 0.14 to 0.58, $p=0.001$) (table 3). Having ambulatory physicians as data receivers was associated with higher odds of being operational (OR: 4.65, $p=0.09$) while having a population focus was somewhat associated with lower odds of being operational (OR: 0.29, $p=0.11$), although neither of these associations was statistically significant.

We found five characteristics that were associated with a higher degree of financial viability in bivariate analyses (table 4). RHIOs in the 0–24% category exchanged an average of 2.7 types of data, those in the 25–74% category exchanged an average of 2.9 types, and those in the 75–100% exchanged an average of 3.8 types ($p=0.009$). Similarly, RHIOs in the lowest category of financial viability had an average of 3.1 types of participants, those in the middle category had an average of 4.5 and those in the highest had an average of 4.7, although this difference did not quite achieve statistical significance ($p=0.06$). Other factors associated with financial viability in a statistically significant

Table 1 Overview of RHIO* characteristics (N = 81)

Status	Number of RHIOs
Operational	43
Planning	27
Defunct	11
Location	Percent of RHIOs
Northeast	23
South	27
Midwest	23
West	25
Not specified	1
Region covered	
State	30
County or city	69
Not specified	1
Types of data (planned for or exchanged)	
Test results	88
Inpatient data	75
Medication history	73
Outpatient data	73
Public health reports	27
Types of participants in data exchange (committed to participate or participating)	
Ambulatory physician	83
Hospital	83
Lab	59
Imaging center	47
Public health department	41
Pharmacy	40
Payer	36
Pharmacy benefit manager	17
Population focus	
Medicaid	22
Chronic disease	17
Emergency department users	15
High-cost	10
Funding source while planning (moderate or substantial)	
Time or in-kind resources	80
Grant, contract or appropriation	60
One-time financial contribution	47
Recurring fee	33

*RHIOs that were exchanging (or planning to exchange) data for at least 5000 patients. RHIO, Regional Health Information Organization.

Table 2 Characteristics of RHIOs by operational status*

	Operational (N = 43) Mean (SD)	Non-operational (N = 38) Mean (SD)	p Value
Unique types of participants (committed to participate or participating)	4.8 (2.2)	3.6 (2.4)	0.03
Types of data (planned for or exchanged)	3.0 (1.3)	3.8 (1.4)	0.008
	Percent	Percent	p Value
Funding source while planning (moderate or substantial)			
Grants	54%	68%	0.17
One-time or recurring fee from participants	56%	61%	0.68
Participant types			
Ambulatory physicians as receiver	81%	71%	0.27
Hospital as receiver	74%	74%	0.94
Lab or radiology as provider	72%	74%	0.87
Past collaboration between participants	62%	60%	0.82
Population focus	28%	50%	0.04
Time planning for clinical data exchange (median months)	16	36	<0.001

*Operational is defined as actively exchanging clinical data between independent entities. RHIO, Regional Health Information Organization.

Table 3 Factors associated with being operational

	OR	95% CI	p Value
Unique types of participants (committed to participate or participating)	1.90	1.33, 2.71	<0.001
Types of data (planned for or exchanged)	0.29	0.14, 0.58	0.001
Population focus	0.29	0.06, 1.34	0.11
Grants	0.52	0.13, 1.97	0.33
One-time or recurring fee from participants	0.80	0.22, 2.87	0.73
Ambulatory physicians as receiver	4.65	0.79, 27.53	0.09
Hospital as receiver	0.80	0.11, 5.86	0.83
Lab or radiology as provider	0.52	0.07, 3.71	0.52
Past collaboration between participants	2.64	0.68, 10.17	0.16

manner included having ambulatory physicians as data receivers (p=0.002), having hospitals as data receivers (p=0.002) and receiving funding from participants during the planning phase (p=0.008).

In the multivariate analysis, we found three independent predictors of greater financial viability (ie, the likelihood of being in a higher category of percent of operating costs covered by participants). These included having ambulatory physicians as receivers of data (the OR of being in a higher category was 4.98, p=0.02), having hospitals as a data receiver (OR: 4.68, p=0.037, and receiving a one-time or recurring payment from participants while planning (OR: 3.43, p=0.045) (table 5). In contrast, receiving a grant as a moderate or substantial form of support while planning was associated with lower odds of being in a higher category, but this association did not quite reach statistical significance (OR: 0.35, p=0.067).

When we included time planning for clinical data exchange in the multivariate models, there was no association with financial viability (OR: 1.01, p=0.74) and the effect estimates on the other variables in this model did not change meaningfully (see online Appendix). In the operational model, we found that RHIOs

Table 4 Characteristics of RHIOs by financial viability (N = 70)*

	0–24% (N = 18) Mean (SD)	25–74% (N = 20) Mean (SD)	75–100% (N = 32) Mean (SD)	p Value†
Unique types of participants (committed to participate or participating)	3.11 (2.56)	4.50 (2.04)	4.69 (2.28)	0.061
Types of data (planned for or exchanged)	2.67 (1.72)	2.85 (1.27)	3.78 (1.13)	0.0086
	Percent	Percent	Percent	p Value‡
Funding source while planning (moderate or substantial)				
Grants	56%	75%	56%	0.34
One-time or recurring fee from participants	28%	65%	72%	0.008
Participant types				
Ambulatory physicians as receiver	50%	75%	94%	0.002
Hospital as receiver	50%	70%	94%	0.002
Lab or radiology as provider	56%	80%	78%	0.16
Population focus	39%	40%	28%	0.61
Past collaboration between participants	50%	55%	69%	0.37
Time planning for clinical data exchange (months)	25.8 (16.3)	25.6 (12.9)	30.1 (21.7)	0.62

*Financial viability is defined as the percent of operating costs covered by revenue from participating entities. The last column (75–100%) represents RHIOs with the highest degree of financial viability. The p values are generated from statistical tests for trends across the three groups that assess the probability that the differences are due to random chance alone.

†ANOVA

‡Pearson.

RHIO, Regional Health Information Organization.

Table 5 Factors associated with financial viability

	OR*	95% CI	p Value
Unique types of participants (committed to participate or participating)	1.00	0.72, 1.38	0.99
Types of data (planned for or exchanged)	1.17	0.79, 1.74	0.44
Population focus	1.32	0.36, 4.83	0.67
Grants	0.35	0.12, 1.08	0.067
One-time or recurring fee from participants	3.43	1.03, 11.47	0.045
Ambulatory physicians as receiver	4.98	1.37, 18.10	0.015
Hospital as receiver	4.68	1.09, 19.99	0.037
Lab or radiology as provider	1.20	0.20, 7.25	0.85
Past collaboration between participants	1.59	0.59, 4.28	0.36

*ORs from the ordered logistic regression can be interpreted as the odds of being in a higher category of percent of operating costs covered by revenue from participating entities (ie, going from the 0–24% to the 25–74% group, or going from the 25–74% to the 75–100% group).

planning for longer had a slightly lower likelihood of becoming operational (OR: 0.94, p=0.003). In addition, having a population focus was associated with lower odds of being operational and this relationship achieved statistical significance (OR: 0.13, p=0.03). There were no other notable differences.

DISCUSSION

We examined a national census of Regional Health Information Organizations and found that RHIOs that exchanged a narrower set of data among a broader group of stakeholder types for a general population were more likely to be operational. Operational RHIOs spent less time planning for data exchange. RHIOs with ambulatory physicians and hospitals as data receivers, and those that received fees from participants while planning were more likely to be financially viable. Receiving grants while planning was associated with substantially lower odds of becoming financially viable, although this relationship did not quite reach statistical significance.

In retrospect, many of our findings should not come as a surprise. When starting a new effort, engaging a broad range of participants enables the RHIO to leverage more resources, and focusing on a narrow set of data exchange simplifies the technical and potentially legal challenges. While these likely help surmount barriers to becoming operational, financial viability requires engaging a set of stakeholders who believe in the value of HIE and are willing to pay for it. Willingness to financially support the RHIO before it is operational is a clear sign that participants value HIE, which may be the reason that these RHIOs have a higher likelihood of being financially viable. Further, ambulatory practices and hospitals have the most pressing need for easily accessible clinical data and, therefore, their participation seems to be critically important to achieving viability. Thus, including stakeholders who stand to benefit from HIE is important, but securing their financial support early is an equally important and distinct advantage. Although grants may enable RHIOs to incur operating expenses early, our findings suggest that this also may lead to spending resources beyond what participants have the appetite or ability to cover once grant funding runs out.

Prior work and policy context

There has been little empirical evidence to guide policymakers seeking to support HIE efforts. The 2008 eHealth Initiative survey of HIEs reports several characteristics of operational efforts.⁶ However, they only systematically distinguish this group from their non-operational counterparts in one instance,

reporting that 36% of operational efforts cite finding a sustainable business model as “very difficult” compared to 50% of all respondents. The HIT Transition Group conducted a cross-sectional survey of 50 RHIOs in early 2006.⁷ They found that early stage efforts rely more on grants while mature efforts more often collect fees from members.

The lack of a consistent definition of a RHIO has hampered some of the key empirical work in this area. The eHealth Initiative survey has focused on a broad set of efforts that support HIE⁶ while the HIT Transition Group focused on efforts that “transfer ... electronic health records between multiple partners”.⁷ The widely publicized definition from the National Alliance for HIT (NAHIT) defines a RHIO as an organization that brings together stakeholders in a given region and governs HIE among them.¹¹ Our definition falls somewhere in between as we only included efforts that facilitated electronic exchange of data between *independent* entities but they were not required to exchange the entire health record or exist as a separate organization with a multi-stakeholder governance structure.

These distinctions become material as the HIE requirements for meaningful use are defined and provider organizations decide how to meet them. The most recent meaningful use definition from the HIT Policy Committee includes the capability to exchange key types of clinical information electronically, but it does not require exchange of the entire record.¹² In addition, the most recent recommendations from the HIE Work Group suggest certification of HIE components,¹³ which could be provided by a third-party entity but could also be accomplished through a set of agreements between provider organizations. Taken together, it appears that efforts supporting specific types of clinical data exchange between independent entities via an array of organizational arrangements will be promoted by the American Recovery and Reinvestment Act HIT incentives. The efforts captured in our survey closely reflect this group, and therefore our findings serve to inform how they can become viable and self-sustaining.

Limitations

Our study has several limitations. We attempted to compare RHIOs at different phases of development, which necessarily results in measures that could not be identical across groups. However, when possible, we constructed measures in multiple ways to test for robustness of our conclusions. We used a lenient measure of financial viability and there may be a different set of factors that characterize RHIOs that are able to cover both capital and operating costs with revenue from participants. Given that RHIOs are still nascent, we believe a lenient approach was appropriate, but as RHIOs become better established, a more stringent measure of financial viability may be necessary. Next, we were not able to assess causality but suggest that future work relies on longitudinal data in order to examine causality more robustly. Our set of characteristics was limited and there are likely to be other important predictors of RHIO success that we were not able

to characterize. Finally, the data used for this analysis were self-reported by the RHIOs and we were not able to independently verify responses.

CONCLUSION

Our nation has embarked on an important and expensive mission to use HIT to transform the healthcare system. HIE, which lies at the heart of this broader effort, needs to be successful if we are to realize substantial financial and clinical benefits of HIT. Given that RHIOs are likely to serve as the foundation of our effort to catalyze HIE, it is critical to identify how they can be successful. Our work suggests that RHIOs find a broad group of stakeholders and begin with a narrow set of activities to help them get off the ground. Further, we believe that judicious use of grants, possibly through ‘matching’ mechanisms where stakeholders are also asked to contribute early, will help to ensure that RHIOs become viable and self-sustaining.

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