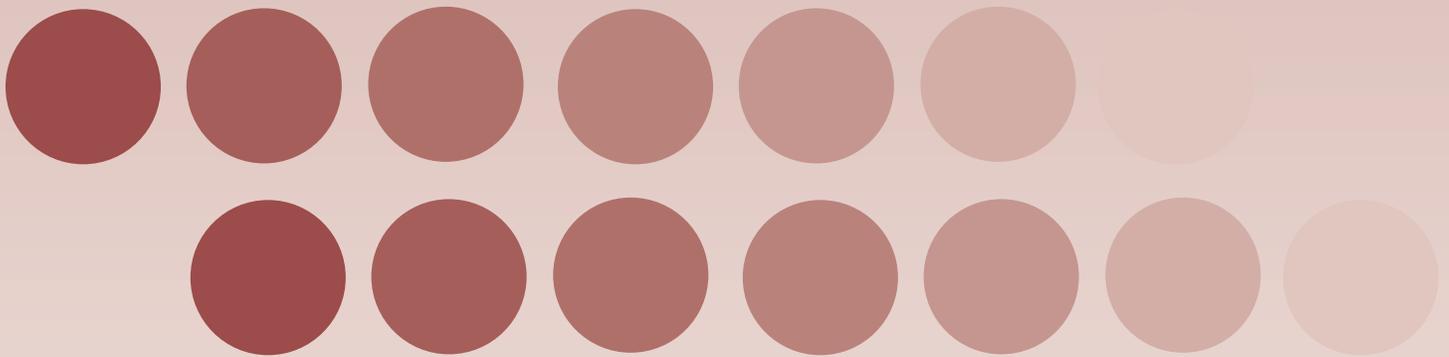


Final ACTION Contract Report

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



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

Implementation Handbook

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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/Purpose

The purpose of this Implementation Guidance is to highlight some key aspects of the electronic health record (EHR) system implementation process, with a specific focus on strategies for use of advanced functionality for customized, point-of-care decision support related to electronic laboratory data. The intention for the Guidance is to augment already available tools with some practical observations relevant to community health centers, physician practices, and other healthcare organizations contemplating EHR system adoption. The implementation strategies discussed in this Guidance are tied to case study observations in an attempt to bring recommendations throughout the Guidance to life through real-world experience.

The Guidance was informed by two formal evaluation activities: (1) initial and ongoing assessment of the EHR implementation process and (2) an evaluation of clinical decision support for electronic laboratory testing. The latter has surfaced multiple insights into key issues that must be addressed for successful utilization of decision support. Observations from both evaluation activities suggest emphasis on three major aspects, highlighted throughout our discussion:

1. Creating Organizational Alignment and Support
2. Technical Considerations
3. Implementation Process and Use of Advanced Functionality

The three themes above are discussed in the following sections: Background/Framework, Strategic Implementation Considerations, and Case Studies.

I. Background/Framework: The Promise of EHRs With Advanced Functionality

Current EHR Adoption Rates

Health information technology (health IT), such as an EHR, has the potential to improve the quality and safety of health care delivery. Despite widespread agreement about the promise of EHRs, adoption has been slow, especially in ambulatory settings. In a national survey of 2,758 physicians, DesRoches and colleagues found that 13 percent of physician practices had implemented a “basic” system, and only 4 percent were using “fully functional” EHRs.¹ The distinguishing factor between basic and full functionality was that EHRs defined as having basic functionality did not have certain order-entry capabilities and clinical decision support (CDS). According to the Institute of Medicine’s framework for capabilities of an EHR,² robust functionality includes aspects like 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.

Vision for how EHRs Can Improve Care Delivery

An EHR system with the functionality to support safety and quality initiatives holds the potential to transform the way care is delivered. EHRs can facilitate the delivery of culturally appropriate care (e.g., by flagging that the patient may need an interpreter if English proficiency is limited), coordinate care for the individual patient by making available relevant, actionable data (e.g., medications, preventive services, screenings, etc.); identifying opportunities for improvement across entire populations; and eventually producing data to inform national quality and safety initiatives. To fully realize this potential, however, EHRs must be deliberately implemented with thought given to these end goals. Elements of health IT to support quality improvement and patient safety include—

- Standardization of documentation.
- Enhanced availability of information (patient, population, and knowledge-based).
- Integration of patient-level health information across settings and disciplines.
- Enhanced ability to analyze and display information.
- Decision support for care against evidence based standards.
- Performance measurement and reporting.

Most available commercial products are not positioned to be utilized for some of these functions, in particular CDS and performance measurement. Rather, significant investment of time and resources is required on the part of the user to develop these functionalities. Even given the appropriate technical capabilities, an appropriate, detailed implementation plan must be

coupled with infrastructure for ongoing evaluation and support to ensure that the advanced functionality is used optimally when the system is rolled out.

Role of CDS

The overall goal of CDS—which is defined by the Health Information and Management Systems Society (HIMSS) as a mechanism of “providing clinicians or patients with clinical knowledge and patient-related information, intelligently filtered, or presented at appropriate times”³—is to improve outcomes important to an organization. Evidence suggests that CDS has the potential to positively benefit both the diagnosis and management of chronic conditions, as well as the identification of patients eligible for preventive screening services, though there is great variation in the literature about the actual effect size of CDS.⁴⁻⁶ Active decision support attempts to bridge the “know-do” gap—the large chasm between what is known to be the best clinical science for a patient and what actually happens in clinical practice.⁷

EHR in Use

Throughout this Implementation Handbook, we provide concrete examples from a local EHR implementation at the Alliance of Chicago Community Health Services (Alliance) to illuminate the broader messages. The Alliance is a network of federally qualified community health centers (CHCs) that formed in 2002 with a shared vision of EHR implementation across the entire network. These Centers carried out an AHRQ demonstration project to use a commercial product to report against national quality measures. Two of the four founding health centers were subsequently involved in the AHRQ-funded ACTION Project titled “*Improving Quality Through Health IT: Testing the Feasibility and Assessing the Impact of Using Existing Health IT Infrastructure for Better Care Delivery.*”

Use of the EHR by the Alliance Centers is distinguished by the integration of evidence-based practice recommendations into the end-user interface to provide decision support at the point of care and to facilitate subsequent reporting against national performance measures. To drive consistent use of the system as well as uniformly apply data elements and capture methods, the Alliance implemented the EHR system as a centrally hosted application, with uniform content across all the Centers. The implementation plan was designed around the necessity to use the EHR technology’s full functionality from the moment the system was implemented, or “go-live.” As an example, clinical laboratory interfaces were established between the EHR and all lab vendors used by the various health centers prior to go-live.

Initial CDS was designed around the initial clinical performance measures of focus for diabetes, cardiovascular disease, asthma, depression, HIV, and preventive care.

A data warehouse was developed to enable more robust data analysis and reporting at the provider, health center, and population levels than is typically native to a commercial EHR. Clinical dashboards summarizing performance against national measures are issued monthly across the Centers, and provider- and practice-level reports are utilized at the Centers to support performance improvement and provider evaluation processes.

The Alliance sites have been live on the system for about 3 years. Clinical leadership committee work, end user surveys, studies such as the AHRQ study and ongoing optimization

efforts have provided increasing insights into facilitators and barriers of effective CDS. Turning these insights into optimization strategies is a key area of focus to strengthen current use and improve future implementations.

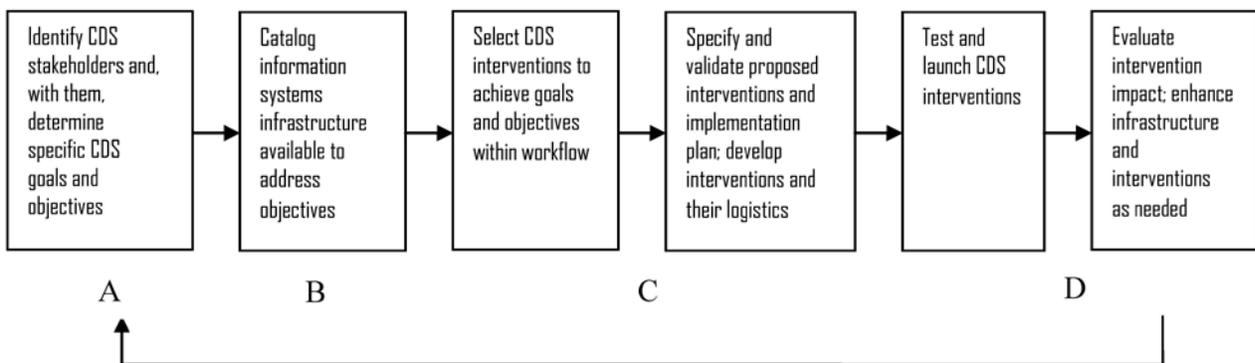
II. Strategic Implementation Considerations to Achieve Clinical Decision Support

In this section, we review the components associated with successful implementation of EHR-enabled clinical decision support (CDS). We have organized observations into four areas:

- A. Developing CDS Goals
- B. Cataloging Available Systems and Components
- C. Selection, Development, and Implementation
- D. Evaluation of Impact

These can be related to the framework offered by the Health Information Management Systems Society (HIMSS) outline for implementation of CDS (Figure 1).⁸

Figure 1. HIMSS model: steps for applying CDS to improve outcomes



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A. Developing CDS Goals

From a practical standpoint, development of CDS goals involves not only defining objectives to be achieved, but positioning the organizational will and resources to achieve them. Aspects articulating a vision, creating organizational alignment, development of an infrastructure to support ongoing identification of specific decision support content and priorities and incorporating change management principles to managing change, and dealing with resistance.

Articulating a Vision

The first step for implementation of EHR-enabled CDS is organizational consensus around a well-articulated vision for how the new technology can transform care. Built into this vision is

the understanding that the status quo (paper medical records, in this case) is no longer acceptable to providing the high quality, safe, equitable care that an organization desires. At various points during the implementation of the EHR, it will become necessary to return to the stated vision to guide decisionmaking, resources, and strategies to overcome potential resistance.

Examples of components that may be part of a shared vision for an EHR include—

- Useful and practical at the point of care.
- Holistic – promoting multidisciplinary model of care.
- Facilitates the delivery of coordinated, seamless care to the patient.
- Integrated with clinical workflow to promote efficiency and timely use of information.
- Interfaced with other electronic data bases to promote timely, efficient data capture and continuity of care.
- Tool for incorporating evidence-based recommendations into practice.
- Capable of providing population level data and reporting to support quality improvement.

Underlying these components of the vision, it will be necessary to gain support for adoption of commonly held standards of care, uniform and timely data capture, and an identified set of performance measures.

To achieve needed support by clinicians, these standards of care need to be related to a shared set of values for overall clinical quality, such as those promulgated by the Institute of Medicine's *Crossing The Quality Chasm* report:

- Safe
- Effective
- Efficient
- Timely
- Equitable
- Patient Centered.

Relating goals involving CDS to these higher values of quality is key to overcoming resistance to aspects of the implementation such as practice guidelines, uniform data definitions and capture methods, and increased effort required for using advanced functions of an EHR.

Infrastructure to Support Management of CDS

Beginning with the goal-setting stage, it is important to identify an organization structure with appropriate investment of clinical leadership and technical knowledge to (1) make specific recommendations regarding content and format; (2) manage clinician use; and (3) make ongoing adjustment based upon evaluation of CDS processes and outcomes. In addition to appropriate clinical expertise and representation, it is important that a practical decisionmaking process be identified. Ideally, the decisionmaking process should incorporate informatics best practices and clinical evidence rather than simply opinion. It is critical that the investment in this infrastructure is seen as an ongoing commitment, to assure that initial recommendations are supported,

appropriately adjusted and evolved over time, and that responsive performance improvement initiatives can be developed. Individuals participating in this infrastructure also have a key role to play in managing organizational change and resistance.

Creating Organizational Alignment

Because of the magnitude of change involved, an effective EHR implementation process must incorporate principles of change management. Daryl Conner (citation) outlines four key roles in the change process:

- Sponsor – individual with authority to legitimize change and to allocate necessary resources.
- Change Agent – individual charges with bringing about the change.
- Target – individual carrying out the changed processes.
- Advocate – individual who supports the change and can provide encouragement and assistance but who has no direct organizational role in the change process.

Clarification and effective execution of all of these roles is crucial, beginning with effective sponsorship by executive leadership. The vision for the implementation must be articulated and reaffirmed by the organizational leadership throughout the process. In a subsequent section, we discuss the other important roles that are key to the success of EHR implementation. This sponsorship must include clinical leadership. As primary end users of the EHR, clinicians must be productively engaged in all major steps in the project, including product selection, design of the clinical content templates to be used at the point of care, testing the system, preload, go-live, and ongoing evaluation/modification. Sponsorship to achieve clinician buy-in relies upon a well-articulated vision communicated and reinforced by sponsors and change agents.

Approach to Resistance

Early in the change process, rewards are an effective tool to gain support for the change. For clinical staff this may include public recognition, incentives, and workflow efficiency gains. Midway through the process, “logistical hassles” become effective. Logistical hassles represent ways in which it becomes more difficult to practice in the old way. An example is making it easier to find laboratory results in the EHR than in paper or removing paper requisitions from the work area.

At the late stages, negative consequences for failing to adhere to new processes may become necessary. Examples of the impact of failure to establish/reinforce clinician vision for use of decision support follow in the case study.

B. Cataloging Available Systems/Components

For organizations that are in the selection process for an EHR, certain technical features are of key interest with respect to CDS:

- Ability to customize format and content of CDS. While the degree to which an organization may have the desire and/or resources to develop organizational-specific CDS strategies may vary, the ability to adjust these on at least macro levels to match clinical practice is helpful.
- Degree to which data elements can be captured easily in the workflow. To be useful at point of care and decisionmaking, data capture must be real time. Since this implies that clinical staff will need to document in the course of practice and while face to face with patients, the data elements must be structured appropriately.
- Ability to interface with other electronic data sources. Particularly in the case of laboratory testing where significant data is available in electronic format, the ability of the system to accept this data without need for separate data entry is an important practical consideration.

Once the particular software system is selected, the functionality available for CDS needs to be catalogued and evaluated. This includes the forms in which decision support can be provided ranging from more passive (e.g., templates/pre-constructed order sets) to more active (e.g., pop-up prompts based upon specified patient criteria) If the system has standardized CDS available, this needs to be compared to organizational specific protocols to identify gaps or inconsistencies. Mechanisms for altering/suppressing decision support also need to be understood.

Finally, the cataloging process includes the assessment of the organization's ability to manage CDS content, delivery and use. This includes not only clinical expertise, but also informatics and the technical expertise needed to manage the IT components of the system.

C. Selection, Development, and Implementation of CDS

Once an organization has achieved alignment around the vision of the EHR implementation for advanced use and contemplated the necessary administrative and technical aspects of the project, consideration should be given to an approach to implementation that will specifically foster clinician buy-in and optimal use. Important elements of implementation to consider are as follows:

- Selection of the implementation team
- Workflow redesign
- Approach to CDS
- Performance measure integration
- Technical build
- Training
- End-user satisfaction/engagement
- Optimization activities

Identification of an Implementation Team

Although each implementation is unique, there are several attributes of the teams responsible for successful implementations, detailed in the following table.

Table 1. Key attributes of an implementation team

Implementation Team Attributes
▪ Team comprises cross-departmental staff . Establishing an environment of mutual trust and respect is the foundation for building and maintaining an effective team.
▪ Effective communication among all team members, including clinicians, administrators, and practice support staff.
▪ A clinical champion and an administrative champion are identified. These people are opinion/implementation leaders in the health center.
▪ The team meets together on a regular basis to discuss the project status.
▪ Ground rules are established for meetings.
▪ Each team member "owns the change" and understands why the change will be an improvement.
▪ All affected stakeholders are part of the project and agree to the project process and goals.

For a robust scope of CDS, the following roles/functions should be represented on the Implementation Team: providers, nurses, medical assistants, IT management, clinical management administrative management, patient support services (e.g., reception, billing), quality improvement, data management, medical records, and behavioral health/case management. Just implementing an EHR system gives a clinical practice the opportunity to improve the care delivered to patients.

Implementation activities should be guided by a specific and detailed work plan. This work plan should include attention to several key processes: workflow analysis and redesign, data migration, training, etc.

Workflow Documentation and Reengineering

Implementation of CDS is likely to highlight the need to reengineer potential workflow barriers to facilitate and support staff to more effectively capture necessary data elements to deliver care. Conversely, the ability to provide adequate opportunity to interact with the EHR at points of care where decisionmaking takes place may require significant alterations in care processes. Documentation of the clinical workflows done for EHR implementation serves as a basis for this analysis.

Failure to account for workflow considerations can lead to ineffective data capture at critical points in the care process, or may lead to uncoupling of decision support from real time decision-making, rendering it ineffective in impacting care.

Technical Considerations

As mentioned earlier, the following technical considerations are particularly critical to the use of advanced EHR functionality such as CDS and quality measurement:

- Role of structured data elements.
- Creation of laboratory interfaces.
- Format of clinical prompts.
- Technical performance.
- Staff training/productivity expectations.

Role of Structured Data Elements

Development of end-user templates – clinical content. In order for clinical data to be used in meaningful ways, there are several key considerations: (a) most of the data must be entered into defined, structured fields in the EHR; (b) the data capture must fit seamlessly into the clinician's workflow during the patient visit and not require extra clicks or navigations to new screens; (c) the data captured on the front end of the EHR must be mapped on the back end to clinical practice recommendations and algorithms to calculate performance on quality measures; and (d) the system must be flexible enough to allow for modifications when the evidence underlying guidelines or CDS changes.

Importance of preloaded information. Preloading involves initializing a patient's electronic chart with clinical information from the paper record. Just as the development of clinical content for end-user templates requires consensus from clinicians, deciding which data elements are preloaded into the EHR should also be a consensus-driven process. There are three ways to preload information into an EHR chart for the first time:

- Enter discrete clinical data manually through an update. Staff can add data for clinical lists (such as medications, problems, allergies, directives, vital signs, immunizations, and lab data) using preload encounter forms or a chart update (e.g., updates problems, medications).
- Import specific discrete observation data. This option requires the creation of a lab interface (see below). Lab data can be imported into the chart and into a flowsheet, and many labs can send historical information electronically to assist in preloading patient data.
- Import other information through an interface. This option includes importing patient demographic (which can be linked to quality measures to examine if disparities in care exist for specific groups to target interventions effectively) and appointment data typically received from a Practice Management System or using documents imported via a transcription interface. This can include hospital discharge notes, letters, and previous office notes.

In order for data to be used for advanced functions like CDS and quality measures, organizations might consider preloading the following fields:

- Problems – active problems from problem list, summary page, or flow sheet
- Medications – from medication list, summary page, or flow sheet
- Allergies
- Date of last physical exam – from progress notes
- Height, weight, head circumference, BMI
- Pulse, respirations, and blood pressure at last visit
- In-house labs – most recent
- HIV testing
- Preventive care dates: Pap smears, mammograms, hemocult, sigmoidoscopy, colonoscopy, lead screening
- Immunizations
- Brief medical, family, social history – using brief one page form

Individual practices may decide to preload additional data based on the unique patient populations served, such as patients with a specific chronic disease.

Creation of Laboratory Interfaces. Since most practices rely on offsite laboratories, it is desirable to create a functional interface for test results to seamlessly populate the EHR from the lab. In the absence of interfaces, and/or where data cannot be reported in a compatible format, results must be manually entered. Manual processes are resource intensive, and may lead to inaccurate or incomplete data capture.

Interfaces with national reference lab systems require utilizing standard HL7 formatting to ensure that the in-bound data can be mapped to appropriate data standards in the EHR itself. Lab data must be in these EHR-standard fields in order to be used in CDS and national performance measure algorithms.

Although laboratory standards exist (called LOINC codes), many reference labs use proprietary coding for results. In response to this, many commercial EHRs have developed mapping tools to translate results from reference labs into their own language. Practices considering EHR implementation should investigate whether or not their EHR vendor has completed such mapping.

The lack of conformance by reference laboratories to standard LOINC codes complicates the process of developing and managing interfaces. To support effective CDS, the interface must be continuously monitored to assure that changes in coding do not interfere with accurate data population of the EHR. This problem can be partially alleviated through a two way interface including outgoing orders and incoming results. Where reliance on manual processes cannot be avoided, workflows must be carefully developed, monitored and revised as needed.

In the case study, the significant negative impact of unreliable laboratory data on accuracy of and clinician confidence in decision support underscores the importance of investment of resources for interface development and monitoring/quality control of automated and manual processes.

Format of Clinical Prompts. A detailed approach to CDS is presented in Section C below, but it is worth noting a couple of technical considerations related to prompts.

According to HIMSS, there are six types, or varieties, of CDS:

1. Documentation/forms templates
2. Relevant data presentation
3. Order creation facilitators
4. Time-based checking and protocol/pathway support
5. Reference information and guidance
6. Reactive alerts and reminders

Technical Performance of the EHR. Initial and ongoing monitoring of the EHR system itself is necessary to ensure that the technical architecture is functioning adequately. Aspects of the IT infrastructure that should be monitored include testing of the following:

- Hardware such as the edge router, core router, cabling of network equipment.
- Workstations to ensure preloaded clinical data is available prior to go-live.
- Reliability of printers and end user workstations.
- Scanning functions for hard copies of documents from outside organizations.
- System stress.

Staff Training/Productivity Expectations

Staff Training. Each end user needs training relevant to his/her position. The table below lists suggested classroom training hours by role in the clinical practices.

Table 2. Suggested classroom training hours by role in the clinical practices

Role	Training Hours
Providers – <i>Physicians, Nurse Practitioners, Physicians Assistants, Nurse Midwives</i>	24 hours
Nurses	16 hours
Medical Assistants	12 hours
Behavioral Health Staff	8 hours
Case Managers	4 hours
Lab Staff	4 hours
Front Desk Staff	2 hours
IT/Support Staff	Attend clinical end user training + 2 hours support training
QI/Data Staff	1 hour
Management Staff	Attend training in appropriate departments

Once a user has completed classroom training, a proven way to retain and incorporate the new knowledge is to practice in the clinical environment. The Implementation Team should build in on-the-job training that includes simulations in the clinic, “go-slows,” and dress rehearsal prior to Go-Live. Given the significant amount of training needed, practices must consider and adjust for the productivity cost of scheduling training for clinic staff.

Productivity. Scheduling plan involves scheduling designated patients for simulations and determining how many patients the providers are expected to see during the first few weeks of

Go Live. You will need to develop a plan to return to normal productivity over the course of a few weeks or months.

D. Evaluation of Impact

Performance Measure Integration

One of the key aspects of most organizations' vision for health IT integration is to improve the quality of care being delivered. However, the ability to leverage an EHR to support CDS and performance measurement is not an automatic function in most commercial EHRs. Often significant effort is needed to create the standardized data capture on the front end and develop detailed measure algorithms on the back end. Supported by grant funding, the Alliance broke down the specifications for nationally-endorsed performance measures, ensured that all necessary data elements were present in discrete EHR fields, and designed passive and active decision support to drive providers to populate data in those fields. The Alliance then developed a clinical data warehouse to aggregate all necessary data elements into performance calculations. In completing this work, the Alliance has gained significant insights, including:

- Defining the discrete data elements which must be collected for each measure
- Defining inclusion and exclusion criteria
- Building content and format into end user screens in the EHR to facilitate collection of the measures which must be collected at the point of care.
- Identifying outside sources of data (such as laboratory test data) and constructing necessary interfaces
- Developing report formats and protocols and training providers.

It has become clear that ongoing interaction between the clinical end user, the EHR software developer, and the performance measure developer is critical to address the level of detail which must be addressed.

Most national performance measures are now specified for use in EHRs, and should therefore be integrated into systems that practices are implementing. Practice leadership, QI staff, and providers should agree upon what measures will be collected, and which data elements are needed to calculate such measures.

End User Satisfaction/Engagement

To evaluate the impact of EHR implementation, assessing end user satisfaction with the system is a critical step. While some tools are widely available at the national level, many organizations develop their own survey, allowing the flexibility to add specific questions of interest. For example, if an organization was interested in the effectiveness of the CDS currently built into the EHR, the survey might contain questions on alert fatigue, helpfulness of the existing documentation templates, usefulness of links available on different screens to access more clinical information, and overall satisfaction with how well decision support is helping

drive better care. Broader questions to continuously monitor clinician buy-in and engagement are also important components of the survey.

Optimization Activities

Once the EHR has been successfully implemented and in use for some time, most practices will naturally begin to think about the next phase in EHR use: *optimization*. Ongoing refinement of CDS is an important aspect of this optimization. Optimization activities include advanced or remedial training, refinement of decision support delivery methodology, enhancement in scope of CDS, further integration of CDS with point of care CDS, and adjunctive technology.

Practices should have in place a process for incorporating results of user feedback and evaluation data, upgrades to software and technology, changes in medical knowledge and evolving insights in informatics science into continuous improvements in the CDS system. Furthermore, as Health Information Technology advances, practices will need to plan for the introduction of advanced technology to integrate with the EHR. Examples of such technology may include:

- Patient portal or personal health record
- Videoconferencing for telemedicine
- Public health database interfaces
- Medical device integration
- Connectivity for health information exchange

III. Case Studies

In this section we describe our experience implementing a commercially-available EHR in federally qualified community health centers. The EHR was implemented with the deliberate intention to be leveraged as a tool to improve the quality, safety, and equity of care delivered to the underserved, vulnerable populations at the health centers.

EHR Implementation in Two Community Health Centers

Howard Brown Health Center and Heartland Health Outreach are two of the four founding members of the Alliance of Chicago Community Health Services (Alliance).

Brief Overview of Howard Brown, Heartland Health Outreach

Howard Brown Health Center is the Midwest's premier lesbian, gay, bisexual, and transgender (LGBT) health care organization, and leads the region in addressing the comprehensive health care needs of people in the LGBT community. In response to community needs, Howard Brown has developed a comprehensive range of services including primary health care, health education programs, case management, counseling, and psychotherapy. Visit volume at its largest location is greater than 10,000 patient visits per year, of which over 1,600 patients have HIV/AIDS. According to its mission, Howard Brown provides services to individuals regardless of means or ability to pay, and is an important part of Chicago's safety net for clinics facing both financial and cultural barriers to care.

Howard Brown is also involved in research. In 1982, Howard Brown was chosen by the National Institutes of Health to participate in the largest study of HIV and AIDS in the world. More than 20 years later, the study still continues at Howard Brown, and follows the general health and the longitudinal progression of HIV in its HIV-positive subjects.

Heartland Health Outreach is a federally funded community health center and healthcare for the homeless site, providing primary health care, mental health and addiction services, and oral health care to homeless, immigrant, refugee, HIV positive, and working poor populations at various sites throughout the city and through outreach efforts. With nationally known model programs, Heartland Health Outreach provides innovative and culturally appropriate mental health services to the most poor and vulnerable people in the city. In addition to primary health care services, daytime drop-in centers, behavioral health and case management services, and residential programs help people stay out of mental hospitals and off the street. Heartland Health Outreach also offers specialized mental health care to refugees and trains providers locally and nationally to practice culturally appropriate health care.

EHR Roll Out/Timeline

Howard Brown and Heartland both went live with the Alliance's centrally hosted EHR in 2006 – in October and December, respectively. Each center has multiple clinical sites, and selected their largest site to be the first to go-live, then rolled out the EHR to their remaining

sites throughout 2007. As a result of the Alliance’s comprehensive approach to implementation, Howard Brown and Heartland both went live with full functionality (see list below) all at once. This approach, known as the “big bang theory,” ensures that all data being collected at office visits and through interfaces is entered into discrete, searchable fields from the very beginning. Some of the components of full functionality include—

- Provider decision support
- Disease management forms – with discrete data element fields mapped to national performance measures
- Medication safety functionality
- On-line provider order entry
- Referral management
- Access to comprehensive patient education content

Formal Evaluation of EHR Implementation

Initial Evaluation. When the Alliance first selected an EHR and developed a plan to implement it at all its health centers, the organization worked with an external researcher to formally evaluate the project—especially with respect to use of advanced functionality such as CDS. The purpose of the evaluation was to demonstrate achievement on each of the four project goals. Below is a list of the goals and the current status of each:

1. EHR implementation that ensures consistency and accuracy of health information
STATUS: All four founding Alliance health center members are live on the centrally hosted EHR, sharing uniform data capture methods, clinical content and CDS. Content covers all clinical services including primary care, ophthalmology, podiatry, dental care, nutrition, mental health, case management, and outreach.
2. Ability of the data warehouse to aggregate, monitor, and feed data back to the organization.
STATUS: A clinical data warehouse is operational and being utilized for reporting against national performance measures at the individual provider, clinical site, and entire health center level, and stratified by race and ethnicity.
3. Use of the EHR/data warehouse to implement national performance measures for evidence-based care.
STATUS: Both active and passive decision support against national guidelines is being provided to practitioners for preventive care, diabetes, cardiovascular disease, asthma, and HIV
4. IT-facilitated improvements in patient safety and ability to deliver evidence-based care.
STATUS: Dashboard reports are being provided monthly to all health centers, and used for improvement initiatives, provider evaluation, and planning.

Ongoing Evaluation. Ongoing monitoring of the Alliance’s EHR takes place under several domains:

- Patient Satisfaction – A patient satisfaction survey is administered to all Alliance health centers every 6 months.
- System Use Measures – The Alliance routinely collects and distributes measures related to use of the EHR itself. Many of the measures are related to use of disease management forms, in which CDS is embedded. This system use information can then be paired with information on clinical performance measures, provider satisfaction, and other metrics.
- Provider Satisfaction – Many of the questions on the Alliance’s Biannual End User Satisfaction Survey are designed to understand whether the advanced functionality, such as CDS and access to lab data, influence the way the end user delivers care. A sample question from the survey is below.

Table 3. Sample question from Alliance’s Biannual End User Satisfaction Survey

Instruction: Based on your experience, indicate the ease of which GE Centricity allows you to perform the following tasks:	
	Does not apply to me Very difficult Somewhat difficult Somewhat easy Very easy
A.	Obtain and review patient information and data
B.	Document care for my patients
C.	View lab tests for my patients
D.	Prevent adverse events (e.g., drug-drug interaction, drug-allergy interaction)
E.	Track preventive care for my patients
F.	Manage chronic disease conditions for my patients
G.	Manage orders
H.	Manage referrals
I.	Provide patient educational materials
J.	Analyze outcomes of care
K.	Access the EHR from offsite locations
L.	Communicate with my colleagues to coordinate care
M.	Communicate with my patients
N.	Enhance the continuity of care my organization is able to provide

AHRQ-Funded Evaluation of EHR Use for Laboratory Ordering and Laboratory-Based Decision Support for Chronic Disease Management. In 2008, the Health Research and Educational Trust (HRET) in collaboration with researchers from Northwestern University and other institutions conducted an evaluation of EHR use at Howard Brown Health Center and Heartland Health Outreach. The evaluation was specifically focused on how the EHR facilitates lab ordering and results communication at the point of care to improve quality of care in two important areas: treatment of HIV and screening for cervical cancer. To gather information about these functions as well as barriers to using built-in decision support for laboratory testing, key informant interviews were conducted with 27 staff members across the two centers, 8 of whom were clinicians (4 physicians and 3 nurse practitioners, and 1 physician assistant). IT personnel, administrators, lab supervisors and technicians, nurses, and medical assistants were also

interviewed. The following describes staffs' experience using the EHR for laboratory-related tasks, including problems encountered and suggestions for improvement.

Electronic laboratory ordering. In general, clinicians reported that the EHR has 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 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. Additionally, clinicians reported that searching for infrequently ordered tests is not straightforward, i.e., tests are not categorized intuitively.

In contrast to clinicians, laboratory staff reported that the EHR has had little impact on their efficiency in ordering tests, the primary reason being 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.

Electronic results retrieval and viewing. Test results are sent electronically from the reference lab to the EHR, specifically to the ordering clinician's desktop. Once the clinician signs off on a result it automatically populates the patient record. All staff interviewed agree that this process has notably improved access to test results at the point of care. Physicians reported that having electronic access to results facilitates communication with patients, especially regarding their treatment progress. Electronic access to laboratory results has also made tracking provider compliance with clinical practice guidelines easier compared to performing paper chart reviews.

The majority of lab results are transferred directly to clinicians' desktops without issue however there have been ongoing challenges with certain tests such as Pap smears. It is unclear why Pap smears in particular do not populate the EHR; however results generally fail to populate if the information received from the reference laboratory is formatted differently than how it is formatted in the EHR. For example, date of birth and provider identification number each has a unique format in the EHR. Since orders are entered manually, the potential for formatting errors during the order entry process is also fairly high. Results that do not populate the EHR are sent to an error file and are manually entered by laboratory staff. To resolve this issue the Alliance is planning to replace its current laboratory interface with one that is bidirectional so that both orders and results can be transmitted electronically.

Since there is no system alert when results do not populate the EHR, clinicians may not realize they are missing until the next patient visit. When they do notice a result is missing, clinicians stated that they rely on laboratory staff to help them locate it in the system or call the reference lab.

Laboratory-based decision support for chronic disease management. CDS for laboratory ordering for both HIV and cervical cancer screening was considered by many clinicians interviewed to be ineffective. The primary reason is that lab results do not consistently populate

the system's decision support tools (i.e., disease management forms), which in turn renders protocol-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 populate the EHR. Viral load and CBC results also do not consistently populate the forms. As a workaround, some clinicians 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 clinicians use this workaround to ensure that system-generated clinical performance reports accurately reflect their compliance with evidence-based laboratory test guidelines. Despite these challenges, clinicians recognize the value of having CDS in the EHR, stating that the reminders for laboratory ordering are useful when they are accurate.

Impact of the EHR on duplicate lab tests, followup for cervical cancer screening and guideline compliance. An additional component of the HRET evaluation utilized quantitative data to investigate the impact of the EHR on duplicate viral load lab tests for HIV patients, abnormal Pap smears lacking followup and guideline compliance. Data from 6 months prior to implementation was compared to that from 6 and 12 months postimplementation.

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

There was a very small number of duplicate viral load tests both before and after implementation (<1 percent of tests performed both before and after). Duplicate viral load tests are not an issue for clinics possibly because providers and patients tend to be very aware of status on this important lab.

In contrast, the community clinics exhibited low levels of followup for abnormal Pap smears prior to implementation, a problem that persisted after implementation. The fact that followup for abnormal Pap smears did not improve following implementation of the current EHR system indicates that data and technology alone are not sufficient to improve care. Decision support or additional functionality targeting this area is warranted.

Guideline compliance for HIV lab measures and for cervical cancer screening did not show a statistically significant improvement at 6 or 12 months post implementation. However, when current compliance rates 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 evident.

No formal cost-effectiveness analysis on duplicate lab tests or follow up for cervical cancer screening was performed because the lack of statistical significance means that the cost-effectiveness ratio would be undefined. The fact that there was a very small number of duplicate viral load tests suggests that the use of EHR should focus on alternative interventions where the return on investment is likely to be greater.

Lessons learned and next steps. Several strategies have been implemented in the Centers as a result of the findings of the study:

- Workflows for capturing the results of Pap smears have been refined and/or reinforced through retraining and implementation of quality control procedures.

- Clinical staff have been engaged through the Clinical Leadership Committee to work proactively to address concerns about data integrity.
- As clinical staff become increasingly reliant on the EHR to perform administrative tasks, they are able to dedicate more time to improving follow up and management of abnormal laboratory results. There are two ways in which the EHR and data produced may facilitate such improvements on a longer term. Data on poor followup is now regularly reported through monthly clinical dashboards presented to Health Center leadership and other key stakeholders. These trend data can inform decisions on priorities for performance improvement. In other areas, this data has actually allowed Heartland to secure funding for additional staff for follow up with patients.
- One-on-one retraining of clinicians is also proving effective in identifying additional training needs, and has led to recommendation of a comprehensive postimplementation assessment and retraining 6 to 8 weeks after go-live in new sites.
- Finally, a two-way laboratory interface is being introduced, so that the outgoing order sent directly from the EHR can be matched to the incoming result. The two-way interface improves efficiency as well as accuracy and completeness.

Conclusions

Successful implementation and ongoing support of health IT requires significant capital resources and technical expertise. These are likely not practical or affordable for individual practices to obtain, particularly those in the Safety Net. Health center-controlled networks, such as the Alliance, which supported implementation in the study centers, represent a shared infrastructure through which such resources can be more easily developed and maintained. Furthermore, through this infrastructure, other current and future users of the EHR in the collaboration can benefit from lessons learned and improvements in approach.

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