

Impact of Health IT on Lab Order Use in Community Health Centers



Final Report

Impact of Health IT on Lab Order Use in Community Health Centers

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Preface

This project was funded as an Accelerating Change and Transformation in Organizations and Networks (ACTION) task order contract. ACTION is a 5-year implementation model of field-based research that fosters public–private collaboration in rapid-cycle, applied studies. ACTION promotes innovation in health care delivery by accelerating the development, implementation, diffusion, and uptake of demand-driven and evidence-based products, tools, strategies, and findings. ACTION also develops and diffuses scientific evidence about what does and does not work to improve health care delivery systems. It provides an impressive cadre of delivery-affiliated researchers and sites with a means of testing the application and uptake of research knowledge. With a goal of turning research into practice, ACTION links many of the Nation's largest health care systems with its top health services researchers. For more information about this initiative, go to <http://www.ahrq.gov/research/action.htm>.

This project was one of seven task order contracts awarded under the *Improving Quality through Health IT: Testing the Feasibility and Assessing the Impact of Using Existing Health IT Infrastructure for Better Care Delivery* request for task order (RFTO). The goal of this RFTO was to fund projects that used implemented health IT system functionality to improve care delivery. Of particular interest were projects that demonstrated how health IT can be used to improve decision support, automate quality measurement, improve high-risk transitions across care settings, reduce error or harm, and support system and workflow design, new care models, team-based care, or patient-centered care.

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Introduction

This report describes the results from the study conducted by the Health Research & Educational Trust (HRET) in partnership with the Alliance of Chicago Community Health Services (the Alliance) and investigators from Northwestern University, the University of Maryland, and the Ohio State University. The study evaluated the impact of health information technology (IT) on the use of lab orders in community health centers (CHCs). This report highlights the goals of the project, methods used, and major findings.

I. Purpose

The primary purpose of this study was to assess how the use of health IT can improve care delivery and outcomes by documenting and facilitating the use of lab orders and results information by clinicians in CHCs.

Specifically, the study explored how existing health IT systems in CHCs can be used to facilitate the efficient delivery of lab order and results information at the point of care to improve quality of care in two important areas: treatment of HIV and screening for cervical cancer. These two areas were selected to illustrate the potential of health IT to affect both disease treatment and prevention for populations with HIV and for women who qualify for cervical cancer screening.

Our research objective was to examine how health IT tools can improve compliance with evidence-based lab test guidelines and improve both the efficiency and quality of care by reducing the numbers of duplicate lab tests, “lost” results, and lab results which lack follow-up. We also aimed to measure the economic impact of the tools by estimating the cost of HIT implementation and the cost effectiveness of incremental improvement. Further, we explored how health IT can aid various types of health care practitioners in lab-related tasks. Based on our findings, we proposed a set of promising practices focused on how a specific set of health IT tools can be used to improve both treatment and screening (i.e., HIV treatment and cervical cancer screening and followup) that can be disseminated to other CHCs and physician practices.

The intervention evaluated is a set of three health IT tools contained within the Electronic Health Record System (EHRS) implemented in two Alliance CHCs:

- The use of decision support capabilities, such as alerts and reminders, in clinical documentation and order entry systems.
- The use of an HIV chronic disease management form containing evidence-based protocols for lab tests.
- The use of automated feedback reports documenting organizational and provider-level performance on lab indicators.

II. Scope

The study objectives were met by gathering both quantitative and qualitative data from two Alliance Community Health Centers. In 2006, both Centers implemented the EHRS, which includes information on the quality measures for HIV and cervical cancer screening as well as patient demographic information such as race, ethnicity, language, and socioeconomic status.

A. Setting and Participants

The health care safety net consists of a mix of institutions including hospital emergency departments, public hospitals, CHCs, and free clinics, among others. Although CHCs represent only one component of the health care safety net, they are often seen as a pivotal player. Because the Centers are vanguard providers of vulnerable populations, interventions in the health center setting are of particular interest to clinicians, administrators, and policy makers seeking to improve the quality of care for patients in this health care safety net.

For this study, patients were drawn from two Alliance Centers, Howard Brown Health Center and Heartland Health Outreach. Howard Brown services 6,215 patients, predominantly minority and HIV infected populations. Howard Brown was founded in 1974 to provide testing and treatment of sexually transmitted diseases within the lesbian, gay, bisexual, and transgender community. It now provides an expansive network of programs and services, accomplished with a diverse and qualified staff of licensed doctors, nurses, health care practitioners, renowned research professionals, and prominent community leaders.

Heartland Health Outreach provides primary health care, mental health and addiction services, and oral health care to homeless and low-income Chicagoans at various sites throughout the city and through street outreach. Heartland Health Outreach is the health care partner of Heartland Alliance for Human Needs & Human Rights, a service-based human rights organization that provides housing, health care, human services, and human rights protections to more than 72,000 impoverished people annually. The Center serves 21,228 patients, 58 percent of whom are women and 67 percent of whom are African-American. Seventy-five percent of Heartland's patients' socioeconomic status is below the Federal Poverty Index.

B. Background on Health IT Systems in Place

The vision for implementation of the EHRS by clinical leadership of the Centers was to use the system as a tool to advance quality and safety of health care delivery at the individual patient and population level. Consequently, the Alliance EHRS is equipped with robust functionality including provider decision support, medication safety functionality, fully functional on-line provider order entry and referral management, as well as access to comprehensive patient education content.

The EHRS also contains a sophisticated data warehouse. The Alliance Clinical Data Warehouse (CDW) is a performance-optimized, indexed, reporting data warehouse with support for both text-based and numeric data queries. The data structure maintained supports clinician level productivity reports, profiles, and chronic disease management indicators for

Diabetes, Cardiovascular Disease, HIV, Major Depression, as well as preventive care measures. The Alliance CDW is able to run reports at a database instance, enterprise, location(s) of care, department within location of care, and/or individual provider level, with the ability to aggregate locations of care into a single report. The Alliance CDW is also able to restrict specific named user access to a database instance, and within that instance, to a specific enterprise, one or more locations of care, and within location of care to one or more departments or providers. In addition, the CDW is able to produce reports on population cohorts based on clinical observations, problems, medications, and/or demographic characteristics allowable under Federal law.

III. Methods

To assess the extent of the problem and the impact of health IT we conducted an evaluation with both quantitative and qualitative components.

A. Quantitative Methods

Using quantitative methods we measured the impact of health IT tools on numbers of duplicate lab tests for HIV patients and results lacking followup for women screened for cervical cancer. In addition, we assessed the impact of health IT on compliance with evidence-based HIV guidelines for lab tests. We also gathered data to measure the costs associated with the intervention.

1. Laboratory Data

To assess the impact of the health IT tools we gathered lab data from several points in time at the two Centers. Data taken from 6 months prior to the implementation of the EHRs were compared to data 6 and 12 months post implementation and in some cases 20 months postimplementation. Data were extracted from the EHRs data warehouse and analyzed in Microsoft® Excel. Patient-level data without identifiers were provided for all measures except the HIV guideline compliance data, which were provided in an aggregate form.

To assess guideline compliance, we measured the percentage of patients compliant with various HIV lab protocols (see Table 1). To examine redundant lab tests we measured the frequency of Viral Load tests for the same patient within a seven day period. This test was selected both because of its clinical importance in the management of HIV and because of its high cost. On average the Viral Load test costs \$160 with a range of \$100-250. To assess problems with lab test followup we measured the number of patients with abnormal Pap smears without a subsequent Pap smear within a 3- to 5-month period. Additional measures are described in Table 2.

Table 1. Lab test guideline compliance measures

Patients With HIV	Frequency
Viral Load	3 months
CD4 count	3 months
Lipid Profile (HDL, LDL, Triglyceride, and Cholesterol)	1 year
Hep B antibodies	Once or until immune
Hep A antibodies	Once or until immune
Hep C antibodies	Once
RPR (syphilis screen)	Once
Liver function tests (basic metabolic panel)	3 months–1 year (depending on medication regimen)
Toxoplasmosis titer	At diagnosis

Table 2. Additional measures

Patients With HIV	Measurement Area
Two or more Viral Load tests within a 7-day period	Duplicate lab tests
Women	
Abnormal Pap smear without a followup Pap smear within 3 to 5 months.	Lab results lacking of followup

2. Cost-Effectiveness Data

The economic analysis entailed a Cost Estimation of implementing the various aspects of the health IT intervention. In addition a Cost-effectiveness Analysis of the intervention on cervical cancer patients and a Medical Cost Savings analysis of the intervention on HIV patients were planned but were unable to be completed because we did not find significant post intervention improvement. This issue will be discussed in more detail in Section IV, subsection A.

The costs of implementing the health IT intervention involve both initial fixed (i.e., start-up) costs of the IT system as well as the ongoing costs of using the health IT. The start-up costs have been captured as the Alliance implementation team has kept detailed project plans for both Howard Brown Health Center and Heartland Health Outreach. To capture start-up costs, the Alliance team provided data as to the initial hardware (network and site level user equipment), software, cost of preload, and “professional services” needed to support the implementation of the system. In addition to these start-up costs, there are ongoing (variable costs) associated with this health IT intervention, which include both IT support and clinician involvement in patient care.

To assess the additional time spent due to the implementation of the health IT intervention, we used an expedited version of the “time and motion” approach, whereby six clinicians and ancillary personnel provided details on the amount of time spent on various activities.

Based on this data, the total costs of implementing the IT intervention were calculated based upon cost categories. The aggregate costs involved summing across each individual component and across various clinical and ancillary personnel.

B. Qualitative Methods

We gathered qualitative data via 1- to 2-day site visits and followup telephone calls to two CHCs and the Alliance headquarters. Prior to the site visits and telephone interviews, we identified key informants based on job title. Thirty-three key informants were interviewed including IT staff, laboratory staff, clinical staff, and administration (see Table 3 for complete breakdown of participants). During the site visits, at least two study investigators interviewed each informant, and interviews lasted 30 to 60 minutes. Followup telephone calls were used to interview key informants who were not able to be present during the site visits. All interviews were recorded and transcribed verbatim.

Table 3. Key informant interview totals

Site	Type	Job title	Number
Howard Brown	<i>Clinical Personnel</i>	Physicians/NPs	4
Howard Brown	<i>Clinical Personnel</i>	Nurses	2
Howard Brown	<i>Clinical Personnel</i>	Medical Assistants	2
Howard Brown	<i>Administrative Personnel</i>	Administrators (clinic manager and medical director)	2
Howard Brown	<i>Administrative Personnel</i>	IT Personnel	2
Howard Brown	<i>Administrative Personnel</i>	Lab Personnel	2
Howard Brown	<i>Other Personnel</i>	Patient Navigator	1
Heartland Health Outreach	<i>Clinical Personnel</i>	Physicians/NPs	3
Heartland Health Outreach	<i>Clinical Personnel</i>	Nurses	3
Heartland Health Outreach	<i>Administrative Personnel</i>	Administrators (clinic manager and medical director)	2
Heartland Health Outreach	<i>Administrative Personnel</i>	IT Personnel	1
Heartland Health Outreach	<i>Administrative Personnel</i>	Lab Personnel	1
Heartland Health Outreach	<i>Other Personnel</i>	Case manager	1
Alliance Staff		Implementation Services Manager/Former Director of Operations for HHO	1
Alliance Staff		COO	1
Alliance Staff		Director of Performance Excellence	1
Alliance Staff		Clinical Implementation Specialist	1
Alliance Staff		CMO	1
Alliance Staff		IT	1
		<i>Total Number of Interviews Completed</i>	33

Interviewers used a semistructured interview guide that included open-ended questions and several questions probing for more detailed information. The topics covered during the interviews included the rationale for EHRS adoption; the EHRS implementation process; roles and responsibilities during implementation; implementation barriers; benefits of the EHRS; utilization of the EHRS in lab ordering and results communication at the point of care; barriers to using built-in decision support for laboratory testing; workflow changes resulting from EHRS implementation; and perceptions about leadership support. Interview guides were pilot tested in another comparable CHC and refined prior to use in this study.

We coded interview transcripts to identify broad themes and patterns subsequently analyzed using the qualitative data analysis software program Atlas.ti (version 5.5).

IV. Results

The evaluation yielded a set of interesting yet mixed results. While some positive impact of the EHRS was found, some areas for improvement remained. Interviews with key informants revealed EHRS-associated improvements in workflow as well as areas in which the EHRS remained ineffective.

A. Quantitative Component

While a statistically significant improvement before and after implementation of the EHRS was not found, there were several findings of interest.

1. Duplicate Tests

The study documented the number of duplicate Viral Load tests for HIV patients before and after implementation of the EHRS. While a statistically significant improvement after implementation was not found, the Centers performed well on this measure both before and after implementation. Less than 1 percent of tests were duplicated in all time intervals examined. Duplicate Viral Load tests are not an issue for Centers possibly because providers and patients tend to be very aware of status on this important lab.

2. Followup for Abnormal Pap Smears

In contrast, low rates of followup after abnormal Pap smears were found in both Centers studied despite the existence of an EHRS. On average fewer than 7 percent of abnormal Pap smears received followup. Table 4 describes the rate of abnormal Pap smears in each Center, and Table 5 describes the follow-up rates by Center. Due to limited data in the time period preceding implementation of the EHRS, we were unable to compare follow-up rates pre and post implementation. However, in the post period there remained great opportunity for improvement.

Table 4. Rates of abnormal Pap smears

Pap Result	Center A	Center B	Total
Abnormal	21 (12.5%)	39 (7.6%)	60 (8.8%)
Normal	144	465	609
Other	3	7	10
<i>Total</i>	<i>168</i>	<i>513</i>	<i>681</i>

Table 5. Rates of followup after abnormal Pap smears

	Center A	Center B	Total
Abnormal without followup	20	34	54
Abnormal with follow up	1(4.8%)	3(8.1%)	4(6.9%)
Total	21	37	58

3. Guideline Compliance

Guideline compliance for HIV lab measures did not show statistically significant improvement at 6 or 12 months postimplementation. However, when current compliance rates (20 months postimplementation) were included in the analysis a trend of improvement is evident on numerous measures. This finding illustrates that in certain areas there may be a lengthy time period after implementation (in this case almost 2 years) before substantial improvement is detected. See Table 6 for compliance levels at the various time intervals.

The Alliance was unable to provide compliance measures for Hepatitis A, B, and C screening, and toxoplasmosis titer. Lipid and toxoplasmosis results were not provided as the preloaded samples for these measures were too small for meaningful analysis. In the case of the toxoplasmosis this deficiency is most likely because the guideline calls for the test at the time of diagnosis, and many patients may have been diagnosed in the distant past. The hepatitis measures were complicated by the fact that they were not pure lab measures. The guidelines call for a hepatitis screening or evidence of a vaccination.

Table 6. Guideline compliance rates for HIV lab test

	Pre EHRS	6 Months Post EHRS	12 Months Post EHRS	20 Months Post EHRS
Viral load	68%	63%	58%	68%
CD4	67%	63%	64%	73%
Lipid profile	84%	89%	87%	93%
Liver function tests	88%	84%	84%	87%

4. Cost Analyses

The lack of statistical improvement in the two quantitative outcomes of interest did not allow for a calculation of an incremental cost-effectiveness ratio. The denominator of the cost-effectiveness ratio is zero when there is no statistical difference in outcomes (i.e., no improvement in outcomes associated with adoption of the EHRS), and division by zero is not mathematically possible. From a cost-effectiveness standpoint, a program that does not improve a health outcome does not provide value for money unless there are other components of the program that were not captured. Given that we did not find a suitable

effectiveness measure, our analysis focused instead on the costs of implementation rather than ongoing costs.

The costs of program implementation include both start-up and continuing operation costs. Estimates for start-up costs range from \$143,360 to \$168,340 for hardware, software, and related implementation costs for personnel. In addition, there are estimated infrastructure costs of \$14,500 to \$22,000 and lost productivity costs due to training at initiation of \$9,349 to \$12,466. Ongoing costs for hardware, software, and related operational costs for personnel range from \$30,272 to \$45,128 per year.

B. Qualitative Component

1. Benefits of the EHRS

Access to patient information. According to clinicians, not having to search for Paper charts is the primary advantage of having an EHRS; a patient's record is always accessible.

Staff communication. The EHRS has improved staff's ability to communicate with each other about patient care. If a provider is in the room with a patient, another staff member can communicate with him/her by sending a "flag" to the provider's desktop.

Documentation. Staff agreed that the EHRS has improved the quality and quantity of documentation. However, some clinicians stated that charting takes more time now that the record is electronic. Unlike a Paper chart, information is entered in multiple sections rather than on a single page. Having to "jump back and forth" between different sections during a patient visit is cumbersome and does not "fit the way providers think and document during a visit." As a workaround, staff take notes and enter the information into the chart later.

In addition, the EHRS was not customized to facilitate sensitive and culturally appropriate documentation for the unique populations served by CHCs. Documenting gender, mental and behavioral health issues, HIV status, and homelessness provided challenges and required creative workarounds.

2. EHRS Areas for Improvement

The key areas for improvement of the EHRS focused primarily on usability issues as opposed to the EHRS purpose or functionality. One common theme focused on aspects of the system that slowed providers down during visits. The following functional areas presented usability challenges that resulted in time-consuming workarounds.

- **Log in:** For security reasons, providers are required to log out each time they leave the exam room. This results in providers having to re-log in for each patient visit. One provider commented, "If you're seeing patients every fifteen minutes it can really cut into your time."
- **System speed:** At times the overall performance of the system is slow. This results in frustrated providers hand writing notes to be input at a later time.

- Search function: For certain clinical areas the search functionality is particularly burdensome. Providers must scroll through pages of similar terms before encountering common medications or diagnosis codes.
- Lab order printouts: Because the interface between the laboratory vendor and the EHRS is unidirectional, lab staff must print out orders from the EHRS and manually enter them into the laboratory system.

3. Impact on Workflow

Laboratory ordering. Clinicians reported that the EHRS made the lab ordering process more efficient. During the patient visit, clinicians simply click on the test they want to order and the request is sent electronically to the lab. This process takes less time than searching for and filling out a Paper requisition. For HIV, customized test panels are also considered helpful since they enable clinicians to order multiple labs at the same time with a single click.

Not being able to search the system for lab tests by Center was cited as a barrier to electronic ordering. Presently clinicians must scroll through all Centers' tests, which is time-consuming. Clinicians also reported that searching for infrequently ordered tests is not straightforward, i.e. tests are not categorized intuitively. Similarly, the way lab results are organized on the patient flow sheet (alphabetically) makes it difficult for providers to perform a quick search to determine whether a particular test has been performed previously.

Unlike clinicians, laboratory staff reported that the EHRS has had little impact, positive or negative, on ordering tests. The primary reason is that the ordering process is still largely manual for the lab. Although clinicians can place orders electronically, the lab receives this information on Paper via printouts. Laboratory staff must then manually enter the order into the reference lab's system. In addition, electronic ordering does not prevent clinicians from placing orders with missing or inaccurate diagnosis codes. Since this information is required by the reference lab for processing, laboratory staff must either search the record or contact the clinician who ordered the test to obtain this information. For tests that are not already in the EHRS, lab staff must have an IT person add the test to the system so that the result will transfer properly into the record.

Results retrieval and viewing. There was consensus among clinicians that laboratory result turnaround times are faster since the introduction of the EHRS. Physicians reported that having electronic access to results at the point of care saves time since it is no longer necessary to print out lab results. Others also reported that being able to graphically display trends in lab values over time facilitates communication with patients, especially regarding their treatment progress.

Test results are sent electronically from the reference lab to the EHRS. However, problems with the interface between the EHRS and the reference laboratory prevent certain test results from transferring directly into the EHRS, such as Pap smears. This creates workflow barriers for both laboratory staff and clinicians. Results that do not populate the EHRS are sent to an error file and must be manually entered by laboratory staff. Since there is no system alert when lab results do not transfer into the EHRS, clinicians may be unaware that a result is missing until the next patient visit. When they do notice a result is missing they must rely on laboratory staff to help track down the result.

Quality monitoring. Electronic access to laboratory results and other types of information has made tracking provider compliance with clinical practice guidelines and performance reporting easier compared to doing Paper chart reviews. However, obtaining accurate data for certain lab-based performance measures has been problematic due to issues with the lab interface.

Decision support for laboratory ordering. To provide patient-specific decision support at the point of care, clinical decision support systems (CDSS) need to interface with the electronic medical record to retrieve patient-specific data and to effect recommended actions through computerized order entry. A major barrier to creating effective CDSS is a lack of national interoperability standards for integrating clinical decision support systems with the EHRs and other relevant systems (e.g., laboratory vendor systems).

In this study, many clinicians considered clinical decision support for laboratory ordering for both HIV and cervical cancer screening to be ineffective. The primary reason is that lab results do not consistently populate the patient flow sheet or disease management forms, which in turn renders guideline-driven prompts for testing inaccurate. Consequently, clinicians end up ignoring the prompts. This issue is particularly problematic for cervical cancer screening, since neither the date nor the result of the Pap smear test automatically populates the EHRs. Viral Load and CBC results also do not consistently populate the disease management forms.

Chronic disease management forms. In theory, providers consider disease management forms for HIV, cervical cancer and other chronic conditions as valuable decision support tools for ensuring compliance with evidence-based clinical practice guidelines. However, there are two major issues with the forms which have yet to be fully resolved. First, alerts for labs and vaccinations are often incorrect because the data that trigger them (e.g., lab results, test dates and diagnosis codes) are either incomplete or inaccurate. Second, the forms are too lengthy and contain too many components. Therefore, clinicians are often unable to complete the form during the patient visit. This is problematic because unless every measure on the form has been “checked off,” it counts against providers’ performance. For these reasons, many providers don’t use the forms.

As a workaround, some providers reported that they manually enter results into the disease management form themselves. Although burdensome, one physician stated that “this is the only way I can keep track of what I have done.” Other providers use this workaround to ensure that system-generated performance reports accurately reflect their compliance with practice guidelines. Despite these challenges, providers recognize the value of having clinical decision support in the EHRs, stating that the reminders for laboratory ordering are useful when they are accurate.

4. EHRs Implementation

Staff training and clinic productivity. Training was conducted by Alliance staff and each Center’s Implementation Team (comprised of staff from IT, nursing, operations, lab, medicine, and senior management). Staff were first trained in groups according to position, i.e., physicians, nurses and medical assistants, case managers, lab, IT, and registration staff. Each group received approximately 2 to 24 hours of training. Training sessions were tailored

to each group's workflow. Extensive training was also provided to individuals serving as "super users." The super user's role was to support staff after implementation as well as train new employees on the system. Although the primary super users at each Center were IT staff, physicians, nurses, and medical directors also served in this role.

Subsequent training included simulations in the clinic, "go-slows," and a dress rehearsal prior to implementation. During the simulations, volunteer patients were brought in to the clinic and "walked through each one of the different stations." Following each walk-through, staff discussed what worked and what did not, and adjusted workflows accordingly.

Staff perceptions about training on the EHRs were mixed. While some described the training as comprehensive, others stated that it did not sufficiently prepare them to transition from Paper to electronic records for several reasons. First, the training was too basic and not tailored specifically enough to their workflow. Second, it was offered too far in advance (3 weeks) of implementation. As a result, staff had forgotten much of what they learned once the system went live. Third, there was not enough "hands on" training provided, and fourth, there was not enough time for staff to test the redesigned workflows and address any issues that came up prior to implementation.

During the first two weeks after implementation, clinic productivity was reduced by 50 percent to give staff time to adapt to the new workflows. Productivity was increased incrementally after this, returning to 100 percent approximately 6 weeks after implementation. Staff members agreed that increasing productivity incrementally helped them become comfortable with using the system.

Postimplementation support. For 30 days following implementation, Alliance staff remained on site to provide hands-on training. IT staff were also available in the clinic to help answer staff's questions and concerns as they arose. Many staff reported that this is when they truly learned how to use the system. However, providers stated that even after several months they still do not consider themselves to be efficient users and do not know how to use the system's more complex features.

Ongoing training offered by the Alliance has been very limited although staff agreed that this would be beneficial. Training on how to navigate the system more efficiently, how to use its search functions, and common workarounds for certain system-related issues were suggested. In addition, there is limited training for system updates. Typically users are informed of updates via email with telephonic training available. Some users feel that hands-on training for system updates with significant changes would be valuable.

CHC-specific barriers. Several EHRs implementation problems were related to the distinct features of the CHC setting. Key informants from both CHCs and the Alliance noted the difficulty of complying with all regulatory requirements associated with Federal funding. For example, documentation requirements for certain programs were reportedly so detailed that the staff needed to run queries by hand or use additional software to generate reports rather than rely on the EHRs. While this challenge could certainly be classified as an EHR-specific challenge, respondents' comments made it clear that the requirement was more of a CHC and regulatory issue than an EHR-specific issue, as no off-the-shelf product could reasonably be expected to facilitate this complex reporting.

Technical barriers. Technical challenges that emerged included problems with the lab interface, delays logging onto the system and printing, and other barriers resulting from having multiple sites of care and multiple types of providers. Users perceived these technical challenges to directly and indirectly create barriers to workflow. To resolve the lab interface issue the Alliance is planning to replace its current interface with one that is bidirectional so that both orders and results can be transmitted electronically.

V. Discussion

A. Limitations

These findings are qualified by several limitations. First, the generalizability of the results is limited given our findings are based on two Centers within a single network utilizing the same EHRS system. While the findings seem applicable to most CHCs and most types of EHRS, they may not be generalizable to other types of organizations using other kinds of health IT tools.

The sample sizes used in the quantitative analyses were small. Larger samples would have allowed us to perform tests of statistical significance as opposed to mere observations of differences and trends. In addition, we were unable to obtain data for the period prior to the EHRS implementation for abnormal Paps. Preimplementation data may have allowed us to state whether the EHRS was having any impact on follow-up rates. In addition, several HIV labs were excluded due to insufficient data. However, we believe these labs are likely to have shown trends consistent with the available data.

A limitation of the qualitative findings is that they are based on perceptions from a limited number of users. Other users may have different perceptions of the impact of the system on productivity and workflow. Our findings, however, are based on consistent themes in the perceptions of personnel in a variety of roles.

Despite these limitations, the data that are reported provide some valuable insights into the actual experience of two Centers. While the results may not reach the level of statistical significance and may not be generalizable beyond the safety net environment, they nonetheless can be used to identify opportunities for improvement and assist organizations in anticipating barriers in implementation.

B. Implications

These findings highlight the fact that while health IT has the potential to improve quality of care by facilitating laboratory ordering and management of lab results, these improvements may be accompanied by corresponding setbacks. Despite these mixed results the CHCs studied overall had positive views of the EHRS and its organizational impact.

The findings illustrate that while systems such as these are beneficial in many ways, they do not solve every quality issue, nor is the timing of the improvement always instantaneous. Improvement may be very gradual and preceded by a period of deterioration. This initial deterioration may be caused by technical challenges, workflow issues, or user inexperience with the system. The process of identifying and resolving these issues may take many months. Users also noted that post implementation support has been limited. Organizations

would benefit from a lengthy period post go-live in which hands-on support is available. In addition, follow up trainings, particularly following system updates, could benefit users of all levels. This additional support may shorten the delay before improvement is evident.

Our study also revealed several aspects of the CHC setting that should be considered in EHRs implementations. First, some off-the-shelf EHRs systems may not have adequate documentation tools for the unique patient populations served by CHCs. For example, large number of transgender and intersexed patients presented challenges to the EHRs used by the Centers studied. In addition, the considerable regulatory reporting requirements placed on CHCs should in theory be facilitated by an EHRs. Our findings, however, indicate that not all systems are responsive to these unique requirements and resulted in Centers performing manual tasks.

In addition, the costs associated with these systems are not insignificant. Both start up and ongoing costs can be substantial. While these estimates may vary across systems and organizations, the relative magnitudes provide insight into the major “cost buckets,” which include technology as well as personnel time. Furthermore, the cost estimates provide a relative magnitude of the start-up costs versus the costs of continuing an EHRs program.

VI. Conclusion

The CHCs studied overall had a positive experience implementing and using an EHRS. Despite the barriers encountered during and after implementation, users and organizational leaders agree that they do not wish to return to the preimplementation environment. While the impact of the EHRS on access to and management of lab information for two patient populations showed mixed results, the organizations appear to be headed toward improvement in both areas.

Several factors could help other Centers interested in the process of implementing an EHRS shift the balance in favor of improvement. There currently is a dearth of health IT products on the market customized to the needs of CHCs. The areas of clinical documentation and reporting appear to be the most problematic. EHRS vendors willing to develop products tailored to the unique needs of CHCs or willing to customize their existing products for this setting are needed.

Even with the requisite customization, CHCs implementing these systems should anticipate inconsistent impacts on quality and efficiency. While health IT can be greatly beneficial in both areas, achieving this improvement takes time and effort. Interfaces represent one specific technical area that is often problematic. Resolving these types of technical challenges can be a lengthy process.

In addition, special attention to certain issues or populations may be warranted. This evidence suggests that followup after abnormal Pap smears in a CHC setting is one such area. Perhaps specific health IT tools within an EHRS need to be focused on this area or existing decision support needs fine tuning. Regardless of how health IT may be able to assist, CHCs should look closely at this area.

These findings are not meant to discourage the use of health IT but rather to encourage organizations to set realistic expectations. It may take years for users to take full advantage of the advanced functionality that drives the quality and efficiency improvement promised by health IT tools. Improvement trends are often unpredictable for the first several years due to unforeseen technical and workflow issues. Progress in using health IT to improve quality of care is also hindered by a lack of national interoperability standards governing information exchange between systems.