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# Clinical Value-Add for Health Information Exchange (HIE)

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## Citation

J Joshi. *Clinical Value-Add for Health Information Exchange (HIE)*. The Internet Journal of Medical Informatics. 2010 Volume 6 Number 1.

## Abstract

**Objectives:** We describe the clinical utility- both positive and negative- of Health Information Exchanges (HIE) in order to ascertain how true value can be attained through the adoption of such a system. **Methods:** We performed a literature review over multiple databases of 350 articles pertaining to the topic. After screening for relevance, we selected 135 articles that discuss studies pertaining to HIE. **Results:** We populated two tables with information synthesized from the 135 journal articles. One table focuses on the positive aspects of HIE, and the second table focuses on the negative aspects of HIE. Our focus is to highlight clear benefits, notable uncertainties, and position them in juxtapose to establish a clear comparison. **Conclusions:** Though HIE have both positive and negative aspects, one must focus on the specificities of the health institution, including patient volume, demographics, and health focus, in order to determine the value of implementing such a system.

## INTRODUCTION

Health Information Exchanges (HIE) are rapidly advancing as the next step in improving patient care using technological applications. HIE affect the fundamental patient care system by transforming how medical information is delivered and disseminated. Medicine in America has long been a fragmented field; and with the ever increasing amount of transactional volume of patient information, the need to integrate the system in a coherent manner becomes all the more imperative. However, intuitive benefits of such a system belie inherent risks in creating such a system. Adapting a large scale HIE creates logistical and patient safety related problems. Numerous government and private organizations have developed studies or simulations detailing both the positive and negative aspects of HIE. Published studies that demonstrate seemingly apparent benefits are often limited in nature and contingently specific. We perform a systematic review of the literature and present the information to obtain a comprehensive view of how truly effective HIE can be. We focus our review on the clinical implications of HIE systems.

From the available data, we extrapolate key parameters to construct a value-added table highlighting the benefits and risks or uncertainties of a HIE. We focus on those attributes which affect patient management, influence physician decision-making, and impact both short-term and long-term decision analyses.

## METHODS

We performed an indexed internet search using the following search engines: PubMed, Cochrane Database, and Google scholar. The searches took place June, July, August, and October of 2010. We began with the phrase, "Health Information Exchange (HIE)", and broadened the search terminology to include similar terminology associated with HIE, thus maximizing sensitivity. We reviewed the literature directly addressing studies and surveys conducted on the topic. Sources include independent consultant reviews, academic journals, and articles detailing academic based HIE initiatives. Our search catered to broad based studies pertinent to the general patient population, and not any specialty specific study. Although we did not distinguish set criteria for what constitutes our targeted practice, we took aims to distinguish the scope of each study to better assess its applicability in reflecting general populations.

Studies were mostly taken from academic published journals available through the search engines. However, a few private, consulting based studies were included in the study, but denoted as such.

Data was extracted from the study, synthesized, and integrated into descriptive excerpts detailing key points. We populated the data within a two dimensional matrix highlighting key clinical parameters. Clinical parameters and the associated benefits included are commonly accepted metrics used to gauge improvements upon implementing

EMR/EHR.<sup>1</sup> A literature search and expert review at the Chicago Health Information Technology Regional Extension Center (CHITREC) helped establish the framework of the matrix. The clinical parameters include lab results, medications, prescriptions, previous outpatient visits, emergency visits, current ambulatory outpatient visits, quality of notes, long term benefits, time efficiency, and diagnoses. The benefits associated include quality of care, effect of patients, cost savings to physicians, error reduction, and organizational efficiency and regulatory compliance. Two parallel dimensional matrices were created in which one highlighted the positive aspects of HIE and the other highlighted the negative aspects.

The studies were then classified based on the nature of the article, and the material covered. We first divided each study into either a qualitative or quantitative study. Quantitative studies include any study formatted as a hypothesis testing study, cross sectional study, or predictive analysis. All classification schemes and syntheses were developed internally.

We then abstracted the relevant data from the articles using narrative synthesis. In synthesizing the articles, we reviewed the nature of the article, and the nature of the HIE discussed. We identified studies on mostly generalist based systems, emergency system only systems, and rarely specialty based systems. We found significant overlap amongst the many articles. While most qualitative, and some quantitative, studies reviewed the entire HIE system, some focused on a particular aspect. We noted what aspect was highlighted in the study accordingly. Many HIE range in geographic and demographic scope. Those exchange centers that were studied within a limited context were distinguished from those that encompassed all patients within the HIE.

Since few of the studies were quantitative in nature, it became difficult to analyze them through a standard meta-analysis. We abstracted details in select studies and identified themes within each publication. The themes formed the basis of the value-added graph allowing the concepts from each publication to organically flow into the two dimensional table.

There are no funding sources to disclose at any point in our data collection.

## **RESULTS**

Of the nearly 350 studies reviewed, we included 135 studies. The relatively high rate of inclusion is largely due to the

nature of the review and the assistance of established review studies that guided our literature review. Inclusion criteria included a specific mentioning of HIE and RHIO, or the transition of EHR and EMR to HIE. Further inclusion criteria includes any mentioning of HIE research, applicability, prominent obstacles, or inherent limitations. Of the studies compiled that met all the inclusion criteria 18% (24/135) were quantitative in nature. Of the study methods, 7% (10/135) only primary surveys, 28% (38/135) were editorial in nature, 47% (64/135) were informational in nature, 2% (3/135) conducted interviews, and 10% (14/135) were review articles. One study ran a simulation, and another study exemplified various business models applicable to a HIE. The majority claimed to be broad in scope and to represent that typical patient community. In our study, we find that 73% (98/135) maintain a broad scope. The remaining studies either specified a geographic scope or a particular clinical focus.

We did not distinguish between open and closed exchange systems since most new models considering adopting HIE are open models. However, for certain cases, such as emergency departments, we included only community based studies, therefore accepting only open based systems. This arrangement better suited our study's focus in developing generalizations for sustainable competitive advantage. Of the studies that met the inclusion criteria, 21% (28/135) focused on primary operations of an HIE, 3% (4/135) exclusively on emergency departments in community hospitals, 2% (2/135) on the financial aspects of HIE, 5% (6/135) on only patient safety and privacy, 2% (2/135) on HIV patient safety, 3% (3/135) on long term continuity of care, 11% (15/135) on the transition between electronic records and a viable exchange model, 4% (6/135) on improving adoption rates among hospitals, 3% (4/135) on utilizing standardizations, 4% (5/135) on improving cost effectiveness of HIE, and 2% (3/135) on developing a national scale model.

After cataloguing our studies, we integrated each study into our value-added table.

Figure 1  
Table 1

	Lab Results	Medications	Prescriptions	Previous and Repeat Visits to other Physicians	Emergency Visits	Ambulatory Visits	Quality of Overall Notes	Lung Term Benefits	Time Efficiency	Diagnosis
<b>Positive</b>										
Quality of Care	Information from other institutions prior lab results and insurance bills and reduce the risk of missing laboratory results	More parallelly improve medication compliance, reduce duplicate medications, reduce interactions, and reduce drug costs	More than 10% of patients' prescriptions are not filled	Interim reports to avoid repeating of tests and certain infectious diseases more efficient and complete	Emergency department has a percentage of patients with information available during admission and less percentage of emergency department visits	Increase emergency department visits and certain infectious diseases more efficient and complete	Customizable templates and specific functional capabilities for increasing efficiency of physicians	Summed emergency visits are being to reduce the number of emergency visits and reduce the number of emergency department visits	Physicians reduced operational time to have the lab results for the waiting patients	State funded HIE programs are subject to public access and publication of records for other clinicians
Effect on Patients	Instantly available, allowing data to change the care and meaningful for patients	More parallelly improve medication compliance, reduce duplicate medications, reduce interactions, and reduce drug costs	Patients receive medication information that is more complete and accurate	Patients receive medication information that is more complete and accurate	HIE reduces the number of emergency department visits and certain infectious diseases more efficient and complete	Patients receive medication information that is more complete and accurate	Patients on average provide more complete and accurate information	All patients receive the same information and are able to access it from any device	HIE patients reduced the number of emergency visits and certain infectious diseases more efficient and complete	Patients prefer not to repeat medical tests and reducing the number of emergency visits to that medical practice
Cost Saving to Physician	Publicly available, allowing data to change the care and meaningful for patients	HIE cost is not significant and will be offset by the savings from the reduction in emergency department visits and certain infectious diseases more efficient and complete	More than 10% of patients' prescriptions are not filled	Interim reports to avoid repeating of tests and certain infectious diseases more efficient and complete	Emergency department has a percentage of patients with information available during admission and less percentage of emergency department visits	Increase emergency department visits and certain infectious diseases more efficient and complete	Customizable templates and specific functional capabilities for increasing efficiency of physicians	Summed emergency visits are being to reduce the number of emergency visits and reduce the number of emergency department visits	Physicians reduced operational time to have the lab results for the waiting patients	State funded HIE programs are subject to public access and publication of records for other clinicians
Error Reduction	Information from other institutions prior lab results and insurance bills and reduce the risk of missing laboratory results	More parallelly improve medication compliance, reduce duplicate medications, reduce interactions, and reduce drug costs	More than 10% of patients' prescriptions are not filled	Interim reports to avoid repeating of tests and certain infectious diseases more efficient and complete	Emergency department has a percentage of patients with information available during admission and less percentage of emergency department visits	Increase emergency department visits and certain infectious diseases more efficient and complete	Customizable templates and specific functional capabilities for increasing efficiency of physicians	Summed emergency visits are being to reduce the number of emergency visits and reduce the number of emergency department visits	Physicians reduced operational time to have the lab results for the waiting patients	State funded HIE programs are subject to public access and publication of records for other clinicians
Organizational Efficiency and Regulatory Compliance	HIE are local or regional and are subject to the same regulations as other systems	More parallelly improve medication compliance, reduce duplicate medications, reduce interactions, and reduce drug costs	More than 10% of patients' prescriptions are not filled	Interim reports to avoid repeating of tests and certain infectious diseases more efficient and complete	Emergency department has a percentage of patients with information available during admission and less percentage of emergency department visits	Increase emergency department visits and certain infectious diseases more efficient and complete	Customizable templates and specific functional capabilities for increasing efficiency of physicians	Summed emergency visits are being to reduce the number of emergency visits and reduce the number of emergency department visits	Physicians reduced operational time to have the lab results for the waiting patients	State funded HIE programs are subject to public access and publication of records for other clinicians

DISCUSSION

Our table suggests that the context by which we gauge each clinical parameter determines the net benefit or downside. The benefits reaped from organizing emergency visits through an electronic exchange quickly fade when viewed from the perspective of the physicians themselves. The potential benefit of recording infection rates nationally become markedly more pronounced as the marginal size of the exchange system decreases. The intricacies of geographic scope of scale add another dimension that further complicates understanding all of the benefits. While certain articles note clear benefits in more closed, homogenous patient populations, it is not clear how those benefits translate to larger health institutions. This is not to say that large clinics do not contain unique benefits in and of themselves. The established literature and prior studies attest to the unique benefits of each system. In our tables, we attempt to capitalize on the general principles that construe benefits and downsides in each clinical parameter per the vantage point of the clinicians.

Since our goal is to determine what principles can be generalized to all HIE inclusive of size, scale or scope, our contribution lies in identifying the clinical parameters in parallel. This discrete format demonstrates that no one parameter can be ubiquitously assigned as a benefit or downside.

Figure 2  
Table 2

	Lab Results	Medications	Prescriptions	Previous and Repeat Visits to other Physicians	Emergency Visits	Ambulatory Visits	Quality of Overall Notes	Lung Term Benefits	Time Efficiency	Diagnosis
<b>Negative</b>										
Quality of Care	True benefits from integrating HIE to results are volume dependent and are not accurate data entry	Medication data on HIE is subject to error stemming from a high volume of data entry	Adverse drug events that are truly related to volume issues are not captured	Limitations in HIE require the patient to repeat information in order to begin the process of diagnosis	Many emergency physicians require the patient to repeat information in order to begin the process of diagnosis	Patients receive medication information that is more complete and accurate	Physicians believe that a significant portion of the information on HIE is not accurate	Physicians and patients are not using the information on HIE as much as they should	The number of emergency visits is being to reduce the number of emergency department visits	The utility of HIE in diagnosis is being to reduce the number of emergency visits and certain infectious diseases more efficient and complete
Effect on Patients	Lab results that affect patient management are already maintained in established patient portals that HIE may improve report	Due to many challenges in integrating HIE, many patients are not using the information on HIE	Adverse drug events that are truly related to volume issues are not captured	Limitations in HIE require the patient to repeat information in order to begin the process of diagnosis	Many emergency physicians require the patient to repeat information in order to begin the process of diagnosis	Patients receive medication information that is more complete and accurate	Physicians believe that a significant portion of the information on HIE is not accurate	Physicians and patients are not using the information on HIE as much as they should	The number of emergency visits is being to reduce the number of emergency department visits	The utility of HIE in diagnosis is being to reduce the number of emergency visits and certain infectious diseases more efficient and complete
Cost Saving to Physician	The calculated net savings may be high volume of patients and a relatively increased patient population, which is not true	Placing medication orders on HIE requires a relatively increased patient population, which is not true	Adverse drug events that are truly related to volume issues are not captured	Limitations in HIE require the patient to repeat information in order to begin the process of diagnosis	Many emergency physicians require the patient to repeat information in order to begin the process of diagnosis	Patients receive medication information that is more complete and accurate	Physicians believe that a significant portion of the information on HIE is not accurate	Physicians and patients are not using the information on HIE as much as they should	The number of emergency visits is being to reduce the number of emergency department visits	The utility of HIE in diagnosis is being to reduce the number of emergency visits and certain infectious diseases more efficient and complete
Error Reduction	HIE improve or decrease effectiveness by both improving the accuracy and reducing the number of tests required, the volume of data is more homogeneous	Costs for less commonly used or more expensive medications are the greatest barrier to the adoption of HIE	Adverse drug events that are truly related to volume issues are not captured	Limitations in HIE require the patient to repeat information in order to begin the process of diagnosis	Many emergency physicians require the patient to repeat information in order to begin the process of diagnosis	Patients receive medication information that is more complete and accurate	Physicians believe that a significant portion of the information on HIE is not accurate	Physicians and patients are not using the information on HIE as much as they should	The number of emergency visits is being to reduce the number of emergency department visits	The utility of HIE in diagnosis is being to reduce the number of emergency visits and certain infectious diseases more efficient and complete
Organizational Efficiency and Regulatory Compliance	All HIE maintain the same level of compliance as existing systems	All HIE maintain the same level of compliance as existing systems	Adverse drug events that are truly related to volume issues are not captured	Limitations in HIE require the patient to repeat information in order to begin the process of diagnosis	Many emergency physicians require the patient to repeat information in order to begin the process of diagnosis	Patients receive medication information that is more complete and accurate	Physicians believe that a significant portion of the information on HIE is not accurate	Physicians and patients are not using the information on HIE as much as they should	The number of emergency visits is being to reduce the number of emergency department visits	The utility of HIE in diagnosis is being to reduce the number of emergency visits and certain infectious diseases more efficient and complete

Our value-added proposition implies we turn towards a more nuanced understanding of an HIE's competitive advantage. A sustainable competitive advantage is the ability to provide a service to the target consumer in a manner that an alternative option cannot. To identify true benefits, one must determine what additional benefits an HIE would provide within a specific context. For instance, will the target consumer be government organizations instituting a system that hospital systems buy into? Or will the target consumer be smaller practice groups that are sought after by larger academic or insurance based systems? These questions affect the scope and viability of HIE.

While many of the benefits of HIE can be countered with legitimate uncertainties, one should not discount the burgeoning potential of these systems. Disruptive innovations, which HIE's propose to become in today's healthcare, have the ability to convert seemingly low value solutions into viable options that become the optimal path. In a field such as information technology exchange, network externalities play an immense role in creating consumer

awareness and increasing the value of the technology. Many uncertainties are influenced by the physician's willingness to adopt or accept the role of HIE. Increased implementation by physicians will have a positive exponential effect and mitigate such uncertainties.

Research into the field should be inventive and bold. With such a complex concept involving innumerable variables, it is not likely to be solved without many prior attempts. Beyond finding an optimal operational model for HIE, experimentation will identify why concepts have not worked in the past.

Limitations in this study include the methods of collection to the overall analysis, and the data abstraction. We were unable to perform a meta-analysis of the available literature because few of them were quantitative in nature. Further majority of the studies pertaining to this topic are subject to journalistic bias. The authors, predominantly leaders in the field, have certain perspectives on how an exchange system should run. Abstracting a narrative synthesis from their vantage point provides only a portion of the functionality relating to HIE.

Additionally, our search was limited to the strength of the terminology we used for our literature search. Key terms such as "Health Information Exchange" may not adequately encompass all the literature available on the subject. We avoided this error in part by cross referencing our literature review with established literature searches to ensure comprehensiveness. However, those journal articles referencing HIE with unique terminology or case specific phrases are likely to have been missed. We also limited our search to English-based studies and included only a limited number of unique search engines to further our literature review.

### ACKNOWLEDGEMENTS

We would like to acknowledge Dr. Abel Kho of the Chicago Health Information Technology Regional Extension Center (CHITREC) and Northwestern University for their contribution, expertise, and advice during the data collection and interpretation process.

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