

Influences on Emergency Clinician Use of Health Information Exchange: Qualitative Study from the Indiana Network for Patient Care

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Abstract

Background: Health information exchange (HIE) supports clinical decision-making in emergency medicine settings. Despite evidence and policies that encourage adoption of HIE, usage by clinicians is limited. Moreover, few studies examine usage of HIE years after adoption by hospitals or clinics.

Objective: To examine perceptions and usage of a mature, operational HIE system by emergency department (ED) clinicians years after its implementation.

Methods: We interviewed 21 clinicians in various roles (e.g., attending physician, nurse practitioner) across multiple health systems that participate in a statewide HIE network. We asked questions about their use of the HIE system and the factors that facilitate or inhibit use. Analysis of interview transcripts was guided by a theoretical framework derived from information systems theories describing individual perception of and usage behavior towards HIE systems.

Results: A total of 26 factors across 6 domains were identified by respondents. All respondents recognized the value of HIE for medical decision-making in the ED, and access to information via the HIE was preferred over traditional methods of calling other facilities or waiting for faxed records. Ease of use, particularly single sign on (SSO) functionality, was recognized as a key facilitator to routine use, enabling clinician access via a single click from their EHR directly into the patient's HIE record. Access to integrated data and advanced search features supported clinical decision-making. Limited training and poor system usability were identified as barriers to use.

Conclusions: Achieving widespread adoption and use of HIE systems globally will require a focused effort to address multiple individual perception and behavioral factors. Researchers, HIE organizational leaders, and policymakers alike should leverage these factors to achieve the goals of HIE and interoperability. Clinical Trial: N/A

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Original Manuscript

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ABSTRACT

Background

Health information exchange (HIE) supports clinical decision-making in emergency medicine settings. Despite evidence and policies that encourage adoption of HIE, usage by clinicians is limited. Moreover, few studies examine usage of HIE years after adoption by hospitals or clinics.

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A total of 26 factors across 6 domains were identified by respondents. All respondents recognized the value of HIE for medical decision-making in the ED, and access to information via the HIE was preferred over traditional methods of calling other facilities or waiting for faxed records. Ease of use, particularly single sign on (SSO) functionality, was recognized as a key facilitator to routine use, enabling clinician access via a single click from their EHR directly into the patient's HIE record. Access to integrated data and advanced search features supported clinical decision-making. Limited training and poor system usability were identified as barriers to use.

Conclusions

Achieving widespread adoption and use of HIE systems globally will require a focused effort to address multiple individual perception and behavioral factors. Researchers, HIE organizational leaders, and policymakers alike should leverage these factors to achieve the goals of HIE and interoperability.

INTRODUCTION

Adoption and use of health information exchange (HIE), the electronic transfer of patient-level data or information across diverse and often competing health-related organizations [1], offers a number of benefits, including reductions in inpatient readmissions, reduced duplicative laboratory and imaging studies, and decreased inpatient length of stay [2]. Multiple studies have demonstrated benefits especially to emergency department (ED) care [3-8]. Moreover, HIE facilitates intelligent communication, including clinical decision support [9], remote monitoring [2], and automated data integration [10]. Because HIE is linked to better outcomes and efficiencies in care delivery processes, U.S. health policies, including the Health Information Technology for Economic and Clinical Health (HITECH) Act [11] and the 21st Century Cures Act [12], have systematically encouraged adoption and use across myriad clinical settings [13].

As a result of multiple federal and state-level policies, HIE availability, and the types of HIE available (e.g., community-based, vendor-based), has increased in many communities across the nation [14 15]. In 2021, according to the Office of the National Coordinator for Health Information Technology (ONC) [16], 61% of hospitals reported using an HIE to electronically query or find patient health information from external sources, suggesting that most clinicians use HIE routinely in care delivery. Moreover, ONC reported that in 2021, 4-out-of-10 hospitals reported participating in more than one type of HIE, most of which reported exchanging data with a community-based HIE network [16].

However, despite clear policy incentives, a robust literature demonstrating impact, increasing organizational adoption and evidence of more widespread availability, the actual state of individual usage of HIE in clinical practice appears to be limited. For example, using log data from a community-based HIE in operation for over 15 years, we observed low rates of use among providers across inpatient, emergency, and outpatient settings despite overall increased adoption and usage over time [17]. Other studies and reviews report relatively low usage by clinicians [18]. As a further

complication, much of the existing evidence on clinician use and perceptions occurred when HIE was a novel intervention or shortly after implementation. These studies documented multiple barriers to implementation and use, including HIE system conflicts with workflow and usability challenges [19]. Clinicians may also be frustrated by the lack of information available (e.g., breadth and depth) from smaller-scale exchange efforts [20]. While these earlier studies are critical, HIE has evolved, EHR system and workflows have continued to change, and modern HIE is less an innovation but a routine capability.

A better understanding of actual usage would support system improvements and identify additional, and potentially valuable, use cases. This is particularly true in the ED setting, where clinicians may not have a longitudinal relationship with the patient, and access to prior information may be difficult [21]. Prior research involving ED clinicians prior to implementation of technologies for accessing past medical history found that these clinicians desired better access and information on prior medical information [20–21]. Despite the value of HIE in the ED, reviews suggest the ED is becoming a less studied setting [22]. This study sought to elucidate ED users' perceptions and usage of a mature, and robust HIE system.

Purpose

Because our knowledge of HIE use by providers is limited, we conducted a qualitative study of ED clinicians to capture perceptions and usage of an operational HIE system many years after its introduction in the community. Our goal was to better understand when HIE is useful and the context of HIE use in ED care. We hypothesized that clinicians would perceive HIE to be useful and effective, yet HIE would not be used for every patient, given the availability of information from a broad array of sources including the patient, family, and intra-organizational EHR data.

METHODS

Study Design and Setting

The study employed qualitative methods to explore the antecedents of HIE use-factors that either

facilitate or act as barriers to its adoption within ED settings. We recruited ED clinicians with access to the Indiana Network for Patient Care (INPC), a community-based HIE network operational since the late 1990s [23]. The INPC is managed by the Indiana Health Information Exchange (IHIE), which has systematically expanded the service area and capabilities of the INPC integrating longitudinal data from 38 health systems, encompassing over 100 hospitals with EDs [24 25]. The INPC is routinely used as a platform for research [26], including innovations in HIE [27-30] and interoperability [31 32].

Clinicians with access to the INPC interact with patient medical records via a web-based intelligent communication system known as CareWeb. Originally, CareWeb was developed using Java. The current version was redesigned around 2009 using ZK, an open-source Ajax (Java-based) Web application framework for mobile and web apps. Users are managed by IHIE, and updated user lists are provided regularly by each INPC organization. As depicted in **Fig. 1**, the CareWeb system provides access to patients' integrated, longitudinal medical records. By default, recent notes and results are displayed in reverse chronological order. The lefthand menu provides access to specific types of information (e.g., immunizations, radiology, discharge summaries) as well as CareWeb Search, an intelligent search that enables clinicians to query patients' medical records. In the past, clinicians logged into CareWeb using an internet browser -- outside of their EHR system (see **Supplementary Material**). Today, clinicians access CareWeb primarily via a button in their EHR system that launches a web browser and pulls up the same patient the clinician has open in their EHR.

Date	Results	Updated	Status	ORD#
13-Apr-2015 09:39	Visit Note-Gopher	Updated : 13-Apr-2015 09:39	Final	207683370*21363
10-Apr-2015 09:39	HIV Counseling Questionnaire	Updated : 13-Apr-2015 09:39	Final	207683370*133870*2015041000390
10-Apr-2015 09:38	HIV Questionnaire	Updated : 13-Apr-2015 09:39	Final	207683370*133870*2015041000380
10-Apr-2015 09:38	HIV-1/HIV-2 Ab Oral	Updated : 13-Apr-2015 09:39	Final	207683370*2*33870*2015041000380
26-Feb-2015 09:11	OTHER NURSING ORDER #1	Updated : 26-Feb-2015 09:12	Final	207282964*0*13670*2015022609110
26-Feb-2015 09:12	Visit Note-Gopher	Updated : 26-Feb-2015 09:12	Final	207282964*0*21363
16-Feb-2015 15:04	Admission Note-Gopher	Updated : 16-Feb-2015 15:04	Final	207180013*0*21364
08-Jan-2015 09:10	Visit Note-Gopher	Updated : 08-Jan-2015 09:10	Final	1112222*0*21363
14-Nov-2014 13:27	Visit Note-Gopher	Updated : 14-Nov-2014 13:27	Final	206415370*0*21363
06-Nov-2014 15:29	Visit Note-Gopher	Updated : 06-Nov-2014 15:29	Final	206339150*0*21363

Fig. 1 Screenshot of the CareWeb applications that clinicians use to access patient medical records available in the Indiana Network for Patient Care (INPC)

Our target participants were ED clinicians practicing in central Indiana, a region with the longest-established use of the INPC that includes urban, suburban, and rural communities. We purposely sampled clinicians with a target sample size of 30, stratified by clinical role (e.g., physician, nurse practitioner or physician assistant, registered nurse). The target sample was further stratified by level of HIE use, observed from INPC log files that measure number of logins to CareWeb. We purposely sought to include non-users (e.g., clinicians with a login who did not have any login events), low users (e.g., occasional, lower volume of logins compared to others), and high users (e.g., users with higher volume of logins compared to others). We recruited clinicians across the strata until thematic saturation was achieved after 21 interviews [33 34].

Theoretical framework

Our research is grounded in a novel integration of three conceptual frameworks from the information sciences (**Fig. 2**). These frameworks are compatible and complementary given that each theory centers on the concept of Information System (IS) use and its antecedents. The combined model allows for examination of factors that influence behavioral intention (BI) and use that, in turn, influences net benefits. In the context of HIE use within ED settings, which manage a substantial

proportion of clinical conditions, the integrated theoretical model facilitates a comprehensive exploration of factors influencing ED clinician intentions to use HIE as a part of patient care. This exploration extends to understanding how these factors influence decision-making processes regarding individual care delivery and impact patient care outcomes. We hypothesized that a variety of factors, including system quality (e.g., ease of use) and information quality (such as data available in the INPC for patient care), would influence clinicians' engagement with the HIE platform.

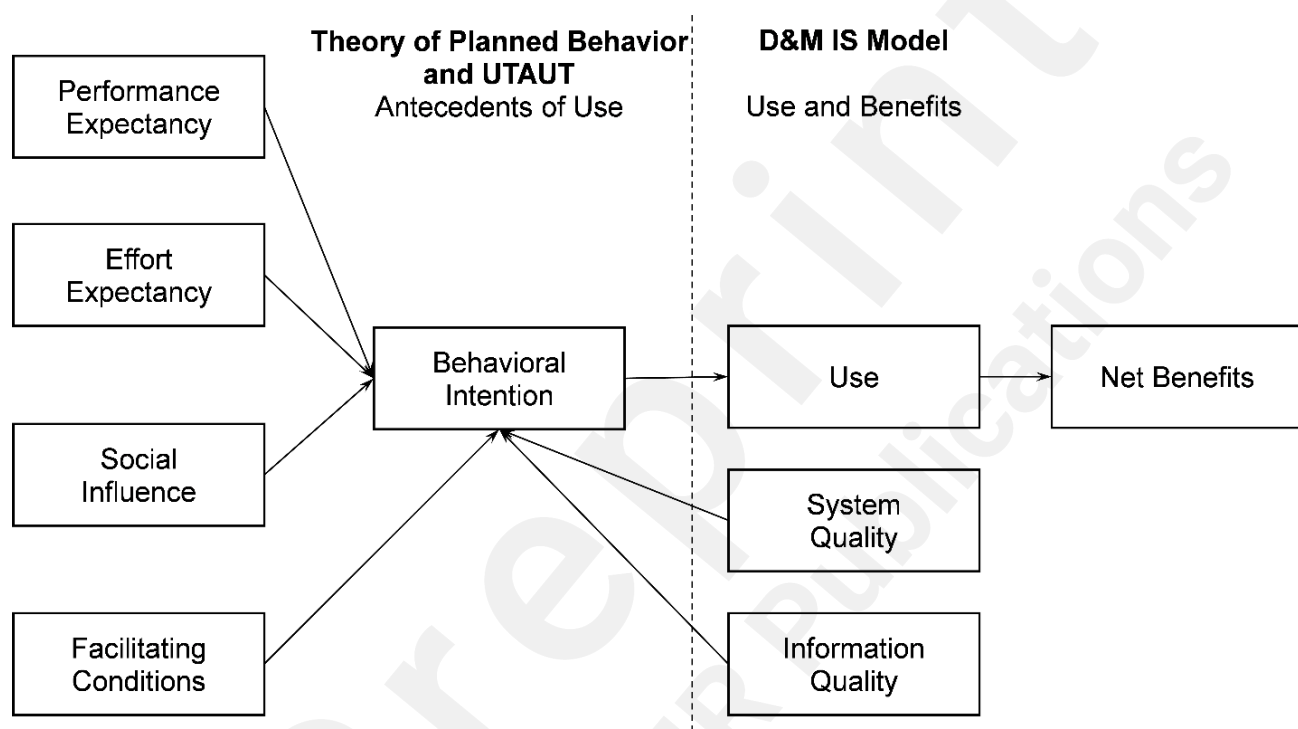


Fig. 2 Theoretical framework used to guide the research. The framework integrates concepts from the Theory of Planned Behavior, Unified Theory of Acceptance and Use of Technology (UTAUT), and DeLone and McLean (D&M) Information System (IS) Success Model

The *Theory of Planned Behavior* posits that human behavior follows BI, which is influenced by a number of factors including subjective norms [35]. This theory has been widely used in many fields, including health care, to explain behaviors as well as the factors that influence behaviors like vaccination [36] or the introduction of electronic health record systems [37 38]. The *Unified Theory of Acceptance and Use of Technology Model (UTAUT)* is a model that enables measurement and study of the acceptance and use of technology, which has been previously used to examine the

adoption and use of EHR systems [39-41]. The UTAUT identifies three primary constructs that influence BI: performance expectancy, effort expectancy, and social influence [39 42]. Performance expectancy is the degree to which an individual believes that using the system will help in improving their performance. Effort expectancy is the ease of using the system. Social influence refers to the degree to which an individual perceives important others (e.g., supervisor, influential colleague) believe he or she should use the new system. The UTAUT posits an additional construct—facilitating conditions—which refers to the individual’s belief that sufficient organizational and technical infrastructure exists to support use of the system.

The *DeLone and McLean (D&M) IS Success Model* is a multidimensional, interrelated framework for conceptualizing the success of an IS [43 44]. The model involves three distinct, but interrelated, levels of success: technical involving system quality (e.g., does the system do what it was intended); semantic involving information quality (e.g., does the information convey the intended meaning); and effectiveness involving the effect of the IS on the receiver (e.g., user behavior, individual impact, organizational impact). Success is defined as net benefits to either the user or the organization. The choice of “net benefits” is purposeful since there are always costs to implementing and/or using an IS. Furthermore, the model allows for examination of the complex interrelationships between use and impact (e.g., use of a system influences the products that in turn influence the individual user which may in turn impact organizational outputs).

Data collection

Semi-structured interviews were conducted between February 2019 through January 2020 via Zoom, Skype, and telephone calls with ED providers. Several respondents preferred to be interviewed on their day off from their home. Interviews lasted approximately 45 minutes, and respondents received a small gift card as remuneration for their time.

During each interview, one researcher facilitated discussion while another took detailed notes. Questions aimed at eliciting clinicians’ experiences seeking information on patients from outside

facilities, awareness and use of the INPC during ED encounters, perceptions of INPC tools including its interface, and use of any other HIE tools like Care Everywhere. Probing questions were asked to dig deeper into clinicians' experiences with HIE, particularly when responses were vague or involved specific use cases. All interviews were audio-recorded and transcribed verbatim and anonymized to protect participant confidentiality. The interview guide is included in the **Supplementary Material**.

Data analysis

We analyzed interviews through a deductive approach. The initial codebook was developed by BED based on the theoretical framework, which was iteratively refined with input from the broader study team, including CB. Two coders [BR and MF] then analyzed the transcripts independently, meeting weekly throughout the process to review each other's coding, discuss and refine codes and sub-codes, and draw codes into broader themes. Any disagreements between coders were resolved through discussion with BED. UG later independently reviewed and summarized these codes to ensure accuracy. Data were coded and analyzed using NVivo 12 [45].

Ethics

This study was approved by the Institutional Review Board (IRB) of Indiana University.

RESULTS

Participant Summary

We interviewed a total of 21 ED clinicians drawn from 7 distinct health systems [**Table 1**]. Most respondents reported being in practice for an average of five years (Range: 1-23 years), with seven respondents reported being in practice for two years or less. Several respondents reported dedicating between 80% and 100% of their time to clinical activities, while others balanced patient care with administrative roles such as division chief, medical director, or manager.

Table 1 Participants by Clinical Role and Site

	Large Health System	Community Hospital	Total
Physician (MD)	6	5	11

Registered Nurse (RN)	1	4	5
Nurse Practitioner	2	1	3
Physician Assistant (PA)	2	0	2
Total	11	10	21

Summary of Findings

Most ED clinicians had practiced in Indiana for over 10 years and reported being frequent users of the Indiana HIE, even though several were categorized as low users based on system logging events. Knowledge of HIE was generally acquired during their time in residency or through informal peer support on the job. Some clinicians received information about the intelligent communications CareWeb system when coming on board Indiana-based health systems from out-of-state. Clinicians unanimously emphasized the critical role of CareWeb in accessing patient information for informed decision-making and improving continuity of care.

Most clinicians recognized the strong utility of the HIE while identifying areas for improvement, particularly in accessing the most relevant subset of information for clinical decision-making. HIE use was constrained by data availability, with most clinicians estimating its use for approximately 20% of their patient population. Ease of use, particularly the single sign-on (SSO) functionality, was recognized as a key facilitator, allowing access with a single click from the EHR system directly into the patient's record within CareWeb. Although clinicians noted the usability of CareWeb in retrieving data from multiple institutions where their patients sought care, they identified gaps in institutional participation within the HIE network.

Clinicians reported that the system was reliable and fast and appreciated that the support was available to them when needed to troubleshoot issues. Yet, many clinicians were unfamiliar with advanced features such as the intelligent search function, which could enhance efficiency by streamlining information retrieval compared to manually scrolling through multiple encounter records. Persistent gaps in training and limitations in system usability were identified as significant barriers to HIE use.

Factors that Influence HIE Usage

As summarized in **Table 2**, respondents identified an array of factors that influence their use of HIE.

A more complete synthesis of responses and example quotes from respondents can be found in **Supplementary Materials**. In this section we summarize some of the major themes from clinicians relevant to their use of HIE.

Table 2: Key factors, summarized by theoretical framework domain, that influence the use of HIE by clinicians in ED settings.

Domain	Factors	Illustrative Quote	Participant (Years in Practice)
Performance Expectancy	Changes to Decision-Making	"I was able to pull up their imaging studies from a week ago which helped guide my decision."	R7 (8y)
	Continuity of Care	"The ability to see that they were just at the hospital twelve hours ago...keeps us from doing unnecessary tests."	R16 (3y)
	Frequency of Use	"I probably use it every day for a few of my patients to confirm what happened at other hospitals."	R5 (15y)
	Information Retrieval in Workflow	"Right after the patient left, I went back to CareWeb to double-check and then it changed the approach we were taking."	R4 (10y)
	Patient Characterization	"By pulling in all their previous admissions, I had a clearer picture of their frequent ED visits and issues."	R9 (7y)
	Efficient Retrieval	"It takes a few minutes to get through all the records, but it's worth it when you're avoiding duplication."	R6 (11y)
Effort Expectancy	Motivation for Information Retrieval	"Patients come from all over, and to give them the best care, we need to know what's been done at other hospitals."	R10 (5y)
	Desired Features for Ease of Use	"I just think if I could make it so that I can stay logged in longer. So not constantly having to log in and log out."	R2 (14y)
	Ease of Use	"CareWeb is fairly self-explanatory, especially for information gathering rather than charting or placing orders."	R1 (23y)
	Effort to Retrieve Information	"It took us a few minutes just to kind of read through, and they were all fairly much the same story."	R1 (23y)
	Features that Facilitate Ease of Use	"I like Care[Web]. I can often go into documents and copy and paste data directly into my notes."	R2 (14y)
	Information Display	"I think it may be organizing it differently... you can primarily organize by dates or something with tabs for labs, etc."	R3 (1y)

	Speed of Information Retrieval	"It's fast compared to a lot of our systems."	R21 (22y)
Social Influence	Discussion of Use	"I first learned about using CareWeb when my colleague mentioned it as a helpful tool during our shift."	R12 (2y)
	Expectation of Use	"It's pretty much expected now that we check the HIE before making any big decisions."	R14 (6y)
	Resident Use	"We always ask the residents to check CareWeb as part of their evaluation process."	R11 (7y)
Facilitating Conditions	Organizational Support	"...a patient came in saying they were just seen and had a test done...I asked the provider if I should contact the facility."	R17 (2y)
	Team Support	"Whenever someone has trouble accessing information, we work together to figure it out."	R19 (4y)
	Training	"A colleague mentioned [the system] as being useful, so that's how I found out about it."	R3 (1y)
	Technical Support	"We always reach out to IT if the system is slow or down, and they respond quickly."	R13 (9y)
Information Quality	Desired Information	"I need to make sure that they haven't had seven CT scans already in 2020."	R2 (14y)
	Missing Information	"I've had this before where a patient was recently discharged but the actual discharge summary is not in the system yet."	R8 (13y)
	Missing Institutions	"The VA has no records online that I know of anywhere, so you always have to call and get records from there."	R1 (23y)
	Usability of Information	"As long as we can get to it, that's super helpful."	R17 (2y)
System Quality	Network Reliability	"...hospitals created that VPN connection, so I don't have a problem with that anymore."	R8 (13y)
	System Reliability	"If that link works...it's so much more useful and quicker."	R1 (23y)

Performance Expectancy

All respondents indicated they knew about CareWeb and used it at least sometimes to look up information. Respondents reported that overall CareWeb enhances the retrieval of information for clinical decision-making. First, the HIE provided access within "five to ten minutes" (R15, 13y), which was an improvement over waiting "fifteen to twenty minutes" (R19, 2y) or "up to an hour" (R13, 4y) to retrieve information from outside facilities. Moreover, as one physician put it, "*A lot of times patients seem to fall apart in the evenings or at night when there's no office staff, and the on-call person doesn't want to/doesn't have the capabilities to fax or email me the patient information.*" (R12, 2y) Second, most respondents reported that accessing CareWeb fits well into clinical

workflow. Respondents generally accessed CareWeb either before they went into the exam room to see the patient or right after examining the patient to “double-check” information they obtained from their conversation with the patient.

Clinicians further viewed accessing the HIE as critical to making good clinical decisions, with most respondents reporting that information from CareWeb had changed a clinical decision. One provider noted that *“Looking at that information can change what needs to be done in the immediate emergent future.”* (R2, 14y) Another provider stated, *“The ability to see that they were just at the hospital twelve hours ago across town and got whatever treatment plan was there... keeps us from doing unnecessary tests.”* (R16, 3y) Reduction in duplicate procedures and tests, especially imaging, was frequently cited by clinicians as a major reason they look up information in the HIE. Some also reported experiences where information in the HIE likely saved their patient’s life. *“Had I not known how big it [tumor] had been before, he might have been discharged, and that could have had a poor outcome for him.”* (R12, 2y)

Respondents also reported instances where the HIE is unlikely to impact their performance as a clinician and therefore cases in which they do not feel they need to use the HIE. First, for patients whose care is immediate in nature, where past history might not make a difference in the care provided, some respondents indicated using the HIE would not be fruitful. Second, some clinicians were less likely to use the HIE if patients reported their prior care was delivered in the same health system. In these cases, providers used only the EHR to lookup prior medical records.

Effort Expectancy

Respondents identified several effort expectancy factors that influence their use of HIE. With respect to factors that encouraged use of HIE, respondents highlighted ease of use, speed of access, comprehensiveness of data, SSO integration with the EHR, search capabilities, and features that allow for copying and pasting information into their local notes. Factors that discouraged use included feeling overwhelmed by the volume of data in the HIE and frequently logging users out of

the system.

Several aspects of the HIE system facilitated ease of use and supported clinicians' effort. Several respondents reported that the system is intuitive to use or "fairly self-explanatory" and requires minimal training for basic functions like accessing patient information which encourages them to use it during clinical encounters. A frequently cited feature was SSO, which allows clinicians to easily click a single button in their home EHR to bring up the same patient's records in CareWeb. Multiple respondents mentioned SSO as a key effort factor that encouraged their use. Providers who mentioned SSO functionality were generally those who had practiced for several years and compared accessing the HIE currently to a time before when accessing it required a separate username and password. For example, one clinician noted, *"Being able to click the button in Cerner that opens and goes directly to the patient's chart without me having to remember and enter another password...has dramatically increased how often I use CareWeb compared to the way it was ten years ago."* (R15, 13 years). Respondents who did not report SSO as a feature were in smaller community hospitals that had not yet implemented this feature, and these respondents often suggested that a more efficient login process would encourage their use of the HIE system.

Similarly, a few respondents reported that the search capability, which enables clinicians to conduct a Google-like search of the records in the HIE, was a major enabling factor to wade through the comprehensive data available. As one clinician summarized it, *"If you want to look up someone's renal function or a CBC, you can just type in CBC in the box, and it'll pull up the most recent ones. These little things are helpful to the clinician on the front lines"* (R8, 13 years). Respondents who did not mention the search feature reported they did not know about it and that it would be a useful, desired feature. For example, one respondent said, *"Especially the lab results, it can get tedious clicking through [multiple pages]"* (R19, 1 year). Finally, some clinicians reported that easily copying and pasting information from the HIE into their notes within their EHR system was an important factor that encouraged their use of CareWeb. *"I can often go into documents and see if*

they've had a CT scan or MRI, then copy and paste that directly into my note. So, I find it the easiest to use" (R2, 14 years).

A few clinicians mentioned challenges with the volume and organization of data within the HIE system. While the respondents noted that comprehensive data were available to them, they felt overwhelmed by the volume of data and the fact that, by default, it is organized in reverse chronological order. These clinicians expressed a desire for tools that allow users to better sort and organize or filter the data to enable streamlined views that facilitate clinical decision-making. Similarly, some clinicians reported getting logged out of the HIE when interrupted or during an encounter. For example, one clinician stated *"I just think if I could make it so that I can stay logged in longer. So not constantly having to log in and log out."* (R2, 14y) They suggested that longer logout times or ways to prevent premature logout would be an improvement. Such features would encourage clinicians' use of the HIE.

Social Influence

Respondents discussed several social influences on HIE usage. Many respondents credited colleagues with introducing them to CareWeb. *"A colleague mentioned it as being useful, so that's how I found out about it."* (R3, 1y). Most respondents who trained in Indiana were introduced to it during their training during residency. One clinician who supervises trainees said, *"I often have to prompt my learners to look in CareWeb"* (R18, 6y). For another clinician, *"The residents encourage us to use CareWeb more than we encourage them"* (R19, 1y). And another clinician stated, *"We all use it. It's extremely helpful"* (R1, 23y). All of these responses suggest that for most clinicians, at least those in training hospitals, there is broad use and a social contract that they use it regularly.

Social influences were less clear in community hospital settings. One clinician in a community hospital stated, *"I think some of [my colleagues] are still requesting records from the coordinator... not knowing what that kind of information exchange is."* (R7, 1y) Therefore, social influence is not ubiquitous across Indiana despite the fact that the HIE has existed for more than two decades.



Facilitating Conditions

Providers discussed several organizational and technical factors that either facilitated their use or acted as barriers to use. Some respondents worked in organizations that actively encouraged use through experienced colleagues who encouraged their peers to use it. A nurse practitioner put it this way, “...a patient came in saying they were just seen and had a test done...I asked the provider if I should contact the facility for records, and he showed me the CareWeb login.” (R17, 2y). However, few respondents indicated their organization embraced the HIE. Rather, their colleagues showed them how to use it or encouraged their use. For example, one provider said, “It’s never been encouraged, and I’ve worked at three different hospitals here in [city].” Another provider stated, “...I don't know if it's a cost issue or utilization, um, but I think not having an auto enrollment um especially for providers is a disadvantage just because it's not available.” (R17, 2y). Therefore, organizational processes may not be set up to encourage HIE use.

A lack of organizational support for HIE was also evidenced in comments from multiple respondents who indicated they learned how to access and use the HIE from colleagues. As one clinician put it, “I just sort of started using it and figured it out myself” (R11, 4y). Another respondent said, “We don’t really include it in our formal onboarding or training of physicians.” (R1, 4y). Moreover, none of the respondents indicated that the HIE or anyone from the clinical organization provided updated, refresher training on the system. As one clinician put it, “there was never like um, information session on how it can be used in a different, different ways that you can navigate through it that might be more beneficial.” (R3, 1y).

Respondents did, however, suggest that they perceived sufficient technical support to use the system when things did not seem to work. An experienced clinician said, “I don't feel as frustrated now because I know I can rely on 24/7 technical support—there's always someone available.” (R14, 14y). Other respondents made similar statements that they felt they could contact someone directly at the HIE or someone on their hospital IT team and receive technical assistance with access to or use of

the HIE system.

Information Quality

All respondents emphasized the critical importance of information quality in the ED. Dimensions of quality mentioned often included completeness and timeliness of information. ED providers expressed a strong desire for detailed past medical records, specifically mentioning laboratory results, imaging reports, encounter notes, and discharge summaries. For example, one provider emphasized, *“I need to make sure that they haven't had seven CT scans already in 2020.”* (R2, 14 years). Many providers noted that the availability of timely information, such as recent diagnostic tests, was critical for swift decision-making in the ED.

Although most respondents said that INPC generally possessed needed information, clinicians did mention specific types of information they felt were missing from the HIE. Some respondents reported incomplete access to records from specialized care settings, such as psychiatric facilities or smaller independent healthcare providers. One provider noted, *“Most patients get cardiology care at XYZ, and I almost never find an EKG from them.”* (R11, 4y). A frequently mentioned institution was the Veterans Health Administration (VHA), where clinicians strongly desired information on encounters but they perceived as requiring a phone call to request a fax. Additionally, respondents highlighted difficulty in accessing raw imaging data, with some relying solely on reports due to the time constraints inherent in ED workflows.

System Quality

Nearly all respondents indicated that the INPC was reliable, especially over a virtual private network (VPN) connection that most were using to access their EHR system. Few clinicians reported technical challenges, except one provider did not have much luck with their VPN connection from home. An experienced provider who has accessed the INPC in multiple ways over the years noted that VPN and other modern networking solutions reduced technical barriers to accessing the INPC, thus motivating increased HIE use. System upgrades and downtime, when they occur, were noted by

clinicians as challenging. However, most respondents noted that these occurred infrequently and were no less bothersome than when their EHR systems go down.

DISCUSSION

This study of ED clinicians working in various health systems with access to a mature, statewide intelligent communications system highlights the complex, interrelated, and multifaceted factors influencing HIE use. Although purposely sampled to include clinicians who rarely used the HIE system and those who use it regularly (based on log data), respondents generally reported using CareWeb regularly. The HIE system was overwhelmingly viewed favorably by the clinicians, who unanimously preferred accessing information from other hospitals via the HIE instead of methods like phone calls and faxed requests. Multiple effort, performance, social and organizational factors encouraged use of the HIE. These included the level of integration with their EHR (e.g., SSO, easy button), comprehensive information that influences decision-making, and peers who encourage and demonstrate its use. Yet, several clinicians reported multiple effort, performance, and organizational factors that discouraged use. These factors included information missing from specific sources, information overload, and lack of training. The findings have implications for the advancement and adoption of HIE networks, including policies that could encourage HIE use and strategies for HIE operations.

Importance of Research on HIE Use and Study Contributions

This study makes several important contributions to the existing literature on HIE. First, the study employed theoretical frameworks from the information sciences. A recent scoping review from Lum et al. [18] identified gaps in implementation studies of HIE specifically encouraging researchers to “employ theoretical frameworks.” Second, most of the HIE literature focuses on adoption of HIE systems and technologies, which applies to the organization such as whether a hospital reports having the capability to send or receive information with outside hospitals [46 47]. Other studies survey or interview clinicians prior to or just after implementation [48 49], with virtually no studies

of clinician perceptions of HIE years after implementation.[20] Moreover, few studies examine the level of use by clinicians, and while the American Hospital Association IT Survey asks organizations to report how “frequently do providers” use health information received electronically “from outside providers or sources,” it is unclear how hospitals determine a response of “often” versus “sometimes” versus “rarely.” In this study, respondents characterized their frequency of use. Third, respondent comments provide valuable context to prior work that examined the benefits of HIE [250], underscoring that data available through HIE networks indeed influences clinical decision-making, has benefited patient outcomes, and is perceived as highly valuable to clinicians. In other words, HIE systems are critical components of intelligent communications in healthcare.

Implications for Advancing Adoption and Use of HIE

Interoperability and HIE remain key areas of focus for the Assistant Secretary of Technology and Policy (ASTP) and a global priority as specified in many nations’ digital health strategies. Achieving greater adoption and use of HIE will require attention to the factors described in this study. For example, existing studies suggest hospitals with strong adoption of HIE functionality report higher levels of HIE use [51–52]. Therefore, many states and nations will need to continue to focus on performance expectancy factors, improving clinician perceptions of the value HIE [47–53], enabling clinicians to apply HIE knowledge to clinical decision-making, and making the right thing to do the easy thing to do [54]. Asking clinicians to share why they use HIE, quantitative assessments of HIE benefits, and mixed methods studies of clinician use cases are all approaches to support performance expectancy. One example is a statewide survey of clinicians in the Commonwealth of Virginia [55]. Addressing challenges, including usability of HIE systems [56], seamless login mechanisms [57], and other effort expectancy factors will also be critical to securing routine adoption and use. Seamless integration with EHR systems, search functionalities, and ways to optimize interaction with comprehensive patient data are also implied by this study as effort expectancy tactics to support

clinician use.

Social and organizational factors are also critical to HIE adoption and use. A weakness of the INPC is the lack of training for newly hired clinicians. None of the respondents could recall learning about the HIE during onboarding or training by staff from the HIE. While training is often part of HIE implementation, training new and existing users years after implementation is important to sustain and expand use. HIE networks should help health systems incorporate training into onboarding of new clinicians, or the HIE should offer regular *in situ* training opportunities for newly hired employees. Online, on-demand training might also be a strategy to deliver information about new features (e.g., search) or new data sources added to the HIE to existing users. Moreover, establishing a culture where it is expected to use the HIE regularly would also be recommended for HIE networks to develop in partnership with their healthcare facilities to create resiliency that ensures use well beyond the implementation phase.

Finally, findings from this study call into question metrics [58] around clinician use. Respondents characterized their use of HIE between 5% and 30% of the patients they see. These data might help refine expectations around frequent versus “sometimes” usage. Moreover, it implies that there is a theoretical maximum proportion of patients for whom accessing the HIE yields value. Given that this study focused only on the ED setting, a ballpark of 20% of patients might not be appropriate for every HIE use case. Still, these data suggest that work is necessary to refine metrics for clinician use, which may be lower than some want to believe or promote. Regardless of the proportion, however, it is clear clinicians value having information from HIE networks for those patients who will make a difference in their care and outcomes.

Limitations and Future Directions for HIE Research

This study is subject to several limitations. First, the study involved perspectives from clinicians on a single HIE network. Therefore, results may not generalize to all HIE networks despite our efforts to purposely sample clinicians in different roles and at varied hospital sizes and locations. Second,

respondents worked in the ED, and perspectives from other specialties may differ. Third, despite our best attempt to interview clinicians who do not use the HIE regularly, all respondents indicated they use the HIE on a regular basis. This might bias the findings since clinicians who purposely avoid using or have never used the HIE were not interviewed.

While this article provides meaningful insights into the use of HIE in the ED setting, more research is needed to measure HIE use in various clinical settings and establish better indices for clinician use. Longitudinal studies on HIE use in relation to clinical outcomes could more firmly establish the evidence base needed to guide policy and practice. Cost-effectiveness studies involving clinician use data from logs could better demonstrate the value and return on investment in HIE infrastructure. Finally, future research should examine the role of emerging technologies in enhancing HIE functionality, including artificial intelligence (AI) summaries of clinical documents or comprehensive records, and their impact on clinician use.

Conclusions

A study on ED clinicians' perspectives illuminated several factors that encourage and inhibit use of HIE. As policy and organizations move forward with strategies to implement nationwide HIE, noting these factors and leveraging them could be useful in achieving goals of universal adoption and use of HIE. Supporting clinicians' performance and effort with advanced HIE technologies will be critical to adoption and impact on outcomes and costs of care.

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Conflicts of Interest

None of the authors have any competing interests to declare.

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Figure Captions

Fig. 1 Screenshot of the CareWeb applications that clinicians use to access patient medical records available in the Indiana Network for Patient Care (INPC)

Fig. 2 Theoretical framework used to guide the research. The framework integrates concepts from the Theory of Planned Behavior, Unified Theory of Acceptance and Use of Technology (UTAUT), and DeLone and McLean (D&M) Information System (IS) Success Model

Supplementary Files

Multimedia Appendixes

Supplementary material.

URL: <http://asset.jmir.pub/assets/264b1b0d7f839fca159ea52598348a47.docx>