Organizational Uses of Health Information Exchange to Change Cost and Utilization Outcomes: A Typology from a Multi-Site Qualitative Analysis

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ABSTRACT

Health information exchange (HIE) systems facilitate access to patient information for a variety of health care organizations, end users, and clinical and organizational goals. While a complex intervention, organizations’ usage of HIE is often conceptualized and measured narrowly. We sought to provide greater specificity to the concept of HIE as an intervention by formulating a typology of organizational HIE usage. We interviewed representatives of a regional health information organization and health care organizations actively using HIE information to change patient utilization and costs. The resultant typology includes three dimensions: user role, usage initiation, and patient set. This approach to categorizing how health care organizations are actually applying HIE information to clinical and business tasks provides greater clarity about HIE as an intervention and helps elucidate the conceptual linkage between HIE an organizational and patient outcomes.

INTRODUCTION

Health information exchange (HIE) is the electronic sharing of patient information between different health care organizations and providers.[1] Through HIE, physicians, clinical staff, and administrative users have access to patients’ tests, reports, encounters, and summary documents from other providers. Improved access to more comprehensive information may support decision-making, inform providers of additional medications or allergies, and help avoid repeated or duplicate testing.[2] The literature on the effectiveness of HIE is mixed,[3,4] but several evaluations have suggested HIE usage can help avoid unnecessary utilization[5,6] and reduce health care utilization and costs.[7-9] These evaluations tend to either view HIE as a structural capability of the health care organization,[e.g. 10,11,12] or examine the effects of accessing HIE systems in a specific clinical context.[e.g. 5,7,9] The use case underlying many of these evaluations is that HIE fills in the gaps in patient information for clinicians.[2,13]

However, HIE is a much more complex intervention in the daily operation and practices of health care organizations. For example, the use cases for HIE extend to non-clinical staff in health care organizations, such as case managers or social workers, and HIE can support non-clinical functions.[14] Also, conceptualizing HIE activity as a uniform structural resource for an organization obscures much of the variation in information access and usage. Users of HIE systems retrieve and receive different types of information[15] and in different formats (e.g. reports, push messages, or online queries).[16] Furthermore, integrating information from HIE into clinical care or business processes requires more steps than is reflected by basic measures of system access.[17] With all these known variations, how organizations actually put HIE delivered information to use to improve patient outcomes and reduce costs is not well defined.

We sought to provide greater specificity to the concept of HIE as an intervention to change cost and utilization outcomes. While evaluations according to the availability or access of HIE systems have been insightful, they do not capture how individuals and health organizations actually act upon HIE information or integrate HIE into existing workflows and clinical practices. Using qualitative methods, we examined the basic question, how are organizations using the community-wide patient information made available through HIE? To answer this question, we developed a typology of the organizational applications of HIE. This typology provides greater clarity about HIE as an intervention and facilitates the conceptual linkage of this technological intervention to patient outcomes and organizational changes.
METHODS

We selected a qualitative approach to capture the variety of potential patient populations, clinical care settings, work processes, and applications of HIE.

Study site
All data were collected from health care organizations working with the Bronx Regional Health Information Organization (RHIO) in New York. The RHIO is a non-profit organization that facilitates HIE for more than 60 inpatient and ambulatory care organizations and includes information on more than 550,000 patients. The Bronx RHIO was established in 2005 and offers notification alerts of patient utilization, DIRECT messaging, a portal to query patient information, a centralized data repository for analytics, electronic referral management, and analytic services.[18] In 2012, the Bronx RHIO was awarded a CMS Health Care Innovation Award to develop data registries and expand analytic capabilities in order to reduce the cost of care for Medicaid and Medicare patients in the borough. This expansion of services makes the Bronx RHIO an ideal setting for a typology development as it resulted in a large and diverse number of activities supported by HIE. As part of the grant, the Bronx RHIO customizes services for each participant through collaborative consolation, so that HIE information supports each organization’s specific portfolio of services or interventions. This analysis was conducted as part of broader evaluation that includes a quantitative evaluation of impact and costs.

Selection of participants
We conducted interviews with 25 health care organization leaders, clinicians and employees, as well as representatives from the Bronx RHIO from June 2014 to March 2015. Interviewees had titles such as: CMIO, Section Chief, Director, Nurse, Case Manager, Physician, Statistician, and Patient Navigator. A total of 5 organizations were included. We purposefully sought interviewees who were knowledgeable about the organization’s work with the Bronx RHIO, users of information obtained by HIE, and who were participating in the Bronx RHIO’s current CMS supported HIE activities. Bronx RHIO staff identified the key contacts and the key contacts helped to identify the relevant individuals within the organization. Consent was obtained from each individual interviewee. Interviews also occurred opportunistically during the data collection process. Recruitment stopped once all community partners using HIE to support their activities were represented and thematic saturation had been reached. All interviews were audio recorded and transcribed.

Interviews
Interviews followed a semi-structured format with open-ended questions. The interview guide asked about the characteristics of the organization and specifics about the activities (including day to day activities, interventions or projects) supported by HIE. Questions about the role of HIE in these activities were guided by the Triangle Model for evaluating health information technology interventions, which considers technology usage as the product of patient, provider, technology and organization interaction.[19] Data collection occurred through a combination of on-site (72%) and telephone interviews. Interviews lasted an average of 33 minutes.

Interviews occurred in three distinct steps. First, we conducted a focus group with representatives of the Bronx RHIO to obtain an overview of all partner activities. The focus group included a group card-sorting activity, where the respondents were asked to group the partners’ activities according to: 1) project goals; 2) how information is accessed; 3) who accesses the information; and 4) no set criteria (free choice). Next, we interviewed the leadership of the participating health care organizations. Interviews occurred only after the organization was actively applying HIE to an activity (i.e. the site had “gone live”). Organizations were active once they: 1) established procedures and policies for Bronx RHIO information usage; 2) HIE information was being accessed as part of the activity; and 3) HIE information had been applied in the delivery of health care services to patients. Finally, we interviewed those individuals using HIE information or involved in the activities supported by HIE. This approach limited our sample to active users and excluded any organization planning or simply “piloting” HIE usage.

Analysis
The first objective with our qualitative analysis was to develop a typology of HIE usage. We did not select any particular theoretical lens for analyzing the data, but instead followed an iterative, general inductive and comparative approach.[20] First, through a joint reading of three transcripts and review of the card sorting exercise, we identified preliminary themes relevant to defining our typology using open coding. Subsequently, we coded all transcripts together during joint reading sessions, continually checking, revisiting, and adjusting our typology in light of
additional data. As a member check, we reviewed our typology with Bronx RHIO representatives and other HIE evaluators. The second objective was to identify any factors that acted as barriers or enablers of successful usage of HIE. During interviews, we did not formally define success, but for our analyses we defined success solely as a reported application of HIE to meet a goal or job requirement. Therefore, success was both self-reported and could vary between job types and organizations. Determinants of success were identified concurrently during our analysis using an open coding approach. Through discussion and regular meeting sessions, synonymous codes were merged and we grouped each identified theme into the broader categories of determinants suggested by the Triangle Model (i.e. axial coding). Data analysis used NVivo10. The study was approved by the Weill Cornell Medical College Institutional Review Board.

RESULTS

Interviewees represented specialty care centers at an integrated hospital system, a hospital emergency department, a federally qualified health center (FQHC), and a case management organization. We identified 12 examples of different applications of HIE during interviews (Table 1). Some instances of usage were repeated across the organizations (e.g. most had staff authorized to access the Bronx RHIO’s standalone web-based portal). However, other organizational activities were supported by reports consisting of line lists of patients or by automatic notifications of patient emergency department utilization and hospital admissions.

Table 1. Organizational applications of health information exchange – active users of the Bronx Regional Health Information Organization during 2014-2015

<table>
<thead>
<tr>
<th>Organization</th>
<th>Description of HIE-supported project or activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>Listing of patient eligible for care management due to encounters at other facilities</td>
</tr>
<tr>
<td>Health system</td>
<td>Query-based exchange to support geriatric care in the emergency department</td>
</tr>
<tr>
<td>Health system</td>
<td>Listing of recent emergency encounters and admissions for scheduled patients</td>
</tr>
<tr>
<td>Health system</td>
<td>Listing of recently discharged patients to enroll in specialty care centers</td>
</tr>
<tr>
<td>Health system</td>
<td>Listing of health home patients hospitalized for patient navigators to contact</td>
</tr>
<tr>
<td>FQHC</td>
<td>Listing of patients in need of asthma follow-up after emergency visit</td>
</tr>
<tr>
<td>FQHC</td>
<td>Listing of demographic and contact information for health home assigned patients</td>
</tr>
<tr>
<td>FQHC</td>
<td>Query-based exchange during patient visit</td>
</tr>
<tr>
<td>FQHC</td>
<td>Automated notifications of patients’ emergency encounters and admissions</td>
</tr>
<tr>
<td>Case management</td>
<td>Listing of demographic and contact information for care management assigned patients</td>
</tr>
<tr>
<td>Case management</td>
<td>Listing of patients’ recent emergency visits and discharges</td>
</tr>
</tbody>
</table>

Typology

Our typology includes three independent dimensions: USER ROLE, USAGE INITIATION, and PATIENT SET (see Figure 1 on the next page). The typology is applied at the level of the application of HIE in the context of a specific program or activity.

The primary, and most distinguishing, characteristic of each of the organizational applications of HIE was the USER ROLE. Formally, we defined the dimension as the “ultimate consumer of the information.” The USER ROLE dimension does not necessarily measure the individual who interacted with the HIE systems, but instead the focus is on the individual within the organization who was expected to act upon the information or for whom the information was supposed to support their work. This distinction reflects the features we observed during interviews. First, information obtained via HIE could have been delivered to an intended user in any fashion (e.g. a portal, notification, or report). Second, the HIE information may effectively pass through many different hands on the way to the “ultimate consumer” (e.g. proxy users, or analysts who produce reports to give to other staff). We subdivided USER ROLE into two categories. Clinical users included all physicians, nurses, and case managers applying HIE information to direct patient care. Administrative users were managers, analysts, and staff not engaged in clinical care.
The second dimension of the typology describes how information was obtained from HIE. Instead of focusing a specific type of technology used (e.g. DIRECT compared to a portal), we focused on a larger concept: who was responsible for obtaining the information for the end user or who initiates usage (i.e. USAGE INITIATION)? In our sample, the organizations either relied on the Bronx RHIO staff to provide the information in a form for use by end users (i.e. externally generated) or the responsibility for ensuring end users had access to information was managed internally. For example, the Bronx RHIO staff would electronically send one organization’s case managers a detailed report of their clients’ recent emergency encounters and utilization history. To the organization, the information was created externally. In contrast, some organizations utilized staff and resources to generate similar reports or to query the centralized data repository for patient information. As a case in point, one nurse case manager reported she relied on the Hospital’s statistician “to generate that list of potential [clients]” for her. These were instances of internally initiated access to HIE information.

The final dimension, PATIENT SET, refers to the type of patient to whom the information is being applied. Organizations were applying HIE information to two broad types of patients. First, they were using HIE to find information on a pre-defined set of patients, in other words on patients that were already seeking ongoing care from the organization. Generally, these patients were selected subsets of the entire patient populations defined by a specific clinical condition (e.g. diabetes, asthma, etc.) or by utilization levels (e.g. frequent emergency department users). For example, the FQHC was using HIE information to identify which of their existing diabetes patients were out of date on laboratory testing. The Health System applied HIE in a similar fashion by generating line listings of their geriatric and asthma clinic patients’ recent emergency department visits and admissions. Alternative to using HIE to find information about existing patients was applying a set of criteria in order to find patients for inclusion in program or intervention. The criteria for finding patients was often a specific condition or response to a type of event. As an example of this type of patient finding, one organization used HIE to identify patients to include in their medical home and another used HIE to supplement missing demographic data in order to contact individuals recommended by the state Medicaid program for care management. As a third example, the Hospital and Health System used HIE to identify patients that had been recently discharged without usual sources of care to recruit for their care management or outpatient programs.

Organizations could rely on internal or external usage for similar activities (i.e. administrative patient finding or information on predefined patients). We did not observe any clinical users applying HIE services to find patients, however.

Determinants of successful application of HIE
As noted, all organizations were actively using HIE information within the organization. The degree of success was both varied and dependent upon multiple factors. ORGANIZATIONAL FACTORS, such as available resources, established procedures, and dedicated staff, were supportive for both administrative and clinical users. For example, the Health System queried the central data repository to generate a “lost to follow up report” to identify patients recently discharged who had not been seen at their specialty clinics. To act on this information, the Health System had dedicated staff and a “call center does exist, and they can and do respond to orders to make those calls.”
Likewise, for clinical users, the FQHC structured work processes so that information retrieval from HIE was the responsibility of medical assistants and not other clinicians. As another example, the Case Management organization has staff and procedure in place to respond to any automated notifications that are received after normal business hours.

Generally, the application of HIE fit better into administrative workflows than for PROVIDERS. Physicians and nurse practitioners were not often active users of the query-based HIE, and HIE information was more likely to get in front of clinical users if work practices made sure the information was delivered to them or if another user queried databases on their behalf. For physicians, there was variable utility in knowing about recent discharges or emergency department visits. However, administrative users could use even a small bit of information (such as a telephone number), and even outside the context of a patient visit, to perform outreach or other activities. There was generally more certainty that the administrators would act on the information than clinicians. For example, as a manager noted, “I can control the [administrative staff]. They work for me. The doctors don’t…”

PATIENT FACTORS could inhibit the effectiveness of the organization’s application of HIE. As an example, each morning clinicians in specialty clinics serving diabetic and asthmatic patients were provided lists of the recent emergency encounters and admissions for that day’s scheduled patients. Clinicians found that information useful, but the utility of the information was limited because “my no show rate is so high that many of those patients on that report probably don’t show up for their appointments.” In particular, asthma patients were not inclined to follow up with a visit after an emergency department encounter because their symptoms were controlled or their acute needs had already been addressed. In contrast, the show rate for geriatric patients was much higher and as a result the information from HIE was “a great tool.” This may be due to the fact that geriatric patients tended to be quite loyal to their primary care providers who were coordinating the entirety of their care.

Unsurprisingly, lack of integration between HIE TECHNOLOGY and other systems was often viewed as a barrier to usage. This was most noted for query-based HIE, because none of the organizations had a single sign on option within their electronic health record (EHR). As a result, usage of query-based HIE suffered. As one interviewee noted: “I don't actually go to the [portal] because it's very cumbersome….I mean, so how does it fit into my day? It doesn't fit into my day. …” In contrast, internally initiated reports from the centralized analytics database by report writers or data analysts fit much better into workflows. Likewise, interviewees reported alert notifications and aggregated reports created by the Bronx RHIO fit easily into workflows and were much easier approaches to use HIE information.

Finally, patient CONSENT was a recurring theme in our interviews and was consistently a barrier. New York State policy requires active patient consent and that consent be obtained at each site. Clinical and administrative users were unable to access information they believed they needed for unconsented patients. Organizations varied in their approaches to dealing with the challenge of consent, but most tried to incorporate the consent paperwork as part of the registration process. The FQHC had a community health worker on site (funded by the Bronx RHIO) solely to consent and educate patients. This approach was particularly successful, because it coupled a culturally competent representative with technology and a standardized work process. If the community health worker could not obtain patient consent, the clinician was notified within the EHR to also try to obtain consent.

LIMITATIONS

This typology and the factors identified with HIE usage are limited by several factors. First, our findings are based on a single RHIO’s line of services. However, the number of services offered by the RHIO is broad and to a diverse set of health care organizations. Furthermore, these services are consistent with our broader experiences with other HIE-facilitating organizations. Second, it is possible to conceptualize organization’s application of HIE on additional dimensions not represented in our typology. For example, our typology does not include the information content, which has been applied in prior HIE studies of usage. We choose to keep the number of dimensions limited to make it more manageable and easier to apply generally. Also, the relevance of clinical and demographic information as a distinguishing feature of usage is not always clear. Both are often needed and both are often present from any type of usage of HIE (i.e. push and pull systems both provide access to clinical and demographic information). Likewise, the Triangle Model proved to be a useful approach for categorizing themes identified from different care settings, but it is possible that basing our interview guide on an alternative framework would have resulted in additional determinants. Additionally, our typology reflects organizational activity relatively early in the
course of their HIE usage, as such we did not observe all possible combinations of our USER ROLE – INITIATES
USAGE - PATIENT SET typology (as some may not occur frequently). We plan on conducting a second wave of
interviews to better understand how HIE activities evolve over time. Lastly, we did not independently assess or
define successful use of HIE, but let the interviewees define what they viewed as a “successful application of HIE.”

DISCUSSION

Based on interviews with those facilitating HIE activities and health care professionals using HIE services, we
developed a three dimensional typology of organizational use of HIE. Each instance of an organization’s application
of HIE can be categorized according to the type of USER ROLE (clinical or administrative), the USAGE INITIATION
(internally or external), and the PATIENT SET (pre-defined patients or patients to be found). This approach to
categorizing how health care organizations are actually applying HIE information to clinical and business tasks
provides greater clarity about HIE as an intervention and helps elucidate the conceptual linkage between HIE an
organizational and patient outcomes.

Importantly, this study and the resulting typology, illustrates the broad set of possible applications of HIE to health
care organizations. Generally, HIE has been conceptualized[2] and evaluated as a clinical intervention.[3,4] As
reported here, HIE supported direct clinical care, but also case management activities and patient enrollment into
specific programs. These additional use cases are of potential value to health care organizations and also illustrate
the diverse types of users associated with HIE. Other evaluations have noted that HIE is used by more than just
physicians,[21,22] but this typology helps explain the broader purposes and activities of these non-clinical users. In
similar fashion, the typology highlights the unique role HIE can fulfill for health care organizations: as a source of
information on the unfamiliar, hard to reach, and sought out type of patient. Each interviewee had multiple
information systems supplied by their organization or even partner entities (like the state Medicaid agency). Once
those sources had been exhausted, interviewees were turning to HIE to fulfill their information needs.

Considering how organizations actually apply HIE to the care of their patients may help explain many of the current
research findings and can provide guidance to future studies. For example, several evaluations have viewed HIE
from the adoption / implementation perspective by measuring HIE simply as present or absent. This is a perfectly
valid approach and very much in line with the idea of information systems as structural component of the
organization, but findings from the literature using this measurement approach are mixed.[e.g. 10,11,23] Our
typology can help move measurement a step closer to actual processes. Instead of measuring HIE as a structural
feature only, our typology characterizes and clarifies the underlying processes organizations use to apply the
information obtained via HIE. This potential tighter coupling could help better inform the types of outcomes we
should expect from HIE interventions and also suggests considering potential organizational and operational
outcomes in addition to the utilization outcomes which are the focus of most of the existing research. For example,
organizations obtaining regular HIE reports containing information on new patients to enroll in a program clearly
fits expectations of efficiency and productivity gains. While these are important gains, it would be hard pressed to
expect quick changes to patient care and quality from such a usage strategy. Alternatively, changes to care
utilization and cost reduction might be more logical for clinical users with on-demand access to information working
to intervene on a set of pre-defined high-risk patients. Both use cases have a value and utility for a high performing,
cost conscious organization. However, these potential impact of administrative and clinical HIE use cases most
likely will not be reflected in the same dependent variables.

For health care managers, the immediate impact of adoption HIE might be most quickly realized in administrative,
patient finding projects. For one, the risk of non-acceptance of technology tends to run higher among clinicians and
physicians in particular. Second, implementing reports or queries into administrative workflow might be easier.
Third, this type of usage does not require the level of resources or staffing necessary to, for example, mount an
effective case management program to respond to notification alerts. Importantly, as the instances of usage
described in this study illustrate, administrative usage requires minimal information like addresses or telephone
numbers to be effective in reaching previously lost patients. If the patients were truly lost to follow up or impossible
to reach with existing information, any additional patient finding using HIE information is a gain that would not be
realized otherwise. Although not a particularly exciting use case, the 30 day readmission reduction program and
population health approaches like Accountable Care Organizations have heightened the importance of this basic
activity. Administrative use cases may not necessarily be what health information technology advocates and health
reforms hope for from HIE, but it is a start. It then becomes incumbent on the organization and the HIE facilitating
organization to make sure that HIE does not get regulated to only a back-office application, but that the clinical use cases are adopted as well.

Finally, this study reiterates that health care organizations and the usage of health information technology are still subject to the influences of the external environment. In this study, patient consent was a barrier to effective usage. These policies governing the rules and requirements for obtaining patient consent are outside of health care organizations’ or the RHIO’s direct control. In New York State, consent policies are set statewide and developed through a collaborative process facilitated by the New York eHealth Collaborative and includes the State Department of Health, provider representatives and the public.[24,25] Organizations facing externally defined constraints have basically three broad options. The first is to try to address the challenge internally by shifting work process to meet the externally defined expectations. The Bronx RHIO’s funding of onsite staff and organizations building in the consent process into workflows were effectively this approach. The goal of both of these approaches was only to mitigate the perceived challenges dictated by the environment, e.g. New York’s active consent policy places responsibility for consent on the RHIOs, but the actual operationalization of the consent process occurs within health organizations. A second option is to attempt to change the external environment. Health care organizations in states with opt-in policies face workflow challenges and have to expend resources on a process that a) is the benefit of the patient and b) is a burden that their competitors and colleagues in opt-out states do not have to absorb. Health care organizations in states with opt-in policies that are serious about HIE a valuable part of their technology strategy should engage health policy makers to facilitate access to necessary information in a way that still meets patients expectations for privacy. Health policy makers should be willing to work with health care organizations on this issue, because the risk is if they don’t health care organizations will adopt the third potential response to external pressure: HIE just won’t be used.

CONCLUSION

Our study creates a novel typology for characterizing how health care organizations are actually applying HIE information to clinical and administrative tasks. Our typology consists of three distinct dimensions: USER ROLE, USAGE INITIATION, and PATIENT SET. Use of this typology can help support future evaluations and implementations by focusing on the distinct role of the information obtained from HIE plays in activities desired to improve organizational and patient outcomes.

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