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Using Information Technology to Improve Health Quality and Safety in Community Health Centers

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Abstract

Problem—Community health centers (CHCs) face a unique set of challenges and can learn much from each other as they prepare for the adoption of health information technology (HIT).

Purpose—This paper presents a research agenda aimed at providing information CHCs will need to successfully implement HIT.

Key Points—Community health centers must be able to evaluate whether an investment in HIT is the best way to achieve improvements in health outcomes for their communities given the limited resources and high demands they face. Community health centers need better information to guide them in selecting and implementing information technology that will result in improved health quality and safety. Guidance in optimal use of the system, particularly in the effective use of data made available through electronic health records, is needed to realize health care goals. Community health centers need to be active participants in HIT developments in their communities to ensure that their patients benefit from technological advancements that improve health care.

Keywords

electronic health records; health information technology; community health centers; health care quality; health care safety

Community health centers (CHCs), like many other health care settings, are expanding their use of information technology to improve health care and health outcomes for their patients. *Health information technology* (HIT) has been defined as “the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision-making.”¹ It is considered fundamental to improving the quality of health care.²

At our organization, the Institute for Urban Family Health, we implemented a fully integrated electronic health record (EHR) and practice management system at our primary care practice sites four years ago. Drawing on our experience using EHRs and our review of the medical literature on the impact of HIT on the quality and safety of patient care at CHCs and other primary care sites, we have developed a set of research questions for the CHC community to consider as it moves forward in the implementation of HIT.

STRATEGIC PLANNING FOR HEALTH QUALITY AND SAFETY IMPROVEMENTS

How Do CHCs Determine Whether an Investment in HIT will help?

As HIT proliferates throughout the country, we must assess the extent to which it will achieve expected goals. The health care system does not have sufficient resources to engage in this expensive new technology without tracking its return on investment—not only financially, but

in terms of quality improvement and improved efficiency. This is particularly true for CHCs, which serve many of the nation's neediest people. This paper was originally commissioned for the December 2005 meeting, "Health Centers and the Medically Underserved: Building a Research Agenda," in order to provide meeting participants with a common knowledge base on needed research on HIT at health centers.

Community health centers have an obligation to use retained earnings to meet their strategic goals and to expand the public benefits they offer. Thus, they must ask fundamental questions. Is HIT the best use of the limited funds available to a health center for quality improvement linked to the center's strategic plan? Can we predict the public benefit that will accrue from the implementation of HIT in the care related to any single disease or preventive measure? If a health center discovers that late diagnosis of breast cancer is a major community health problem, will an investment in HIT be likely to improve this problem? Would it be more effective to hire an outreach worker?

The expansion of technology must be developed on a solid base of evidence that critically examines the cost/value of HIT development against other potential care improvement interventions. At present, such evidence is limited. We do know that, although EHRs are a central component of HIT, the ultimate goal is not merely to have paperless records. The goal is to make patient data more available for care decisions across a range of health care providers, and to use the power of programmed decision supports to produce prompts and reminders for providers to ensure that best practices are observed and opportunities for preventive health are not missed. One large health maintenance system described its "unsuccessful run at creating an automated medical record" that focused on eliminating a paper record, and reports on a more successful approach that is built on uses such as point-of-service care delivery, epidemiologic research, long-term care management, and guideline development.³

The need for clinical decision supports is evidenced by a much-cited study that found that, despite the promise of evidence-based medicine and the development of clinical guidelines, patients in the United States receive recommended care only half of the time.⁴ Studies of the use of clinical decision support software in primary care practice have found increases in the quality of care provided, such as increased use of preventive measures and risk assessments in an urban pediatric primary care center,⁵ improved care management for diabetic patients in a multispecialty group practice,⁶ improved triage decisions for possible skin cancer in city health clinic and HMO practices,⁷ and increased tuberculosis infection screening for at-risk community health center patients.⁸

Within our own organization, the decision to invest in an EHR system was prompted by our need to monitor enhancements in the quality of care throughout the 20 locations in our multisite practice. The use of clinical reminders built into our EHRs has resulted in greater adherence to clinical guidelines, such as administering pneumococcal vaccines for elderly and at-risk patients. Reminders related to care of diabetes patients have led to a steady decline in the number of patients with uncontrolled diabetes over the past three years.

It has been noted that inappropriate prescribing is the cause of 20% of drug-related adverse events.⁹ Clinical decision supports have been used to address adverse drug events. One study found the alerts had an impact on the ordering of the needed laboratory tests at a primary care safety net health center, especially when alerts indicated that relevant laboratory values were unknown for the patient for whom the prescription was being ordered.¹⁰ A computerized prescription alert feature available to Canadian physicians was found to reduce the initiation of inappropriate prescriptions, but had a variable effect on discontinuation of such prescriptions.¹¹ The ability to order diagnostic tests, a feature included in many EHR systems, has the potential to influence providers' test ordering behavior through automated alerts.^{12,13}

A recent meta-analysis of studies examining the use of clinical decision supports in a variety of settings identified four features of such systems that are associated with improvements in clinical practice.¹⁴ These features include decision support that is provided automatically as part of clinician workflow; that is delivered when and where decisions are being made; that provides “actionable” recommendations; and that used a computer to generate decision support. Further study is needed to examine the magnitude of outcomes, and identify which features have the largest impact.

SELECTING HEALTH INFORMATION TECHNOLOGY

How Do CHCs Determine What Type of HIT to Implement?

Community health centers across the country are in vastly different stages of development in relation to HIT. Eight percent of CHCs currently use EHRs, although 86% use either disease-specific registries, practice management systems, or both.¹⁵ Important research questions arise from the potential outcomes of various levels of HIT investment and from the variety of systems being offered to CHCs nationally.

Although EHRs have been evaluated in technology journals and by professional associations, we did not find a single reference to the effectiveness of different products with respect to quality and safety improvements as we searched for the optimal system. Although this critical information is missing, much is known about effective methods of providing decision supports in EHRs, types of reports that are useful in patient tracking and recall, and other features of EHRs that will assist in improving quality outcomes. A particularly useful text in this regard is “Improving Outcomes with Clinical Decision Support: An Implementer’s Guide.”¹⁶

At the institute, we chose to implement a completely integrated EHR and practice management system (Epic System Corp., Madison, WI), because the company has a stellar record of successful implementations and the software is designed to support community-based primary care settings. We were also impressed that Epic’s client portfolio contained many of the leading health care systems in the United States. The Epic system enables us to pursue the practice of population-based medicine, enhances our out-reach efforts through the creation of computerized patient lists, and provides easier access to patient education materials—all important functions of a CHC.

HIT IMPLEMENTATION

What Strategies Show the Most Promise for Use in CHCs?

As CHC implementation of HIT evolves, it is important for “first adopters” to document and evaluate the HIT implementation process itself.¹⁷ Each center’s experience should improve the odds for success at the centers that come after it. Thus, the research agenda should assess both successes and failures in CHC HIT implementation to identify best practices.

Many implementation issues are ripe for research, including the characteristics of health centers that are associated with successful HIT implementation; the approach to implementation, whether incremental or “big-bang,” as a factor in success; and the timing of implementation. The unique needs of CHCs and their patients may lead to specific types of HIT implementation and attention to special issues, such as sliding fee scales, specialist referrals and tracking, and offering health education information in multiple languages.

For example, there are many models for incorporating existing paper records into a new EHR. We devised a method that worked exceptionally well for us, but may not be suitable for other settings. After being trained on Epic, providers abstracted a new problem list, entered historical immunizations, created an up-to-date medication list, and had medical records staff scan

important documents into the records. Providers were encouraged to do this off-hours for their regular patients before the go-live date for the EHR. This allowed them to practice using the system and reduced delays when patients made their first visit after implementation.

MONITORING HIT USE AND IMPACT

How do CHCs Ensure That Goals are Met?

Health information technology is a tool for improving health care quality by making information available. Health care providers must use it fully for it to have the desired impact. Although we noted studies in which clinical decision supports have an impact on provider adherence to clinical guidelines, other studies have found that decision supports have no impact¹⁸ or that provider adherence is variable. The Veterans' Administration, for example, found high overall adherence (86%) to clinical reminders, but the frequency of reminders may affect adherence rates.¹⁹ Another study found that physicians often do not notice clinical reminders on the screen and do not always agree with the suggested action.²⁰ Although the study reported that the surveyed physicians were generally in favor of clinical decision supports, it concluded that prompts need to be brief, actionable, and based on endorsed guidelines to be accepted by physicians. Similarly, another study documented physicians' decisions to override prescription alerts, and found that physicians deemed one third of the alerts inappropriate.²¹

It is clear that installing these systems will not be enough to improve health care quality. Community health centers will need to identify ways to realize the potential of clinical decision supports by implementing systems that providers accept and find useful. Furthermore, additional resources may be needed to care for the problems that providers identify. Prompting providers to screen for depression, for example, leads to an increased need for mental health workers.

Staff training in the use of EHRs and decision supports is a critical element in HIT implementation. Methods of initial training and ongoing optimization of system use by staff have been developed both by HIT product vendors and users. An internal survey of our providers at the institute revealed that different features of our EHR are used by providers to vastly different extents, although nearly 100% of all progress reports and orders are made in the system. Should health centers insist on a consistent use of the system? Studies are needed to determine the relationship between the use of the system features and clinical outcomes that are achieved by the providers.

USE OF SYSTEM REPORTS

What Types of Data Are Most Useful?

With the implementation of an EHR comes a plethora of data that are stored indefinitely and accumulate rapidly. These data have many implications for research and raise many questions. What types of reports are useful for quality improvement? What is the value of each report to improvements in quality and safety? How do CHCs prioritize their activities when little evidence is available to guide them?

In the first year of our EHR implementation, the institute built a library of decision support tools for providers at the point of care. Because we had been involved in the diabetes collaborative sponsored by the Health Resources and Services Administration, we started by developing a set of measures related to diabetes care. After a year of collecting data electronically, we began an outreach program for patients who had not met certain clinical guidelines.

As we began to produce reports, we became rapidly overwhelmed by the implications of our work. We created listings of diabetics who had not been in the center for over 3 months and whose records indicated poorly controlled diabetes, patients on cholesterol-lowering medication who had not had their liver function tested within recommended guidelines, and those with elevated creatinine levels, indicating possible early kidney failure. Every report we ran resulted in lists of dozens of patients.

There is little knowledge base available to help EHR users compare the relative risks of patients with a variety of missed diagnostic or therapeutic interventions. And no CHC, perhaps no health care system of any kind, has the resources to follow-up on all these issues all the time. Research is needed to accompany diagnostic and therapeutic interventions that help to delineate the risk of these measures not being followed. Guidelines are needed to help EHR users prioritize their outreach efforts and prevent data from overwhelming staff.

POTENTIAL OF HIT IN COMMUNITY HEALTH CENTERS

What Will HIT Look Like in the Future?

There is great potential for HIT to transform the office visit. In the future, patients will be able to book their own appointments on-line and verify their registration information prior to office visits. Electronic interfaces with other data sets prior to patients' appointment can ensure that relevant information is available when needed. Insurance coverage and deductible levels can be verified through an interface with insurance companies. A Regional Health Information Organization database, populated by data from pharmacies, visiting nurse services, laboratories, emergency rooms, hospitals, specialists, and diagnostic centers will be searched to flag available patient information. A public health data bank can be scanned for infectious diseases or other health department alerts and appropriate prompts sent to providers.

When a patient arrives at the HIT-enabled center, a nurse will measure his or her blood pressure, blood sugar, temperature, weight, pulse, and respirations with a single device that is connected electronically to the EHR. In the examination room, a computer screen displaying the patient's medical record is visible for review by both the provider and the patient. Clinical alerts and any outside information can be reviewed as the provider engages in the office visit. As pertinent medical history is noted, additional questions appear on the screen that are programmed from evidence-based clinical guidelines.

The computer scans information from the history and physical, and suggests appropriate material from the multi-lingual patient education database. It can notify providers if programmed algorithms are violated, such as an order for hormone replacement therapy for a patient who has not had a screening for cervical cancer. Laboratory tests are ordered and bar-coded labels are printed in the laboratory to accompany the specimen, with results to be returned through an electronic interface. X-ray orders are sent directly to the appropriate facility based on practice location and appointment availability. Images can be made available immediately upon completion of the x-ray.

The technology to carry out all these functions is currently available. The limited penetration of information technology in the health care industry and the lack of interoperable communication keep us from implementing some of these features now. Experiments in the sharing of information across hospitals, home nursing services, physician offices, health centers, pharmacies, and patients are taking place across the country.²² It is critical that health centers find a seat at the table as these developments take place, representing both themselves as health care providers and the medically needy populations they serve. Further, CHCs will need to determine how we can help our patients to achieve the technological sophistication they will need to participate in these advancements.

Health information technology has great potential for involving patients in their own health care to a much greater extent than they are now. Part of this involvement will require that patients learn to use computers and have access to them. In a demonstration project taking place at Settlement Health in East Harlem in New York City, computers are made available to community residents to search and obtain health information. Librarians at the New York Academy of Medicine Library provide training for the local residents who, together with center providers, review health information available on websites.²³ Similar projects may need to be developed across the country to ensure that CHC patients are not left behind as technology is used increasingly to improve and manage health care.

ROLE OF COMMUNITY HEALTH CENTERS IN ADVANCING KNOWLEDGE

How Can Community Health Centers Use Technology to Advance Knowledge in Clinical Practice?

Data collected in the course of clinical encounters are often inadequate for research; they are incomplete and collected by a variety of people who have not been trained or required to collect it in a consistent manner. For example, our EHR has data on the race of over 96% of patients, but inconsistency in collection methods may make some uses of those data inexact. The ability to correlate race with clinical processes or outcomes is important to CHCs to understand if our work is decreasing racial health disparities, but cannot be done if patients' race data are not collected properly.

Despite limitations, mining data collected in CHC's EHRs may lead to new knowledge. The use of EHRs combined with artificial intelligence is an as yet under-developed field. As both fields evolve, combining artificial intelligence with electronic databases of symptoms, signs, and laboratory values may result in the discovery of unexpected correlations that are beyond our ability to calculate.

Information technology also offers many possibilities for facilitating clinical trials. Decision supports can identify trial candidates from EHR data and facilitate referral to a trial coordinator for further evaluation. People of color and low-income people have been historically underrepresented in clinical trials, thus bringing into question the applicability of the results of those trials to the patients we treat.^{24,25} Enrolling more CHC patients in clinical trials would greatly enhance the state of clinical information available in the United States.

CONCLUSION

The interplay between the rapid development of HIT and the imperative to improve the care of the patients in our community is complex. Although HIT is an important tool for quality improvement, the expense of purchasing, maintaining, training, and using an EHR must be balanced with other quality improvement initiatives. Community health centers must get involved now as networks of providers begin to use HIT to improve care, but careful research and evaluation of these developments is needed to optimize the use of financial and human resources.

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REFERENCES

1. Health Information Technology Leadership Panel; Falls Church: Lewin Group 2006. Final report. [updated 15, May 2006; cited 2006 December 1]. Available from www.hhs.gov/healthit/HITFinalReport.pdf
2. Leadership by example: Coordinating government roles in improving health care policy. Washington, DC: National Academies Press; 2002. Committee on Enhancing Federal Healthcare Quality Programs, Institute of Medicine.
3. Goverman IL. Orienting health care information systems toward quality: How Group Health Cooperative of Puget Sound did it. *Journal of Quality Improvement* 1994;20:595–605.
4. McGlynn EA, Asch SM, Adams J, Keesey J, Hicks J, et al. The quality of health care delivered to adults in the United States. *N Engl J Med* 2003;348:2635–2645. [PubMed: 12826639]
5. Adams WG, Mann AM, Bauchner H. Use of an electronic medical record improves the quality of urban pediatric primary care. *Pediatrics* 2003;111:626–632. [PubMed: 12612247]
6. Baker AM, Lafata JE, Ward RE, Whitehouse F, Divine G. A web-based diabetes care management support system. *Jt Comm J Qual Improv* 2001;27:179–190. [PubMed: 11293835]
7. Gerbert B, Bronstone A, Maurer T, Hofmann R, Berger T. Decision support software to help primary care physicians triage skin cancer: A pilot study. *Arch Dermatol* 2000;136:187–192. [PubMed: 10677094]
8. Steele AW, Eisert S, Davidson A, Sandison T, Lyons P, Garrett N, et al. Using computerized clinical decision support for latent tuberculosis infection screening. *Am J Prev Med* 2005;28:281–284. [PubMed: 15766616]
9. Tamblyn R, Huang A, Perreault R, Jacques A, Roy D, Hanley J, et al. The medical office of the 21st century (MOXXI): Effectiveness of computerized decision-making support in reducing inappropriate prescribing in primary care. *Can Med Assoc J* 2003;169:549–556. [PubMed: 12975221]
10. Steele AW, Eisert S, Witter J, Lyons P, Jones MA, Gabow P, et al. The effect of automated alerts on provider ordering behavior in an outpatient setting. *PloS Medicine* 2005;2:864–870.
11. Tamblyn R, Huang A, Perreault R, Jacques A, Roy D, Hanley J, et al. The medical office of the 21st century (MOXXI): Effectiveness of computerized decision-making support in reducing inappropriate prescribing in primary care. *Can Med Assoc J* 2003;169:549–556. [PubMed: 12975221]
12. Bindels RP, De Clercq A, Winkens RA, Hasman A. A test ordering system with automated reminders for primary care based on practice guidelines. *Int J Med Inform* 2000;58–59:219–233.
13. Bindels R, Hasman A, Kester AD, Talmon JL, De Clercq PA, Winkens RA. The efficacy of an automated feedback system for general practitioners. *Inform Prim Care* 2003;11:69–74. [PubMed: 14567873]
14. Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: A systematic review of trials to identify features critical to success. *Br Med J* 2005;330:765–768. [PubMed: 15767266]
15. National Association of Community Health Centers. 2006 survey of health center use of electronic health information. Washington, DC: 2006. Unpublished data
16. Osheroff, JA.; Pifer, EA.; Teich, JM.; Sittig, DF.; Jenders, RA. Improving outcomes with clinical decision support: An implementer's guide. Chicago: Health Information and Management Systems Society; 2005.
17. Fiscella K, Geiger HJ. Health information technology and quality improvement for community health centers. *Health Aff* 2006;25:405–412.
18. Tierney WM, Overhage JM, Murray MD, Harris LE, Zhou XH, Eckert GJ, et al. Effects of computerized guidelines for managing heart disease in primary care. *J Gen Intern Med* 2003;18:967–976. [PubMed: 14687254]
19. Agrawal A, Mayo-Smith MF. Adherence to computerized clinical reminders in a large healthcare delivery network. *Medinfo* 2004;11:111–114.
20. Sequist TD, Gandhi TK, Karson AS, Fiskio JM, Bugbee D, Cook EE, et al. A randomized trial of electronic clinical reminders to improve quality of care for diabetes and coronary artery disease. *J Am Med Inform Assoc* 2005;12:431–437. [PubMed: 15802479]

21. Schellhase KG, Koepsell TD, Norris TE. Providers' reactions to an automated health maintenance reminder system incorporated into the patient's electronic medical record. *J Am Board Fam Pract* 2003;16(4):312–317. [PubMed: 12949032]
22. McDonald CJ, Overhage JM, Barnes M, Schadow G, Blevins L, Dexter PR, et al. The Indiana Network for Patient Care: A working local health information infrastructure. *Health Aff* 2005;24:1214–1220.
23. New York Academy of Medicine. Unique East Harlem library resource charts 200+ requests first quarter. 2005 Sep 13 [Retrieved August 24, 2006]. [Press release], from www.nyam.org/news/2571.html
24. Svensson CK. Representation of American blacks in clinical trials of new drugs. *J Am Med Assoc* 1989;261:263–265.
25. Murthy VH, Krumholz HM. Gross CP Participation in cancer clinical trials: Race-, sex-, and age-based disparities. *J Am Med Assoc* 2004;291:2720–2726.