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# Perceptions regarding the ease of use and usefulness of health information exchange systems among medical providers, case managers and non-clinical staff members working in HIV care and community settings

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## ABSTRACT

**Purpose:** The objective of this paper is to describe how members of HIV patients' care teams perceived the usefulness and ease of use of newly implemented, innovative health information exchange systems (HIEs) in diverse HIV treatment settings. Five settings with existing electronic medical records (EMRs) received special funding to test enhancements to their systems. Participating clinics and community-based organizations added HIEs permitting bi-directional exchange of information across multiple provider sites serving the same HIV patient population.

**Methods:** We conducted in-depth qualitative interviews and quantitative web-based surveys with case managers, medical providers, and non-clinical staff members to assess the systems' perceived usefulness and ease of use shortly after the HIEs were implemented. Our approach to data analysis was iterative. We first conducted a thematic analysis of the qualitative data and discovered that there were key differences in perceptions and actual use of HIEs across occupational groups. We used these results to guide our analysis of the quantitative survey data, stratifying by occupational group.

**Results:** We found differences in reports of how useful and how well-used HIEs were, by occupation. Medical providers were more likely to use HIEs if they provided easier access to clinical information than was present in existing EMRs. Case managers working inside medical clinics found HIEs to be less helpful because they already had access to the clinical data. In contrast, case managers working in *community settings* appreciated the new access to patient information that the HIEs provided. Non-clinical staff uniformly found the HIEs useful for a broad range of tasks including clinic administration, grant writing and generating reports for funders.

**Conclusion:** Our study offers insights into the use and potential benefits of HIE in the context of HIV care across occupational groups.

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## 1. Introduction

Human immunodeficiency virus (HIV) infection is a chronic condition that, when successfully managed, requires patients to consistently engage with multiple medical and social service providers. Patients typically coordinate their own care, tracking and managing, for example, appointments at different care sites, multiple prescription refills, preventive screening schedules, and diagnostic testing in remote labs, among just a few health-related activities. Recent studies indicate patients' current level of interaction with the care delivery system is not suboptimal; as many as two-thirds of people living with HIV in the US experience unsuppressed viral loads [1].

To improve patients' care experiences and health outcomes, policymakers, health system managers and care providers are increasingly calling for the utilization of health information technology that facilitates the *exchange* of information among all providers involved in a patient's care as a solution for uncoordinated care [2]. Health information exchanges (HIE) that facilitate the exchange of health information across clinical and non-clinical settings can support teams of providers – physicians, health educators, social workers, and pharmacists – caring for patients with HIV [3] by expanding access to patient information.

HIEs are typically characterized by formal agreements and technologies that facilitate the electronic movement of health-related information across organizations within an area or community [4]. These systems allow all members of the patient-care team, regardless of their geographic location, to share key information such as diagnostic test results, existing treatments, kept and missed visits and previous diagnoses so that decisions about a patient's care are fully informed [5,6].

HIEs can only realize their potential to improve care if the *people* working in health care organizations adopt them for their use. While medical providers are generally supportive of the idea of electronic systems for managing health information, the actual adoption of these systems has been less consistent [7,8]. In studies of factors influencing providers' adoption of HIEs, two concepts in particular predict their uptake. *Perceived usefulness*, defined as “the degree to which a person believes that using a particular system would enhance his or her job performance,” [9] is the most powerful predictor of actual use of HIEs. *Perceived ease of use*, defined as “the degree to which a person believes that using a particular system would be free of effort,” also influences a person's likelihood to use HIEs, but to a lesser degree than perceived usefulness [10].

The objective of this paper is to describe how members of HIV patients' care teams perceived usefulness and ease of use of newly implemented, innovative HIEs in diverse HIV treatment settings. We asked medical providers, case managers and non-clinical members of the participating organizations to reflect on issues of use and usefulness and we examined qualitatively if there were differences in adoption across occupation type. We also asked staff working in the same settings to rate the systems' usefulness and ease of use shortly after the systems were implemented. Our study addresses whether HIEs can be helpful for patient care team members seeking to

deliver quality HIV care and offers insights into the use and potential benefits of HIEs in the context of HIV care.

## 2. Methods

In 2007, the US Health Services and Resources Administration (HRSA), under the Special Projects of National Significance (SPNS) program, funded six demonstration sites consisting of groups of participating organizations to design, implement and evaluate enhancements to existing electronic health information exchange (HIE) systems in clinical and community settings providing treatment and care for people living with HIV/AIDS. All participating organizations were existing recipients of funding to care for uninsured HIV infected patients from the payer of last resort, the Ryan White Program. The University of California, San Francisco (UCSF) served as the data coordination and cross-site evaluation center for the initiative. Demonstration sites were located in urban and suburban areas in the states of Louisiana, New York, New Jersey, North Carolina and California. Each site obtained local human research subjects approval in addition to the approval obtained from the University of California, San Francisco.

Each site designed, tailored and implemented enhancements to existing HIE systems according to participating organizations' local needs. Table 1 outlines the characteristics of each site's HIE and the key informants we interviewed, who were the intended users of the systems. Three of the sites developed systems with the common objective of exchanging patient information between HIV clinics and off-site, community-based case management agencies. At two sites, data were exchanged between providers, pharmacies and/or laboratories.

For this analysis, we used both qualitative and quantitative data collected as part of the cross-site evaluation from five of six funded sites. Data from the sixth site were omitted from our analysis because we did not have comparable qualitative data from that site.

*Qualitative Interviews to Assess Influences on Uptake of HIE:* We conducted qualitative interviews to assess the factors influencing the uptake of HIE among users in the participating organizations. Working in collaboration with demonstration project staff in these organizations, we implemented a purposive sample strategy [11] to recruit HIE users best able to respond to our questions of interest. To be eligible for inclusion in the study, the respondent had to be: (1) in a role that encouraged use of the HIE and (2) aware of and trained on the use of the HIE.

We conducted in-depth interviews either over the telephone or in person between July 2008 and December 2010. The qualitative interview guide was developed through a review of the literature on acceptability of HIEs, with special emphasis on the areas of use and usefulness. Specifically, we asked respondents about: their perceptions of use and usefulness of the HIE [9,10]; planned and unintended consequences of the HIE [12]; the value of the HIE for users [13]; barriers to adoption of the HIE [13] and identification of the needs, expectations and motivations of users [14]. We interviewed a total of 60 users with an average of 11 users per site (see Table 1 for a description of respondents). Interviews lasted from 20

**Table 1 – Characteristics of the health information exchange systems, their intended users and key informants at each of the demonstration sites.<sup>a</sup>**

Site	Setting	Description of the HIE	HIE users	Key informants
1	Urban	Web-based health information management system that allows for the real-time sharing of clinical data across sites, enables providers to run reports on aggregated client data within or across clinics.	Medical doctors Nurses Medical assistants Non-clinical staff members	3 Nurses 1 Medical assistant 6 Non-clinical staff
2	Urban	Bi-directional lab interface, electronic prescription portal.	Medical providers Nurses Medical assistants Lab technicians Pharmacists	5 Medical providers 2 Nurses 3 Medical assistants 1 Pharmacist
3	Urban	Snapshot of individual patient “eHealth Report”, snapshot of list of patients with outstanding clinical needs “eClinical Report”, snapshot of patients at high risk and in need of intervention “ePartner Report”	Medical providers Community-based case managers	6 Medical providers 9 Case managers
4	Urban	Web-based portal to a “Continuity of Care Record” containing a snapshot of patient health status information, advanced directives, care documentation and practitioners.	Medical providers Community-based case managers Clinic-based case managers	3 Medical providers 8 Community-based case managers 2 Clinic-based case manager
5	Rural/suburban	Regional health information integration established to enable exchange and use of health information contained in CareWare.	Medical providers Community-based case managers Hospital-based case managers	2 Medical providers 7 Community based providers 2 Hospital-based case managers

<sup>a</sup> We use the term “site” to refer to the group of organizations linked by the HIE.

to 60 min. All interviews were audio-recorded and transcribed verbatim.

*Quantitative Surveys to Assess Perceived Use and Usefulness:* After the implementation of each demonstration site’s HIE, we used a web-based survey to assess perceptions among current and intended users in participating organizations. Demonstration site staff provided the evaluation center with the names and e-mail addresses of the intended users, who were then invited via email to participate in the anonymous online survey. In addition to gathering descriptive information about the respondents, the survey instrument measured the users’ perceived ease of use and perceived usefulness of the HIE using previously validated scales. The instrument [10] consisted of 10 items that measure perceived ease of use (e.g., “It is not easy for me to remember how to perform tasks using ‘the HIE;” see Table 2 for the exact wording of all items) and 10 items that measure the perceived usefulness of the HIE (e.g., “Using ‘the name of the HIE’ allows me to accomplish more work than would otherwise be possible.”). The items are measured on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

### 2.1. Data analysis

Our approach to data analysis was iterative. We first conducted a thematic analysis of the qualitative data and then used these results to guide our analysis of the quantitative data. Subsequent to our initial analysis of the qualitative data, we discovered that there were key differences in perceptions and actual use of HIEs across occupational role; as a result, we analyzed the quantitative data, stratifying by role. All of our

results are presented by occupation – medical providers, case managers and non-clinical staff members.

We conducted a Framework Analysis [15] of the qualitative data. Interviews were organized in Atlas.ti [16]. Our initial approach in reading the transcripts included several *a priori* domains, many of which were expanded upon in further reading and re-reading of the transcripts. Each transcript was assigned a primary analyst, in charge of systematically reviewing and coding the interview as well as a secondary analyst, in charge of reviewing the coded content. Forty-eight codes eventually emerged. For this analysis, we closely read all text associated with the following codes: perceptions of use, usefulness, importance to the individual provider or staff member, functionality, system in practice, challenges, feedback and technology/technical support. We read these excerpts to understand the similarities and differences in experiences with the HIE systems across sites and across the types of users. Following our process of discussing the salience of each segment, we returned to the full transcripts of selected interviews to ensure analytic holism and accuracy of identified themes.

To analyze the quantitative data, we categorized respondents into three groups based on their occupation – medical providers, case managers and non-clinical staff members. We assessed the sample’s demographic characteristics with frequencies and means as applicable. Next, for the *Perceived Ease of Use* and *Usefulness* scales, the individual items were reverse coded as needed, so that higher mean scale scores would reflect greater perceived ease of use and usefulness. The means of the individual items in these scales were generated to note any trends among the three groups. Finally, for each of the two scales, the scores were calculated and compared

**Table 2 – Mean composite and individual item scores in the measure of ‘perceived ease of use’ and ‘perceived usefulness’ (N = 62).**

Scale: 1 = strongly disagree to 5 = strongly agree	Mean (standard deviation; Cronbach's alpha)				p-Value
	Overall	Case managers	Medical providers	Non-clinical staff	
<b>Perceived ease of use: composite score</b>	3.9 (0.58; 0.90)	3.8 (0.59; 0.93)	3.8 (0.57; 0.85)	4.0 (0.61; 0.92)	0.67
I find ‘the HIE’ cumbersome to use. (R) <sup>a</sup>	3.6	3.6	3.6	3.4	
Learning to operate ‘the HIE’ was easy for me.	4.1	3.9	4.0	4.3	
Interaction with ‘the HIE’ is often difficult. (R) <sup>a</sup>	3.8	3.8	3.7	3.8	
I found it easy to get ‘the HIE’ to do what I wanted it to do.	3.8	3.7	3.6	4.0	
‘The HIE’ is rigid and inflexible to interact with. (R) <sup>a</sup>	3.6	3.7	3.4	3.8	
It is easy for me to remember how to perform tasks using ‘the HIE.’	4.0	3.7	4.1	4.3	
Interacting with ‘the HIE’ requires a lot of mental effort. (R) <sup>a</sup>	3.7	3.8	3.7	3.6	
My interaction with ‘the HIE’ is clear and understandable.	4.1	4.0	4.1	4.3	
I feel that it takes a lot of effort to become skillful at using ‘the HIE’. (R) <sup>a</sup>	3.9	3.8	3.9	4.0	
Overall, I feel that ‘the HIE’ is easy to use.	4.2	4.1	4.2	4.3	
<b>Perceived usefulness: composite score</b>	4.0 (0.62; 0.97)	3.8 (0.59; 0.96)	4.0 (0.58; 0.97)	4.2 (0.64; 0.98)	0.10
Using ‘the HIE’ improves the quality of work I do.	4.1	3.9	4.1	4.4	
Using ‘the HIE’ gives me greater control over my work.	3.9	3.6	3.9	4.3	
Using ‘the HIE’ enables me to accomplish tasks more quickly.	4.0	3.8	4.1	4.3	
Using ‘the HIE’ supports critical aspects of my job.	4.1	3.9	4.2	4.3	
Using ‘the HIE’ increases my productivity.	3.9	3.7	3.9	4.2	
Using ‘the HIE’ improves my job performance.	3.9	3.7	3.9	4.3	
Using ‘the HIE’ allows me to accomplish more work than would otherwise be possible.	3.8	3.6	3.8	4.0	
Using ‘the HIE’ enhances my effectiveness on the job.	3.9	3.7	3.9	4.2	
Using ‘the HIE’ makes it easier to do my job.	4.1	4.0	4.1	4.2	
Overall, I feel that ‘the HIE’ is useful in my job.	4.2	4.2	4.1	4.4	

Note: All items were originally measured on a 5 point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).  
<sup>a</sup> On reversing the items as specified above (R), higher scores indicate greater perceived use and usefulness.

across the three groups of users using analysis of variance. We also computed the standard deviations and reliability (Cronbach's alpha) statistics for both scales by occupational group.

### 3. Findings

From the qualitative data, we discovered that the adoption of the HIEs and perceptions of its use and usefulness varied by occupational role of the patient-care team: medical providers, case managers and non-clinical staff such as business managers, administrative staff and billing clerks. Adoption also varied by whether respondents worked within or outside clinics. Case managers, in particular, working outside of clinics in community-based organizations, routinely made use of the new systems. Case managers working inside clinics, on the other hand, used the systems sporadically. The following sections provide details on perceptions by occupational group and whether individuals worked inside clinics or in community-based organizations.

#### 3.1. Medical providers' use of HIE

As part of the design of the initiative, each demonstration site's set of participating organizations included medical providers as a target user group of the HIE. Some HIEs were designed primarily with medical providers in mind (i.e., Sites 1–3). Regardless, we observed that the use of the systems by medical providers depended upon two factors: whether the system's benefits were readily evident to medical providers, and whether the system was efficient to use. Medical providers were unlikely to use the system if they were ambivalent over the value of the information and benefits that the system provided them. Medical providers were particularly sensitive to the extra demands that system enhancements might place on their limited time and already-stressed – and therefore carefully tuned – workflows. If a specific electronic practice could not be easily integrated into pre-existing clinic procedures, then medical providers were less likely to use it. Similarly, if medical providers found a new technology to be less efficient both time- and accuracy-wise, then they declined to use it.

The experience of medical providers at Site 2 demonstrates the challenges the system programmers faced in designing

and implementing HIEs that would be used. Site 2 implemented an electronic prescription-ordering interface and a bi-directional lab interface so that medical providers could order lab tests and receive lab values electronically. Medical providers reported that the system was easy to use and that they had adopted it for ordering lab tests, but they were unwilling to use the system to access the results of completed lab tests. Instead, medical providers adhered to pre-existing workflow habits, preferring to receive and use paper reports of lab results. They said that paper reports were more efficient than electronically available results. As one medical provider stated:

I prefer paper, because I'm used to paper and I'm used to seeing blood work at a glance, as opposed to scrolling up and down on the computer. It's easier for me, because I'm used to it visually. But with the electronic results you have to scroll up and down, then you have to change the screen, go to another screen, go to another task, and you have to go back and forth like that. . . Believe or not, every time you do click, click, click, click, that takes time. I could get through ten patients lab results in the time I could get through one on the computer screen, because it can be so cumbersome to use. And so we all just said, "No, there's no way we would adjust to that."

At the same time, medical providers at Site 2 overwhelmingly used and supported the HIE's other component: the electronic ordering of prescriptions. One reported it as "less work—I just click this button and I'm done," rather than having to print, sign, and hand off a paper prescription to a medical assistant to fax to the pharmacy. Medical providers also reported greater accuracy and fewer errors (no lost papers, no forgetting to fax or call in a prescription) due to this functionality of the HIE. Further, one medical provider reported enjoying the feeling that when the patient visit ended, tasks associated with the visit were "all taken care of." There were no lingering responsibilities once the patient visit ended.

Medical providers described the ways in which the patient-provider encounter shifted as a result of the new technologies. In the example below, we learned that the ease of the e-prescribing technology extended beyond the medical provider to include the patients:

If I can say to the patient, "Oh, look, your refills are due. Are you going to need them?" and they say, "Oh, yeah," then I can just do it right there, and I can reconfirm which medicines they're on. We confirm that with that pharmacy. I can just say, "Okay, it's all been sent," and the patient knows too that I just sent it electronically, and the pharmacy should get it, and it shouldn't be a problem. So, I mean, I think it's much more direct with the patient too. They don't have to say, "Oh, the doctor said he was going to send that prescription. They never got it," you know, 'cause they hear me say it, "Okay. It's been sent."

At Site 3, where a clinical eReport Card was created as a result of this project and shared among clinical and non-clinical providers, one medical provider echoed the relationship outlined by medical providers at Site 2, noting the link between HIEs and work efficiency. To him, the usefulness

of the eReport Card lay in its ability to provide easily accessible and quickly digestible patient medical information.

It's extremely effective at pulling information from multiple areas into one place, which is very time-efficient for me. It really is the direction that an EMR should be going because typically electronic health records are duplicating paper workflows and what this does is simplify a paperwork flow. Meaning, it's integrating multiple types of information into one area, which is constantly being updated.

This same medical provider also found that the aggregated report served as a great tool for conducting patient education.

I print it out and then I go through each indicator with the patient and I write on the hard copy. It actually becomes the written plan of care, which I then provide to the patient and state that these are goals that I'd like to achieve with you. It allows you to set very specific goals.

Another medical provider in Site 3 worked with the information generated in the HIE to get key patient information triggering action on the part of the medical provider. The HIE made it easier for the provider to attend to the priority tasks during the clinical encounter.

Well, we use the [report] in conjunction with orders that do dramatically increase our screening for syphilis. It went from 78% to 99%, somewhere around there, as an internal QI project. And for me, as a provider, my rate of vaccination with Pneumovax has increased significantly because I can see immediately whether they've had it or not, without actually going to look elsewhere in EMR, 'cause looking sometimes means that I don't do it. You know, if I have to page through, scroll through things to find out if somebody had their vaccine, sometimes I don't have time to do that.

Among the sites implementing HIEs focused on sharing patient information across medical settings and community-based agencies, medical providers reported that having access to accurate data regarding the names of other providers involved in the care of their patients, including case manager was useful.

### 3.2. Case managers' use of HIE

Compared to medical providers, most case managers do not have direct access to a great deal of medical information, but whether this access existed or not, conditioned the degree to which case managers found the systems useful. Some of the case managers in our sample worked as employees in the medical clinics, while others were located external to the medical site, in community-based support service settings. We found that the employment setting greatly influenced case managers' perceptions regarding the enhanced HIEs.

In our sample, clinic-based case managers used the systems *sporadically*, while case managers working outside of medical clinics, in community settings, *routinely* made use of the systems. Before the enhanced systems were in place, community-based case managers only had indirect access to patient medical information embedded in patient charts within a primary care clinic. While they needed clinical

information to do their jobs, access to it via faxing, phone, or mail was cumbersome. Once they had direct access to this information through the HIE, community-based case managers reported great satisfaction with the systems.

Community-based case managers in our sample reported that they were able to use the HIE to access clinical information to monitor patients' laboratory values and clinic visits, monitor a patient's various medical care appointments, and work more closely with clinic-based case managers. The newfound and immediate access to information allowed these case managers to fulfill their duties more easily, leading to consistent use of the HIEs. As one case manager reported:

We've got to be in communication with [the clinic] more and, we're trying to get the patients to their doctor's appointments, make sure that they're compliant with their medicines, and that they get their medicines. Or, we are involved if there's a follow up with their doctor's appointments – because a lot of times they have other problems going on other than the HIV. They might have other stuff going on that you've got to work closer with the doctor and the clinic on.

Prior to having direct access to patient lab and appointment information, many community-based case managers relied on patients to self-report this information. Because the patients did not always remember all of the details of their care plans, accessing the HIE allowed case managers to have reliable information they would not otherwise have, such as information about missed appointments or about a patient's health history. The following excerpt illustrates a case manager's satisfaction with the ability to communicate to the patient that medical providers are in touch with one another and discuss the patient's activities:

And then the other thing that has been very helpful is to see lab results because some of our clients deny using crack or cocaine or whatever. And so then they can pull it up and say, "You didn't make your appointment, you told me you did. You told me you quit using crack, you obviously didn't." So, having that ability to confront a client or to reassure them that, yes, we do talk to each other because they think that we don't talk to each other has been very useful. And it has cut down on a lot of the lying and the excuses and trying to get over on us.

Clinic-based case managers did not report using the HIEs with the same frequency. Situated in the medical clinics, they already had access to patient health information via pre-existing electronic medical records (EMRs), which were in place at all sites prior to the initiative. As a result, the clinic-based case managers reported continuing to use the EMRs to access patient medical information and to log case notes as they had been doing. Case management data entered into the EMRs by clinic staff, however, were not automatically populated to the HIEs, and in one case where data were not exchanged, a case manager reported having little enthusiasm for logging notes twice. In these cases, clinic-based case managers perceived the HIEs as unnecessarily redundant. Instead, the continued use of traditional lines of communication – phone and fax – continued between the clinic-based

and community-based case managers. As a respondent in Site 5 stated:

It isn't particularly helpful to what I do because I can get current labs through the hospital system. I can also see what other appointments they have. What medical issues they have. So, the hospital clinic system works better for me, as far as what I do. You can also tell if they have case management or not. The problem is that where I use [the HIE technology], it's difficult to get into. You know, [if I need information] it's usually just easier to call the agency on the phone and say, "What's going on?" It's easier to do that than to look up on the screen. And you get more information.

Case managers at other sites corroborate these experiences at Site 5. At Site 3, the HIE that was developed consisted of an "ePartner Report." This report featured information about "high risk" patients: those hospitalized, admitted to the emergency department, inpatient psychiatric, or detox, patients with "critical CD4 counts" and patients with missing health parameters, such as key labs or health maintenance tasks such as missing TB tests. The intended users of the ePartner Report were community-based case managers working outside of the clinic. Case managers told us that they liked and used this newly-accessible, real-time report to monitor patients' medication adherence, to generate rapid assessments of patients' status on lab values or appointment adherence, and to inform quarterly case conferences. Prior to HIE's implementation, case managers had to compile the data now encapsulated within the HIE via phone calls and faxes with clinics and medical providers, self-reports of patients, and their own case notes. Compiling a complete record required significant amounts of time and energy, and, echoing the statement above by a case manager at Site 5, users in Site 3 reported that patient self-reports were not always accurate. The HIE report allowed case managers to spend less time aggregating information and more time engaging with or providing services to the client.

We're using the program to allow us easier and more timely access to necessary medical records for both assessment purposes and for program enrollment purposes. A lot of programs that serve the HIV positive population require medical documentation verifying their status in order for program eligibility, and sometimes a lot of our patients don't really have – don't keep their medical documentation handy, or they don't really have access to it. It takes a little pressure off us in the fact that if we do need to look up something for the client medically that we have easy access to it.

In Site 4, whose HIE consisted of a web-based portal to patient medical information in order to connect clinical and non-clinical case managers, another case manager corroborated this point. She emphasized the way in which the HIE could provide information in a "quick manner" that was not easily available otherwise. For her, it was "extremely useful."

We're just comparing something really big to something that's extremely useful. I'm not saying that the electronic medical records are not useful, but there's just a lot of little tabs in there, and there's information that I don't need in there. In [the HIE enhancement] I think they've done a

really good job at putting together within a snapshot the information that's important in order to treat a patient. In an [EMR] you have tons of important information, but do I really need to see all of that. I may not. The [HIE] is simple. It's to the point. It gives me access to information in a quick manner that I probably could not get if, you know, the medical provider that my client is seeing doesn't have time to talk to me.

Regardless of her enthusiasm, in practice, this same case manager felt it was often more efficient to use more traditional forms of communication to obtain patient information. The reason for this was that the HIE was not updated in real time.

My concern is with how fast the information is updated. Because when case management teams have a good relationship with the clinic and the hospital and the providers, sometimes it's quicker for us to go to them directly than to go online to the [HIE] to get it.

Maintaining real-time information was a central challenge for Sites 4 and 5 and was central to how and whether users utilized the system in those locations. In Site 4, completion of the HIE fields required stable and consistent interface with other systems (i.e., laboratory results and pharmacy data), which was not always possible. In Site 5, data was entered into the HIE by a data entry staff person, which took time. The site did have plans to eventually build a platform to automatically populate the data in real-time.

Overall, community-based case managers reported appreciating having greater and more immediate access to medical information. The building of better channels for sharing information led, as they reported, to less time spent in patient visits gathering information, and more time providing care.

### 3.3. Non-clinical staff members' use of HIE

Only one group of participating organizations (Site 1) actively targeted the HIEs to non-clinical staff members such as clinic administrators, billing and accounting staff and grant writers, yet non-clinical staff at all sites realized benefits from the HIEs. For example, at Site 5, the newly developed technology provided administrators with direct access to client data, allowing them to conduct billing and reporting more efficiently. One non-clinical staff member, a grants manager, reported that due to the HIE, he could manage the information he needed to do his job more efficiently and autonomously. He reported spending less time consulting clinical staff for patient information and he used the technology to more efficiently oversee case management agencies' activities to assess progress towards meeting contractual obligations.

It helped me be able to do billing, number one, more efficiently. And it's helped me to have my own reports as far as the billing goes - that are specific to our agency - with our HIV support group. I'm able to enter those charges in there and print off a bill, so we can pay our MSW.

[The new system] is in real time, so I don't have to go through a server housed elsewhere and wait till the next morning to replicate and make sure that all of the information is there. I can build a report myself, which can also

be useful when I am talking to donors or when I am writing grants. There is just a variety of ways that I can utilize that information.

For this user, the HIE's new information channels provided direct and positive impacts on administrative responsibilities, such as report writing, billing, and quality management. Direct access to data was important, as was the ability to manage and shape those data as needed.

### 3.4. Results from the quantitative survey of ease of use and usefulness

Because we found significant differences across the role a respondent played on the patient care team, we analyzed the quantitative survey data by stratifying by occupation type. We received 62 responses to the 102 survey invitations emailed to respondents in the five included sites (for a response rate of 61%). The survey sample consisted of 24 case managers, 21 medical providers and 17 non-clinical staff members. Medical providers, case managers and non-clinical staff members were similar in age, race/ethnicity, sexual orientation and reported daily internet use. The average age of all respondents was 40 years. Most respondents were white (47%). About one-quarter was Latino and 20% was African American. Almost 90% of all respondents said that they were heterosexual or straight while the remaining 10% said they were gay, lesbian or bisexual. Compared to medical providers (40%), case managers (75%) and non-clinical staff members (77%) were more likely to be female (both  $p < .05$ ). Overall, most respondents were Internet savvy; the Internet was used daily by 88% of non-clinical staff, 91% of case managers and all of the medical providers (no differences were significant). Compared to medical providers (57%) and case managers (39%) however, non-clinical staff members (12%) were significantly less likely to report that they provided input into the design of the HIE ( $p < .008$ ).

*Perceived Ease of Use and Usefulness:* Table 2 lists the means of each of the items in the perceived ease of use and perceived usefulness scales. The overall composite score for ease of use was high – 3.9 out of 5 – among all occupation groups and there was no significant difference between the groups; across occupation groups, respondents perceived the HIEs to be easy to use. Similarly, with regard to respondents' ratings of the perceived usefulness items, the composite scores were favorable with an overall perceived usefulness score of 4 out of 5 and there were no statistically significant differences across occupation groups.

## 4. Discussion

Overall, we found that perceptions and actual use of enhanced health information systems varied by the provider's role in the patient's care team and also by whether a provider had prior access to clinical information where they worked, be it in a clinic or in a community-based organization. In particular, community-based case managers working outside of clinical settings benefited from having direct access to what had earlier been difficult-to-access clinical information. Meanwhile, medical providers had the opposite problem; prior to



the implementation of the HIE enhancements, they were saturated with access to patient information. For this reason, medical providers benefited when HIEs provided efficient solutions for managing an abundance of information, that is, from solutions that made information easier to use. Non-clinical staff members benefited both from new access to patient information, which they found useful, and from new information management tools, which made the information easier to use.

Our study supports others [17–20] demonstrating that when the specific needs of users are met, usefulness and use is high, although these dimensions varied in our study according to provider type and work setting. The work of medical providers and case managers often resemble putting together the puzzle that is the patient case. Sometimes the pieces are available and need to be fit together; at other times, there are major gaps that resemble missing puzzle pieces such as lab values, case management plans or the last date of a TB test. We found that when they had access to the complete “puzzle,” patient care team members were able to focus on aspects of care that they had previously been unable to or unaware of. For example, many of the HIEs included information about missed appointments; this could provoke an exploratory conversation with a patient about the reasons why missed appointments occur. In another case, Site 4, because the HIE contained pharmacy data, medical providers and case managers were able to definitively know whether or not patients picked up prescriptions. This information facilitated more informed conversations between patients and providers about challenges to medication management. Overall, the enhancements to the HIEs developed as part of this project led to work efficiencies that enabled both clinic- and community-based providers to be more proactive in the care of their HIV-infected patients.

Our findings have implications for system developers because they point to strategies for increasing or optimizing use of HIEs. HIEs were most appreciated and used when they were designed to streamline the existing workflow and creates efficiencies – either by providing new access to critical information or by presenting existing information in a more useful and user-friendly format. In contrast, HIEs were least used when they did not contribute to increasing efficiencies – either because they provided nothing novel or because they were more cumbersome than existing methods. Therefore, we recommend that system developers find avenues to: communicate with users about the systems most promising features; periodically present success stories; be flexible enough to make adjustments as users’ needs change over time; provide periodic booster trainings on features that are underutilized; and, take time to ask users about their experiences in order to understand the ways in which the systems are being used in innovative ways (e.g., using the eHealth as an educational tool with patients). Spending time on these activities in a proactive way may help to accelerate implementation, sustain use, and provide creative opportunities to enhance the utilization of HIEs.

Paradoxically, the results of our quantitative analysis – uniformly ranked perceptions of use and usefulness – do not completely support what we found in the qualitative interviews. As noted, in the qualitative interviews, there were

important variations in reported ease of use and usefulness by provider type. For example, medical providers were not as uniformly enthusiastic about the ease of use of the systems and were more likely to emphasize usefulness. Similarly, there were differences in reported use and usefulness by case managers working within clinics, who had some of the strongest opinions about the limitations of the systems. However, in our quantitative survey, compared to other occupation groups, case managers were just as likely to perceive the HIEs as useful. The divergent findings may be due to our quantitative sample being biased towards respondents with high degrees of acceptability since we relied on project staff within sites to facilitate recruitment on our behalf. We attempted to reduce this bias during the informed consent process by emphasizing the importance of providing truthful responses and ensured confidentiality. Another possible reason for the difference may be our small sample size. In any case, future quantitative studies should explore the potential differences in perceptions within occupation groups based on their role on the patient care team and on their location (clinic vs. community).

Our results may not be generalizable because we did not interview the universe of targeted HIE users and may have overlooked additional factors related to use and usability of HIEs. Future studies should involve larger samples and, in particular, should study the changes in the way medical providers and community case managers interact with each other in the interest of HIV patients. We look to future research to provide us with more information on how the exchange of information, easy access to patient information may lead to improvements in patient outcomes. We also look forward to studies addressing patient acceptability of HIEs; we did not conduct qualitative interviews with patients and do not know whether and how they experienced changes in their quality of care as a result of the expanded use of technology.

Perhaps the most important consequence of implementing HIEs is the potential that they present for ensuring coordinated care. With new evidence emerging about the importance of patient engagement in care for improving health outcomes and reducing on-ward transmission of HIV [1] and with the potential to impact care in large HIV clinic settings, these systems hold the promise for a highly effective response to the epidemic.

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## Authors contributions

All authors provided final approval of the submitted version of this manuscript. Without the contribution of each of the authors, this paper would not have been possible and all authors contributed substantively to the paper.

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## Conflict of interest statement

None of the authors had any financial or personal relationships with other people or organizations that could have inappropriately influenced this work.

**Summary points**

“What is already known on this topic”

- Health information exchange (HIE) implementation and adoption may facilitate coordination of care.
- Little is known about provider attitudes and preferences related to HIE in the field of HIV.

“What this study has added to our knowledge”

- Case managers with limited access to patient data benefit more from HIEs more than case managers located in settings with immediate access to patient data.
- HIV medical providers use information contained in the HIE when it is easier to access than from other systems.
- HIE can facilitate quicker and more efficient identification of potential problems in the care of patients.

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