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ABSTRACT

Increased information availability, timeliness, and comprehensiveness through health information exchange (HIE) can support public health practice. The potential benefits to disease monitoring, disaster response, and other public health activities served as an important justification for the US' investments in HIE. After several years of HIE implementation and funding, we sought to determine if any of the anticipated benefits of exchange participation were accruing to state and local public health practitioners participating in five different exchanges. Using qualitative interviews and template analyses, we identified public health efforts and activities that were improved by participation in HIE. HIE supported public health activities consistent with expectations in the literature. However, no single department realized all the potential benefits of HIE identified. These findings suggest ways to improve HIE usage in public health.

INTRODUCTION

Public and population health benefits are an important justification for the US' significant investment in health information exchange (HIE) and associated interoperable health information technologies.[1][2] During the past decade, the federal government has invested billions to support electronic health record adoption through the Meaningful Use program, which includes requirements for the capabilities to exchange patient information. In addition, the Office of the National Coordinator for Health Information Technology (ONC) has overseen the $547 million State Health Information Exchange Cooperative Agreement Program to establish information exchange activity at a state level.[3] Other federal agencies and individual states have also invested heavily in HIE infrastructures.[4-6] These investments were made with such assumptions that information exchange "improves public health activities and facilitates the early identification and rapid response to public health threats and emergencies,"[7] or that ensuring public health "will depend on the implementation of information technology systems."[8]

HIE, the process of electronically sharing patient information between different organizations, stands to benefit public health.[9] Public health agencies are data driven organizations and HIE increases access to previously difficult to obtain clinical and demographic data. Also, by drawing on data created and stored by multiple healthcare entities, HIE can create longitudinal descriptions of individual patient care and illness. With broad provider participation, HIE data can reflect the healthcare experiences and utilizations of whole communities and populations. This is an advantage over looking at data from a single institution or healthcare system, which is by definition a restricted and limited sample. As a result of these features, HIE is expected to benefit several areas of public health practice from disease surveillance, to disaster response, to healthcare service delivery.[10]

However, public health participation in HIE efforts has historically not been widespread.[11] While some notable examples of public health usages of HIE exist, the realization of the benefits of HIE remain largely undocumented.[12] We sought to determine if any of the anticipated benefits of exchange participation were accruing to public health practitioners. Because no extant survey or tracking tool examines this question and the fact that the potential benefits to public health are so varied, we undertook a qualitative study of public health practitioners' experiences with HIE.

Identifying any successful applications of HIE to benefit public health practice, may help spur wider adoption to support the assessment and assurance of the population's health.

METHODS

We interviewed public health professionals about their usage of HIE and experiences working with exchange facilitating organizations. All of the public health professionals worked at either a state or local health department that was an active participant in an HIE effort.

Sites & Participants

First, we approached active regional health information organizations (RHIOs) and state level exchange entities with public health members to participate in this study. This excluded all RHIO/HIE efforts still in planning phases or health departments without any active users of HIE systems. Prior and ongoing research projects, as well as contacts with other HIE researchers helped to identify the potential participants. We secured cooperation from three local HIE efforts: the Rochester Regional Health Information Organization (Rochester, NY), Southern Tier HealthLink (Binghamton, NY), and the Integrated Care Collaborative of Central Texas (Austin, TX). Two statewide exchanges agreed to participate as well: the Indiana Health Information Exchange and the New Mexico Health Information Collaborative. Each of these exchanges has been in existence for 7+ years and their participation, technology, usage and effectiveness have been previously described.[13-17]

Each HIE effort identified points of contact (such as an HIE committee member) or registered active users at their member health departments for participation. After each interview, we asked informants to recommend other potential interviewees who could provide additional insight about their site's experiences with HIE activities.[18] This approach ensures that the different point-of-views would be considered. We interviewed a total of 22 representatives from 5 local health departments and 2 state health agencies screening for either direct users of HIE systems or the ultimate consumers of HIE obtained information. The interviewees had the various job titles of: epidemiologist, medical director, public health nurse, disease surveillance, case manager, and director of information technology. We obtained individual consent from each participant. To protect confidentiality, we do not report the numbers of interviews or job titles by organization.

Data collection

For each exchange effort, we reviewed instruction manuals, recruitment materials, technical documents, published reports, and websites, or obtained an overview of the exchange effort and a demonstration of their HIE system's interface, data sources, and functionalities. In this way, we were familiarized with the capabilities and objectives of each effort prior to data collection.

Data were collected through a combination of in-person and telephone interviews (PK & JV). Interviews were conducted using a semi-structured protocol developed as part of a larger evaluation of HIE in the State of New York. The guide covered the areas of job responsibilities, HIE usage, workflow fit, and technology perceptions. Consistent with the semi-structured approach, we adapted question wording and probes to match the interviewee's work role, location, and HIE experiences. The interviews were timed to last approximately 30 minutes. All interviews were audio-recorded and transcribed. All data collection began in May 2013 and ended in January 2014. We ended data collection when we had reached thematic saturation[19] and had interviewed respondents from both the state and local agency levels.

Analysis

Because we were interested in a specific set of HIE benefits suggested by researchers, practitioners, and policy makers, we opted to analyze the transcripts using template analysis.[20, 21] This approach begins with an a priori identified set of codes, as opposed to deriving codes from the data themselves like in grounded theory. We selected a template analysis as the best match to our objective of determining if the anticipated benefits of exchange participation were accruing to public health practitioners.

To identify the codes for our template analysis, we reviewed the literature for the benefits of HIE to public health departments. Our search of the phrases "health information exchange" AND "public health" in PubMed yielded 85 citations. After reviewing the titles and abstracts, we selected 16 for full text review. A review of the references of these papers resulted in 2 additional articles for a total of 18 papers. Of these, 10 described realized, potential, or anticipated benefits of HIE to public health practitioners.[10, 22-30] We were focused on the application of HIE to public

health practice, and as such we did not include the potential benefits that could be accrued to the HIE efforts or private providers from data exchange with public health agencies.

Independently, we (PK & JV) abstracted 26 effects from the included articles (kappa = 0.74). We refined this raw list in two ways. First, we divided the identified effects into the activity benefited (e.g. "clinical care") from the reason for the benefit (e.g. "increased access to data"). Next, we merged related and synonymous concepts into single codes (Table 1). We independently coded our transcripts using this template (coding by PK and JV reviewed with RK). Template analysis allows for the identification of new or expected findings within the data, so we were attentive to new themes. Emergent themes were developed independently during our closed readings. To reconcile differences, we combined our independently derived lists of emergent themes, collapsing synonymous terms, and supplying a single definition. We independently recoded our transcripts with the single emergent theme list. We undertook joint readings to resolve differences between our coding schemes.

Table 1. Codes and definitions of health information benefits to public health practice for template analysis.

Category	Code	Definition
Activity benefited		**The service, action, effort, or activity of public health practice that is improved by health information exchange (i.e. the "what")**
	Assessment & planning	All activities of a strategic nature oriented towards community or organizational planning (e.g. quality measurement or community assessments)[10, 22, 30]
	Case management & care coordination	Activities surrounding managing the clinical care and multiple needs of individual patients[26, 27]
	Clinical care	Activities related to patient care or clinical service delivery[10, 26, 27, 30]
	Communication (public)	Information from the public health agency to providers or the public (including alerts about events)[10, 22, 28]
	Preparedness	All emergency or disaster preparation and response efforts[10]
	Surveillance	Collection, monitoring, and investigation of conditions, status, or events as required by law, including syndromic surveillance and outbreak detection[10, 22, 24-30]
	Workplace efficiency	Improved efficiency for public health professionals (i.e. productivity / effort as a function of real or opportunity costs)[22, 26, 27]
Reason for the benefit		**The feature, characteristic, or process by which health information exchange generates benefit (i.e. the "how")**
	Information completeness & quality	More complete and accurate information [22-29]
	Information availability	Access to new or more types of data (including clinical information)[10, 22, 24, 25, 27, 29, 30]
	More timely information	Improvements in the temporal aspects of information (e.g. how fast information can be obtained, how it is available sooner, or how it can be used faster)[24, 25, 27, 29, 30]

Consistent with our primary objective, we reported if, and how, HIE supported each of the identified activities in our template. We then summarized the salient emergent issues. To help ensure respondent confidentiality, we avoided reporting both the location and job title of the interviewee. Instead, we focus on reporting the state in which the interviewee worked and only reported the area of public health practice if that information was relevant to the quote and if we had interviewed multiple individuals in that state with the same job.

RESULTS

According to NVivo's guidelines, we achieved a good level of agreement in our initial independent coding.[31] The kappa score for the "activity benefited" category was 0.71 and 0.82 for the "reason for benefit" category. The overall agreement was 0.75. Differences were resolved by comparing coding and joint discussion.

We identified instances or examples of all 10 anticipated benefits of HIE to public health. All sites reported at least four benefits from HIE (max was 7). All public health agencies realized benefits in the areas of surveillance and workplace efficiency. While benefits were seen across many categories, the level of activity within each was not particularly deep (i.e. few users, integrated into few programs, or applied to a small number of projects).

Assessment & planning

Interviews revealed that some public health departments were using HIE systems to develop a better understanding of their communities. As expected, the assessment activities included traditional public health target areas like Indiana's interest in infant mortality. Likewise, departments in Texas were using HIE data to complete community health assessments and strategic plans and also to understand health disparities. However, public health professionals in Texas were also interested in healthcare utilization patterns and preventable emergency department visits, which are not traditional public health areas. HIE data also supported the practical activity of grant writing.

HIE systems supported these activities by increasing information availability and access to timely data. As one interviewee from Texas noted, "*We're able to get now what we really have not had any way to look at in the past…Because we've only guessed before in terms of how people – especially without health insurance – are using the healthcare system to try to get their primary care needs met…This has given us the ability to actually see that in a way that helps us change our strategies of intervention.*" In Indiana, it was the timeliness of HIE data that was particularly useful, "*…98 percent of the decisions we're making now here at the state department of health are truly data driven…*"

Case management & care coordination

Access to HIE systems supported case management activities and care coordination by increasing data availability and the timeliness of information. For example, a nurse in New York noted how the local HIE system enabled her to monitor the health of tuberculosis (TB) patients: "*If I'm treating a case or a prevent case, it's 9 to 24 months, okay? So, they're under our umbrella for a long time. They could be in the hospital from everything from a major cardiac event to they needed stitches in their hand. That all pertains to us.*" The nurse further used the HIE to follow more detailed clinical information like current medications. Also in New York, a cancer screening program used the system to receive imaging reports for enrolled clients. Likewise, case managers in Texas were able access the recent emergency department encounters of diabetics.

Clinical care

Only the health departments in New York provided direct clinical care to patients. Both New York sites had active HIE users in their TB clinics. One nurse noted how she relied on HIE to obtain imaging results, reports, and laboratory values. "*That aids me. Immediately, I can see whether the results are normal or not, and if they're abnormal, we need to act quickly in determining if, if it's abnormal due to active TB disease…It's something we can act on right away when we get that information.*"

Communication

In all of the other potential benefits areas, the value to public health is in the movement of information to the public health agencies. Alternatively, information and data could flow the other direction: from public health to the community or to providers. This was really only occurring in Indiana, and even then, that was narrow use case. Provider access to the immunization registry data was via local exchanges (i.e. RHIOs). Therefore, providers could use HIE to populate their own local information systems with the state's immunization data. However, this is more like bi-directional data sharing than communication as defined in the literature.

Preparedness

Two departments reported using HIE for preparedness activities, broadly defined to include both preparation and response efforts. New Mexico reported using HIE to help monitor for health complications associated with special events like Native American Tribal gatherings within the state. In New York, however, one public health department had actually put HIE to use during a natural disaster. "*When we had our flood here, 25,000 people were evacuated,*

and they didn't have meds. They didn't know who their physicians were, where they were gonna get their meds. The [HIE] came in and set up their computers and gave access to physicians from both hospitals ...so it enabled them to be continued to do primary care...We sheltered people for 99 days."

Surveillance

As would be expected of systems that compile healthcare utilization, patient characteristics, and diagnoses, HIE systems were widely used for surveillance activities. Because they are a continuum of activities and tasks, this code included both those dealing with the detection of public health events and the steps public health professional undertake to respond to cases of disease. In terms of detection, HIE helped in two ways. First, HIE systems increased provider reporting. A local health department in Indiana "*we're doing a better job of capturing [reportable conditions]*," because electronic laboratory were reported through the HIE. Another professional in Indiana echoed this sentiment: "*We find a lot of cases that were not being reported to us before. Probably the largest number would be Hepatitis C cases, but we see other cases too that we don't get the reports from physicians or sometimes they weren't being reported by the labs to us.*" The second application of HIE to the process of disease detection was in syndromic surveillance efforts. Both state health agencies interviewed, Indiana and New Mexico, reported using HIE for syndromic surveillance.

We also considered public health investigation, the activities public health practitioners undertake in response to identified cases or events, as part of the broader surveillance code. HIE was beneficial to these activities as well. For example, surveillance staff in Texas reported using HIE systems to collect demographic information that was not included on laboratory reports or to access historical test results to determine if cases were chronic or acute. Surveillance staff in New York also used HIE for similar information, but also noted the importance of being able to collect basic information like patient addresses, phone numbers, or dates (and locations) of hospitalizations. In these instances, the HIE systems served to provide access to information that was not available in current public health information systems, information which providers or laboratories tended not to report, or information that took more time and effort to collect (e.g. telephone calls to providers or reviews of charts).

Workplace efficiency

While respondents generally thought systems could be improved or further developed, access to HIE resulted in numerous increases in workplace efficiency. These efficiencies cut across different public health activities and, generally, the improvement was in time saved. For example, one respondent working in a cancer program in New York noted: "*This is just a lifesaver because it eases the burden on [providers] and eases the burden on us...We're not waiting and waiting and waiting and calling them five times and annoying them. We just go [to the HIE] and we get the information we want...It just streamlines the process.*" HIE saved time for surveillance staff by helping them locate case information like demographics or prior test results and by automating the delivery of disease and laboratory reports. As one respondent noted, her job was easier because, "*instead of calling every hospital, I pull up in the [HIE].*" Respondents various noted things like avoiding "*delays,*" being able to "*act faster,*" not having to send "*someone out in the field,*" not "*having to wait,*" and being "*quicker.*"

Respondents from New Mexico also reported operational efficiency in terms of data management. Without the services of the HIE, the state health agency would have to create individual data feeds with each hospital in the state. That approach "*is cumbersome and you have to then work with every single different system and figure out formats and all that other stuff.*" In New Mexico electronic laboratory reports and emergency department data are routed through the state's HIE. In addition, a public health professional from Indiana also noted that the HIE was able to provide services and technologies that his agency was not capable to provide in-house.

Emergent Themes

During the coding phase, several themes emerged (Table 2) that primarily consisted of the concerns public health professionals faced in terms of HIE usage and the requirements necessary for the technology to reach its full potential in terms of usefulness. We grouped emerging themes into the three categories: non-technical factors, technology-related deficiencies, and requested features.

Emergent theme: Non-technical factors

Most of the public health professionals we interviewed were end users with little or no influence over the design and functionality of the HIE systems. The emergent theme of non-technical factors represented all the influences beyond the sphere of the users' interaction with the HIE that led to implementation and integration challenges. Some were unique to a particular area of public health practice, but others were common across our study sample. Financial

limitations were one such cross-cutting challenge. One public health professional summarized his state's reality succinctly: *"Our state funding is very limited"* and *"we can't spend money on infrastructure development."* Respondents from other states noted that limited financial support impeded HIE development: "*[There are] not a lot of funding opportunities for areas to begin implementing an HIE system,"* and that organizations do not have *"the financial wherewithal or the technological wherewithal right now"* to provide support for such an initiative.

Variations in the level of data comprehensiveness were evident in all states. While HIE did increase the amount of data available, universally, public health professionals wanted more. They desired more data types and more sources of data contributing to the exchange effort. However, it was non-participating providers that were seen as the primary drivers of data comprehensiveness. While those engaged in patient care noted that non-participating providers created gaps in their clinical pictures, the non-participants were particularly troublesome for disease surveillance staff. Surveillance staff and epidemiologists talked about the need to get "*the whole population,*" "*a representative sample,*" "*a statewide perspective*," or the "*denominator.*" Without the participation of all providers in their community, they felt the data were limited, or at least highly qualified, for surveillance purposes. Additionally, data comprehensiveness had real implications for usage. One nurse said that she was unable to find any data on a suspected case *"probably 98 percent"* times she accessed the HIE system and another professional's concerns meant that there was hesitancy to use the system: *"I have found the majority of times when I go to [HIE system] that I can't find the patient. So I don't use it very much at all."*

During interviews we noted that data access policies were variable between states and could lead to challenges. Data appeared to be most accessible in New York. A nurse reported that she was simply able to mark HIE queries as "*No Consent Needed, because it's public health needed*". However, in Texas, access of non-consented patients for public health purposes was avoided, because it "*sends out the sirens.*" Another example of a policy-generated limitation occurred in Indiana. According to interviewees, "*(S)tate law basically says, 'You can see these results when it's a reportable positive test.' And so that's become an issue is that we don't see the negative tests in the database. And so, you know, it's hard to calculate incidence or prevalence off of that when you don't see the negative.*"

Emergent theme: Technology-related factors

Technology-related factors represented the technical-orientated challenges associated with the HIE. As an example, data standards and coding reportedly created challenges for one state: "*(O)ur big reference laboratories have their own local codes, which then we have to translate into something that's meaningful, and that takes a lot of time."* A more widespread challenge was the fact that HIE systems were generally not interoperable with any other systems in use at the health departments. The HIE systems might facilitate the timely access of information, but public health practitioners still had to print out patient records and reports from their respective HIE system and hand enter the information into various public health systems. Non-integration also appeared in terms of multiple methods of exchange. A respondent from Indiana noted that not only were there five local exchanges within the state, which prevented them from getting "*the full picture,*" they also had providers "*...that want to establish direct connections with us because they don't want to go through an HIE."*

Emergent theme: Requested features

Our study also revealed that respondents shared similarities in terms of how they would like their HIE system to improve. As expected, these requests were in direct response to the limitations or challenges above or were general comments about system functionality problems. Specifically, when asked what would make HIE better support their daily work requirements, in most cases, interviewees desired more data. Access to physician notes were among the prevalent feature requests as respondents generally agreed that it would *"be nice if the doctor's office notes were in there"* and that having access to them *"would be infinitely helpful."* Similarly, interviewees also expressed an awareness of the legal basis for public health activities and wanted HIE systems to be in line with those requirements. Respondents in Indiana and New York tied their wants for data to compliance with state reporting requirements. For example, in Indiana interviewee specifically wanted the HIE to include reports on other notifiable conditions to support the "*cancer registry for TB, HIV, and some of the other state mandated reporting."*

Within the feature request theme, we also identified different levels of interest in how HIE data could be directly queried by the health departments. In our sample, it was common that any direct analysis or custom reporting queries were often handled by the HIE facilitating organization and not the health departments. The state health agency in New Mexico reported the ability to directly query HIE systems on their own, but local health departments reportedly did not have direct access to the underlying raw data. However, local epidemiologists expressed an interest in being able to do their own queries. In Indiana, one respondent stated, *"If it's something that we could do*

ourselves and not have to rely on them again, it would be just that much faster." A similar sentiment was expressed in Texas: *"epidemiology staff would love to be able to do some things themselves."* Likewise a New York surveillance staff expressed her desire as: "*…let us be public health and figure out what to do with [the data].*"

Table 2. Emergent themes and definitions.

Category	Code	Definition
Non-technical factors		**Challenges caused by factors not related to the direct user-interaction with the health information exchange technologies**
	Financial	The ability or inability of public health or healthcare organizations to fund health information exchange
	Data comprehensiveness	Limitations on 1) data types needed for day-to-day activities (e.g. physician notes, radiology data, community care charts, physicians phone number, etc), and 2) sources of data (e.g. more providers) that would increase representativeness or utility
	Policy complications	The use of health information exchange for public health practice was incompatible or was challenged by organizational or state policies.
Technology-related factors		**Challenges directly related to the limitations of the technology**
	Non-integrated systems	Systems are unable to partially or fully exchange data, resulting in other of data exchange and processing such as paper-based artifacts and end-to-end technology.
	Standards and coding	Issues in the presentation, management, and transmission of data elements and meaning.
	System functionality	Users experience trouble with the technology providing up-to-date data due to system down-time, glitches, or data load errors.
Requested features		
	Query privileges	Epidemiologist's ability to conduct queries themselves and reduce dependence on external parties to provide reports.
	Inclusiveness of state mandated reporting	Facilitation of data sharing in compliance with state mandating.
	Management system modules	Systems to aid in organizational workflow and tracking of cases and outbreaks.

DISCUSSION

Several public health activities can be strengthened by participation in HIE. In this multi-site, multi-state qualitative sample of public health professions, we documented benefits consistent with expectations in the literature. The above results indicate a positive impact of HIE on public health. Nevertheless, that impact is qualified in several key ways and HIE usage in public health is still open to improvement.

First, while each public health department reported benefits from HIE participation, no department was leveraging HIE in all seven of the activities identified in the literature. This lack of comprehensive application of HIE to public health is partially explained by the different capabilities and maturity levels of each HIE effort, the inclusion of both local and state public health agencies, and the different service offerings between the public health agencies.

However, it is also the case that usage within each agency was not widespread. Each public health agency tended to focus on a singular or narrow set of use cases. In our interviewed sites, usage tended to be focused in epidemiology / surveillance units or in clinical care, with less usage in other areas. Again, this may be a product of developing systems, but several of the HIE efforts included in this sample have long histories.

Additionally, many of the documented gains could realistically be replicated on greater scales. For example, HIE did support more comprehensive surveillance data and clearly saved public health employees a lot of time and effort. Efficiency gains are not to be dismissed and public health is always in need of better data, however, these are both intermediate steps to the ultimate goal of better population health. Likewise, public health agencies were using HIE to support community health assessments and planning, but descriptive reports and aggregated statistics are not the same as advanced analytics, modeling, or evaluation. Also, as indicated by the interviewees, not every public health agency with HIE attempted this type of aggregated analysis. Likewise, interviews indicated that little evidence for using HIE to improve communication existed; one state reported sharing data back with providers. However, examples of using shared information systems to alert providers of important public health events exist.[32] These observations are not meant to diminish any of the current accomplishments of public health agencies, but taken together with the limited usage of HIE by public health, clearly more benefits can be realized.

The types of data needed by interviewees indicated one easy fashion HIE efforts can demonstrate their value to public health. A common use of HIE by public health was to essentially "fill in" missing data, but this basic activity supported surveillance efforts and helped workflow efficiencies. Simply enabling public health practicioner access to HIE systems would result in at least these moderate wins. The information available in the HIE does not need to be overly complex, because interviewees indicated that something as simple as demographics or contact information is important to public health. Without contact information, disease control is severely hampered; without demographics, public health agencies cannot assess and attempt to remedy disparities in health. Unfortunately, these are exactly the types of data healthcare information systems have not historically collected well.[33] By pooling data from multiple sources HIE can improve data completeness[23] and be of immediate utility to public health.

The emergent themes in our data documented several areas for improvement. One clear need is better systems integration. The lack of integration and sharing of data between systems is a common problem in public health practice[34] and one that leads to many inefficiencies.[35] In too many instances, public health professionals were accessing an information system that did not directly share data with any of their other data repositories. While the HIE may have useful information, that information was printed, copied, or just remembered for entry into other systems. Also, a dominant need raised by the interviewees themselves was the desire for each exchange effort to be more comprehensive in terms of information and information sources. Public health professionals knew the difference between an information source that was a sample and that which was truly representative of the population. Consistently, the utility of HIE would be higher with more participants on board.

The emergent themes also raise some interesting questions for future research and policy discussions. For one, these findings leave unanswered the optimal approach to HIE analytics. Should health departments advocate for a larger role in analytics through direct access to HIE data as some interviewee suggested? On one hand, state and large local health departments typically employ epidemiologists and biostatisticians with sufficient skills to analyze large datasets. However, technology infrastructures in public health tend to lag behind healthcare organizations and during periods of financial constraints departments may not be able to allocate staff and financial resources necessary to manage and analyze very complex clinical datasets. From the other perspective, HIEs may see being able to offer analytic services themselves as an important revenue stream.[36] Also, as organizations that primarily serve the healthcare system, privacy concerns are paramount for RHIOs and HIEs. This could create natural hesitancies around increasing direct data access. Another question raised by these findings revolves around the consent policies for public health practices. We noted differences in the policies followed in two different states: one allowed for easier public health access and the other appeared to restrict information retrieval to only consented patients. Public health's powers to investigate tend to be broad and allow for the collection of personal health information without written patient authorization.[37] Understanding how individual public health agencies and states view access rules could be important to understanding the actual effectiveness of HIE in supporting public health.

Limitations

These findings are subject to limitations. The activities supported by HIE and the interviewees' experiences with HIE may not be reflective of all public health practitioners. The sample was limited to those experienced with HIE

and the sample represented more developed, functional exchange efforts. Furthermore, while we were able to document benefits, we were not able to quantify any of the reported gains in efficiency, organizational learning, better decision making, or health outcomes.

Conclusion

HIE supported public health activities consistent with expectations in the literature. However, no single department realized the all the potential benefits of HIE. The opportunity exists for public health to make use of HIE to a greater extent. Additionally, HIE efforts can support public health even further by increasing the number of participating providers and increasing the amount of information available.

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