HEALTH CENTERS AND THE MEDICALLY UNDERSERVED: BUILDING A RESEARCH AGENDA

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Role of HIT in Improving Quality and Safety at Health Centers

Commissioned Paper:

Prepared by Neil Calman, MD, President and CEO

and

Diane Hauser, MPA, Senior Analyst

The Institute for Urban Family Health

Supported by the U.S. Department of Health and Human Services, Health Resources and Services Administration (HRSA)

Prepared Comments by:

Jose Camacho, Executive Director, Texas Association of Community Health Centers

Kevin Fiscella, MD, MPH, Associate Director, Rochester Center to Improve Communication in Health Care, University of Rochester School of Medicine & Dentistry

Jeremy Nobel, MD, MPH, Lecturer, Harvard School of Public Health

Ralph Silber, MPH, CEO, Community Health Center Network

The Community Health Center Research Agenda for Implementation of Information Technology as a Tool to Improve Health Quality and Safety

Neil Calman, MD and Diane Hauser, MPA
The Institute for Urban Family Health
New York City

In this paper, we review what is known about the impact of information technology on improving the quality and safety of patient care in community health centers and similar settings, and present a series of research questions to consider as we move forward in the implementation of health information technology (HIT). It is our hope that this paper will provide a springboard for examining the role of HIT in community health centers, and delineating a related agenda of research that will help move us swiftly and skillfully in the needed direction.

Health Information Technology in Community Health Centers and Other Primary Care Settings: Impact on Quality and Safety

Community health centers, 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 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" (Health Information Technology Leadership Panel). It is considered fundamental to improving the quality of health care (Committee on Enhancing Federal Healthcare Quality Programs). While not yet the norm in most health settings, some health centers have implemented health information technologies.

A 2001-02 survey from the National Center for Health Statistics found that while 73 percent of physician offices use electronic billing systems, only 17 percent use electronic health records (EHRs), and fewer than eight percent use computerized prescription order entry (Burt). Hospital emergency and outpatient departments have higher rates of EHR adoption, with 31 percent of emergency departments and 29 percent of out-patient departments using EHRs.

Although still limited in its use, some community health centers have had enough experience with HIT to study and document their experiences. We reviewed these experiences in order to learn what is known about the impact of health information technologies on the quality and safety of care in community health centers. Because we anticipated limited results to searches of CHC-based studies, we also reviewed studies

based in other primary care settings under the assumption that findings could be applicable to CHCs as well. We also included English language studies based in countries outside the U.S. in order to draw on experiences of health systems that have widespread use of HIT.

A. Electronic Health Records and Clinical Supports

Electronic health records are a central component of health information technology. EHR systems vary, with some capturing extensive patient data and others that are more limited. The ultimate goal is not merely to have paperless records, although experience in England where use of EHRs is nearly universal suggests that the quality of information in EHRs is better than that found in traditional paper records (Hippisley-Cox). The goal is to make patient data more available for care decisions, 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. An additional goal is to make the information in EHRs transportable across a broad range of health care providers and, in some cases, to patients themselves.

Once a patient's medical information is available electronically, it can be made available to both patients and to care providers at various points of service. The tremendous potential for improving quality and safety is realized when the EHR is integrated with clinical decision support, test and prescription drug ordering capabilities with built-in alert systems, and other emerging applications. One health system describes 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. With quality of care as the focus, rather than technology, cost, and utlization, components of the system support larger organizational goals and do not splinter into separate, uncoordinated projects (Goverman).

Clinical decision supports that are built into EHRs have been associated with improved patient safety, preventive care, and adherence to clinical guidelines in primary care settings. The importance of such features 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 U.S. receive recommended care only half the time (McGlynn).

Studies of the use of clinical decision support software in primary care practice have found overall increases in the quality of care provided, such as increased use of preventive measures and risk assessments (Adams), improved care management for

diabetic patients (Baker, Harwell), improved triage decisions for possible skin cancer (Gerbert), and increased tuberculosis infection screening for at-risk patients (Steele 2005a). Within our own organization, the Institute for Urban Family Health, use of clinical reminders has resulted in greater adherence to clinical guidelines such as administering pneumococcal vaccines for elderly and at-risk patients, and making referrals for ophthalmology consults for diabetic patients. Reminders to providers that the lab values for a patient indicate that their diabetes needs to be better controlled have led to a gradual and steady decline in the number of uncontrolled diabetics over the past three years. Not all studies of clinical support systems have shown increased adherence to guidelines, however. Tierney reports that evidence-based cardiac care suggestions displayed for physicians had no effect on physician adherence to guidelines (Tierney).

Tamblyn points out that inappropriate prescribing is the cause of 20% of drug-related adverse events (Tamblyn). Clinical decision supports have been used to address adverse drug events. Steele has reported on the implementation of a drug-laboratory test alert system in a primary care safety net health center. A pre- and post-intervention study found that the alert had a positive, though limited, impact on physician drug ordering when relevant lab values were unknown or presented risks. The alerts had a greater impact on the ordering of the needed lab tests when alerts indicated that values were unknown for the patient for whom the prescription was being ordered (Steele 2005b).

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 (Tamblyn). It is also interesting to note that the effect of the system was greatest among physicians who had more computer experience.

The ability to order diagnostic tests is included in many EHR systems. This feature has the potential to influence providers' test ordering behavior through automated alerts. In the Netherlands, national and regional diagnostic test ordering guidelines have been integrated into an automated reminder system for family physicians. An existing program that provides periodic structured feedback to family physicians has been shown to be effective in reducing the number of inappropriate tests ordered, but is labor-intensive. Bindels describes the development of the automated reminder system which focuses on frequently ordered tests for which clear guidelines exist (Bindels 2000). An experimental trial of the system found that the number of ordered diagnostic tests that were not in accordance with the guideline alerts decreased, and that general practitioners accepted half of the system reminders (Bindels 2003).

A recent meta-analysis of studies examining the use of clinical decision supports identified four features of such systems that are associated with improvements in clinical practice (Kawamoto). 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. Honing in on those factors which lead to effective clinical alerts is important, as evidence emerges that clinicians sometimes choose to ignore them.

B. Patient Registries

Some information systems are configured to create patient registries so that care management for a specific patient population can be carefully monitored against clinical guidelines. These registries have been shown to affect modest improvements in care (Baker, East). Even computerized registries created from paper records have had an impact. Protti reports that, in England, interviewed stakeholders pointed out that differently structured EHRs make it impossible to link or transfer data (Protti) and Onofrie reports on the need for consistent internal coding to effectively identify patients that belong in the registry (Onofrie). Yarnall reports on a project to introduce and track the use of health maintenance prompts in a specific patient population at a community health center where incompatible computer systems result in reduced efficiencies (Yarnall). These experiences speak to the need for comprehensive planning in the introduction of electronic information systems in CHCs.

C. EHRs and Patients

Many EHRs include patient education materials that can be tailored for individual patients and, in some cases, can be printed in a variety of languages. A study of cancer screening interventions at one community health center found increased preventive testing among women who received printed material and counseling that were "meant for me" (Rimer). Along with education materials, patients can receive printed visit summaries that they can use to keep track of physician visits and care plans. Some patients of the Institute for Urban Family Health have become so accustomed to receiving after-visit summaries of their encounter that they will remind their providers to print them if their provider forgets.

Taking this a step further, in some systems, patient can access their own medical records. By making the medical records available to patients, information about the patients' own

health status and medical care is demystified. Such access can lead patients to become more informed about and take greater ownership of their own health. A survey of ambulatory patients (Ross) found that both academic primary care center patients and CHC patients expect to benefit from access to their own medical records. CHC patients, however, are more likely to anticipate such benefits as improved physician-patient communication, better understanding of physician instructions increased adherence to treatment, and increased patient education and empowerment. Interestingly, CHC patients anticipated benefits to reviewing their own records, even though they expected to find them confusing. Physicians, on the other hand, anticipated concerns such as increased workload and disruption to the physician-patient relationship.

Physicians, including those within our own organization, have expressed concern about decreased eye contact with patients that results from the use of EHRs (Adams). Fifty-four percent of providers at our Institute indicated, however, that they review the EHR together with their patients during more than 50 percent of visits by engaging them in looking at the flat-panel displays on every exam room desk. This indicates that EHRs may change the dynamics of the patient encounter and that this change may be positive. Adams suggests that newer technologies such as wireless pen-tablets have the potential to improve eye contact, although at the Institute, providers felt they maintained the secrecy of clinical information rather than encouraging patients to become involved in reviewing their own progress.

D. Interconnectivity

The EHR offers dramatic potential to improve care in community health centers even if the information is not connected to any outside source. However, the ability to interface with other sites further enhances this potential. Sharing patient information with other providers at the point of care, including specialists assisting in the care of chronically ill patients, emergency care providers, or inpatient care providers, can improve the quality and safety of patient care. Chin describes the initiation of wide-area networks that allows physicians at multiple rural practice sites, as well as system hospitals, to access and enter patient information. He cites the need for a network to address the fragmented care received by rural residents who often seek only urgent care and choose providers based on available transportation (Chin).

Information and orders coming into and out of community health centers can be managed more efficiently through an interconnected EHR system. Referrals to other providers can be made online. Many physicians are dissatisfied with their management of test results and often experience delays. A recent survey of internists found that physicians seek

greater workflow efficiency, such as generating test result letters to patients, and test tracking capabilities (Poon). With an EHR, tests can be ordered online, and results can be retrieved and filed in the patient's medical record. In addition to maintaining information about prescriptions and providing clinical alerts, interconnected EHRs allow prescriptions to be sent directly to a pharmacy, resulting in improved efficiency for the patient and the potential for improved compliance.

This is a dynamic period in the implementation of information technology in ambulatory care. Although some may say that it is still early in the evolution of EHRs for a health center to make the huge investment required to implement them, the literature on health information technology shows that there is enormous potential for EHRs to improve the care of patients and CHCs need to remain in the forefront of quality improvement activities. EHRs can also lead CHCs to delivering more benefit to their patients for fewer dollars. In Australia, for example, where EHRs are more commonplace, three family physician partners discovered they were using three different approaches to antibiotic administration for urinary tract infections. The doctors tracked their patients' outcomes to gather evidence as to which approach worked best (Dickinson). They learned that the least intensive course of antibiotics had the same effect on patients as treatment with higher doses and longer duration, so patients could subsequently be treated in a less costly manner with fewer medication side effects. Expand that scenario to an entire community health care system, and the impact could be tremendous.

Research Questions for Health Information Technology in CHCs

Our experience using EHRs at our 13 primary care sites and our review of the impact of HIT on the quality and safety of patient care at CHCs and other primary care sites has shaped the formation of ten research questions for the CHC community to consider as it moves toward the implementation of health information technology.

Strategic Planning for Health Quality and Safety Improvements

1. How do CHCs determine whether an investment in health information technology is the best way to improve the quality and safety of health care in their communities? How do CHCs balance the capital, implementation, and training costs of HIT against other priorities as they engage in strategic planning?

While HIT is proliferating throughout the country, it is critical that we assess the extent to which it will achieve the expected goals. The health care system simply does not have sufficient resources to engage in this expensive new technology without tracking its return on investment – not just financially, but in terms of quality improvement, and

improved efficiency. This is particularly true for community health centers, which serve many of the nation's neediest people. CHCs must balance expenditures on HIT against the constant demands for increased and broadened scopes of service.

Community Health Centers have been required over the years to produce strategic plans for their health services development – plans which are based on community need as determined, at least in part, by available health statistics. Health centers have used a variety of methods to develop these plans, from strategic planning retreats with their board of directors and staffs to working collaboratively with public health experts in their communities. As not-for-profit corporations, CHCs also have an obligation to use retained earnings to meet their strategic goals and expand their public benefit. Good planning links these activities to direct a CHC's leadership to use its resources in ways that best address its community's needs.

- Is HIT the best use of the limited funds available to a health center for quality improvement linked to the centers clinical strategic plan?
- How can we predict the public benefit that will accrue from the implementation of HIT – in the care of any single disease entity or preventive measure?

Assume for a minute that Anytown Health Center discovers that a major health problem is their community is the late diagnosis of breast cancer and resultant excess mortality. Is investment in HIT likely to improve this problem? How would a health center predict the potential benefits that might accrue? Would it be smarter to hire another outreach worker? Or setup a mobile mammography unit? Perhaps a simple registry to track at-risk patients in need of cancer screening would be less expensive and more effective.

The rush to expand 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.

Selecting Health Information Technology to Improve Quality and Safety

2. How do CHCs determine what type of health information technology to implement in order to achieve the best quality and safety outcomes? How do CHCs evaluate different systems for their potential to improve quality and safety?

CHCs nationally are in vastly different stages of development in relationship to health information technology. Few are supported by fully functional EHRs. Many have built disease-specific registries using software recommended by the Health Resources and Services Administration (HRSA) or other PC-based software. Others have no experience with clinical computing but have practice management systems that do one or more of the standard functions of appointment scheduling, registration and billing.

CHCs also vary tremendously in the extent to which they have health information technology expertise among their own staff. At our Institute, fourteen full-time HIT staff led by a chief information officer (CIO) support a variety of computer systems including a fully functional EHR in 19 different locations. In a neighboring center without an EHR, one full-time HIT director and two part-time desktop support staff provide service to an almost equal number of providers.

With starting points as different at this, technological advancements to improve quality and safety will vary greatly in their sophistication and capabilities. Important research questions revolve around a central theme of understanding the outcomes one can expect from various levels of HIT investment and from a variety of systems being offered to CHCs nationally. While EHRs have been evaluated in technology magazines and by associations such as the American Academy of Family Physicians, we did not find a single reference comparing the effectiveness of different products on achieving improvements in quality and safety. While 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. One text which is useful in this regard is "Improving Outcomes with Clinical Decision Support: An Implementer's Guide" published by the Healthcare Information And Management Systems Society (H*i*MSS) and authored by Jerome A.Osheroff, MD, et. al. (Osheroff). Users familiar with this text are armed with the information needed to evaluate the *potential* effectiveness of EHRs to improve the quality of care given to their patients.

HIT Implementation

3. What methods of HIT implementation show the most promise for use in CHC environments? Which HIT implementation models are mostly likely to result in health care quality and safety improvements?

As CHC implementation of HIT evolves, it is important for "first adopters" to document and evaluate the HIT implementation process itself. As the process evolves, each center's experience should improve the odds for success for the centers that come after it. Thus, a research agenda needs to be developed to assess both successes and failures in CHC HIT implementation – describing the characteristics of the company, the CHC, the implementation model and other issues – in order to identify best practices. There are many areas ripe for research:

- What are the characteristics of health centers and their leaders that are associated with successful HIT implementation?
- Is HIT best implemented incrementally or in a "big-bang" approach in a community health center? Should centers start with limited functions, e-prescribing and on-line references, or buy a fully functional EHR right from the start?

- When is the right time to jump on the HIT bandwagon?
- How should old medical records be abstracted, copied, scanned or otherwise captured in the new EHR?
- What are the specific needs of CHCs and their patients which might lead to a need for a specific type of IT implementation? Are there special issues related to the roll-out of sliding fee scales, specialist referrals and tracking, impelementing health education information in multiple languages?
- …..and many other questions.

Monitoring HIT Use and Impact

4. How do CHCs monitor the use of technology investments to ensure that quality and safety goals are being met?

If we build it, will they come (and use it)? HIT is a tool for improving health care quality by making information available; must health care providers use it fully in order for it to have the desired impact?

A handful of studies examining the use of clinical reminders by primary care providers have found that adherence is variable. A system of VA clinics which has mandated computerized patient record systems, clinical supports, and clinician training, found overall high adherence to clinical reminders (86%), with variation in specific reminders from 63% for tobacco use cessation, to 96% for hepatitis C risk assessment (Agrawal). The authors suggest that the frequency of reminders (e.g. once vs. every 6 months) may affect adherence rates. Another study found that physicians often don't notice clinical reminders on the screen, and don't always agree with the suggested action. While 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 in order to be accepted by physicians (Sequist).

Similarly, another study documented physicians' decisions to override prescription alerts, and found that physicians deemed one-third of the alerts inappropriate. Independent reviewers agreed with the physicians' override decisions 98% of the time. At our own practice sites, provider use of EHR features varies considerably. In a recently completed and as yet unpublished survey of the Institute's 72 providers using the Epic EHR (response rate 89%) questions were asked about their use of the EHR. The results are shown in the table below. While nearly all prescriptions are written through the EHR, printing after-visit summaries for patients has become routine for only a handful of providers.

Table 1.
IUFH Electronic Health Record User Survey

Providers are asked to estimate the following:

	0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%
Percent of Office Visits you print the After-visit summary for the patient	70% (45)	14% (9)	5% (3)	5% (3)	0% (0)	0% (0)	2% (1)	3% (2)	2% (1)	0% (0)
Percent of Office Visits where you receive one or more Best Practice Alerts	17% (11)	14% (9)	19% (12)	11% (7)	12% (8)	5% (3)	6% (4)	5% (3)	6% (4)	5% (3)
Percent of Office Visits where you ignore one or more Best Practice Alerts	42% (27)	9% (6)	3% (2)	6% (4)	8% (5)	6% (4)	3% (2)	5% (3)	3% (2)	14% (9)
Percent of Best Practice Alerts you ignore overall	42% (27)	9% (6)	3% (2)	0% (0)	11% (7)	5% (3)	3% (2)	6% (4)	8% (5)	12% (8)
Percent of Prescriptions you write through the EHR	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)	2% (1)	6% (4)	92% (59)
Percent of Visits you print educational materials from the Reference section of the HER	12% (8)	12% (8)	12% (8)	8% (5)	12% (8)	12% (8)	12% (8)	8% (5)	5% (3)	5% (3)
Percent of visits where you review prescriptions with your patients after they are printed	2% (1)	0% (0)	0% (0)	2% (1)	6% (4)	3% (2)	2% (1)	17% (11)	22% (14)	46% (29)
Percent of visits where you encourage your patients to look at the computer screen to view information	8% (5)	5% (3)	11% (7)	8% (5)	14% (9)	3% (2)	8% (5)	19 (12)	14% (9)	11% (7)
Percent of visits where you print graphs (BP, weight, labs) for your patients to take with them	44% (28)	8% (5)	8% (5)	6% (4)	8% (5)	8% (5)	8% (5)	8% (5)	2% (1)	2% (1)

Institute for Urban Family Health – EHR User Survey – October 2005

With some data showing that more than half of physicians ignore clinical alerts (Schellhase), it is clear that installing these systems will not be enough to improve health care quality. CHCs will need to identify ways to realize the potential of clinical decision supports by implementing systems that providers accept and find useful.

Training, too, is an issue that is widely discussed. Initial training of staff, ongoing enhancement of staff use of the system and sophisticated methods of optimization of system use have all been developed both by HIT product vendors and by users. As shown above, at the Institute we discovered that different features of our EHR are used by different providers to vastly different extents. Is this an acceptable practice? Should health centers insist on a consistent use of the system or is it acceptable for providers to use the system's tools as they see fit with their own practice? Studies are needed to determine the cause and effect relationship between the use of the system features described in the table above and clinical outcomes that are achieved by the providers. This is an important question as investment in training and optimization can be substantial and it should be proven that these investments lead to improved clinical outcomes, not just more consistent use of system features.

Use of System Reports to Improve Quality

5. What types of health data are most useful and how can they best be used to improve the safety and health outcomes of patient care?

One of the effects of implementing electronic health records is the plethora of data that becomes available to providers, nurses and administrators. With the ability to report on nearly every aspect of care, one must be careful not to overwhelm their staff with new quality improvement interventions.

EHRs collect enormous quantities of data – data which is stored indefinitely and which accumulates rapidly. This has many implications for research.

- What types of reports are useful for quality improvement?
- How often should they be produced and who is responsible for acting on them?
- What is the value each has in relationship to improving quality and safety?
- How does a CHC prioritize their activities when little evidence is available to guide them?

In the first year of our EHR implementation, the Institute focused on building a library of decision support tools available to providers at the point of care. Since we had been involved in the diabetes collaborative, we began with a set of measures related to diabetes care. Once a year had gone by with all orders and reports and laboratory data captured electronically, we began a program to outreach to patients who had failed to meet certain clinical guidelines. While decision supports are most useful when a patient is in the center, printed reports are most useful to guide outreach activities.

As we began to produce reports, we became rapidly overwhelmed by the implications of our work. We knew every diabetic who had not been in the center for over 3 months and whose last HgbA1c (a measure of the control of their diabetes over the past 2 to 3

months) was over 8 (indicating poor control). There were over a hundred such patients. We ran reports of patients on statins (a type of cholesterol lowering medication) and who had not had their liver function tested in more than 9 months (recommendation is for monitoring every 6 months). We ran reports of patients with elevated creatinine levels (indicating possible early kidney failure) to make sure they had all been evaluated by a nephrologist (kidney specialist). Every report we ran resulted in dozens of patient names being produced. One particularly frightening report was of patients who had dangerously high blood pressures (greater than 180 systolic or 110 diastolic) and who had not been seen in over two months. There were 44 such individuals who were walking around at great risk of stroke.

The problem is that there is little knowledge base 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 delineate the risk of these measures not being followed and guidelines must be developed to help EHR users prioritize their outreach efforts.

The Potential of HIT in CHCs

6. What will health information technology look like in 2020 and how can CHCs plan to get there?

The year is 2020. In CHCs across the country, the vast majority of patients book their own appointments through a secure patient portal on the Institute's EHR. While booking their appointments, they are asked to verify their insurance information, address and phone number. Any missing fields in their registration information are highlighted and patients are asked to complete them. The EHR then searches the patient's clinical data and prompts the patient to enter relevant information if available. Diabetics are asked to link their recording blood sugar devices and the data is downloaded automatically. Hypertensive patients do the same with their home blood pressure monitoring devices. Patients are asked if they want to review any part of their record. They are also prompted to insert their portable memory device in their home computer to download any new data from the EHR since they last downloaded their record.

Twenty-four hours before the patient's scheduled appointment, the system electronically interfaces with each of the insurance companies that cover the scheduled patients, and insurance coverage, deductible levels and other data are verified. Any discrepancies between the patient's demographic information and the data in the insurance company's files are highlighted for verification by the center upon the patient's arrival. In addition, the Regional Health Information Organization (RHIO) database is searched to flag the provider if any information is available on the patient from other health care sources. Hot-links to this information are presented to the provider at the time of the visit. This

information is derived from pharmacy data, visiting nurse services, laboratories, emergency room data, hospital discharge data, and from specialists and diagnostic centers, which all participate in the RHIO as information nodes. A public health databank, maintained by the local health department is also scanned for information of relevance to this patient based upon age, gender, residence and disease profile. Any infectious diseases or other alerts that may come from the health department also appear as decision support reminders.

The patient arrives at the center and is greeted by a nurse who takes him or her to a set-up station. Blood pressure, blood sugar, temperature, weight, pulse and respirations are automatically recorded by the nurses as needed with a single device that is connected electronically to the EHR.

The provider then calls the patient into an exam room where a computer screen is angled to be equally visible to the provider and the patient. The provider reviews all the clinical alerts provided, reviews any outside information that has been retrieved overnight, and engages in the office visit as usual. As pertinent medical history is noted, additional questions appear on the screen that the computer deems relevant but that have not yet been addressed. For example, a newly increased creatinine (a test of kidney function) triggers questions about family history of renal disease and recent medications – questions the provider had not asked previously. In addition, a warning appears to the provider to reduce the dose of one of the patient's medications – a medication that can reach toxic levels in someone with kidney impairment. In this case, the medication had been prescribed by another doctor but was picked up in the pharmaceutical database at the time of the visit.

While the provider is entering data from the history and physical exam, the computer scans the information and suggests appropriate patient education materials from its vast, multi-lingual database. It also notifies providers if certain stored algorithms are violated. For example, if a provider orders hormone replacement therapy in a patient who has not had screening for cervical cancer, or a chemotherapy agent known to cause eye damage when no ophthalmology report is recorded, a warning appears to alert the provider that these measures are recommended before initiating therapy.

As the provider validates the billing diagnoses selected by the computer, the computer scans a database of thousands of clinical trials being offered in the area, highlighting those in the provider's main affiliated institution(s). If a relevant clinical trial is found the provider either prints basic information about the trial from the system, or generates a referral to the study coordinator if the patient agrees to explore this further.

Following the visit, the length of time of the encounter is calculated as well as other characteristics of the visit and the visit is coded for billing. All pre-billing edit checks are

performed before the patient leaves the room so the provider can update any information that he or she may have captured incorrectly.

Lab tests are ordered and bar-coded labels are printed in the lab to accompany the specimen. Results are all returned through an electronic interface. X-ray orders are sent directly to the appropriate facility based upon the practice location and the availability of an appointment. Images are available immediately upon completion of the x-ray and reports come through the interface as soon as they are completed.

At the end of the visit, the patient's information is automatically entered into certain queues depending on their characteristics. Preventive tests are flagged in the system based upon age/sex/disease/risk/genetic profiles, and calls, reminder letters, or emails are automatically sent to the patient at the appropriate time and again after 4 weeks.

A beautifully formatted after-visit-summary is printed for the patient to take home. Many patients choose to carry these summaries in an electronic version which is facilitated by a quick swipe of the patient's card through a card reader/writer. Information is transmitted to the RHIO that new information is available on the CHC's EHR about this patient for retrieval by other providers if needed.

A team of information technology outreach workers review reports generated automatically by the EHR which list every patient that is in need of recall for any health maintenance procedure or previously noted problem which remains unresolved or is lost to follow-up. The team phones, text messages and emails patients cajoling them into making (and keeping) appointments for these essential visits. One outreach worker is needed for every 5,000 center users to keep up with this effort.

Is this look at the future merely a pipe-dream? The truth is, all of this is technologically possible at this time. The poor penetration of health information technology in our industry and, thus, the lack of interoperable communication – keeps us from implementing all the features above. And we will have to help our patients in advancing their capabilities with technology as well to keep up with the outcomes providers will achieve with patients who are better computer-enabled.

The point should be clear. We are headed deeper and deeper into the use of intelligent, logic-based decision support systems that will dramatically improve patient safety and improve clinical outcomes by assisting providers in following well-established, evidence-based guidelines in the care of their patients.

- How can CHCs make sure that this technological revolution in care is available to their patients – patients who are often the last to benefit from technological advancements?

- Can we help our patients achieve the technological sophistication they will need to participate in these advancements?

Health centers must make sure they are involved in the major HIT developments that are taking place in their communities. Experiments in the sharing of information across hospitals, home nursing services, physician offices, health centers, pharmacies and patients are taking place across the country. It is critical that health centers find a seat for themselves at the table as these developments take place as they not only represent themselves as providers but also represent the needs of some of the nation's medically needy populations.

HIT 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 themselves and have access to computers for their own use. A demonstration project is taking place at Settlement Health in East Harlem in New York City – an area with some of the highest rates of preventable disease in the United States. This project involves collaboration with the New York Academy of Medicine Library. Settlement provides space for the library to set up computers that are available to the community to search and obtain health information and the library provides training for the community residents who use the computers. Health information is obtained only from websites that have been reviewed by the librarians in conjunction with health providers from the CHC. Similar projects may need to be developed across the country to insure that CHC patients are not left behind as technology is used increasingly to improve their health care.

The Role of CHCs in Advancing Clinical Knowledge

7. How can CHCs use technology to advance the state of knowledge in clinical practice?

Data collected in the course of the clinical encounter is notoriously bad for research as it is often collected incompletely 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 at the Institute has race data on over 96% of patients, but each registration clerk asks the question differently and some may input this data on observation alone. Correlations of clinical processes or outcomes by race is important to our organization in understanding if our work is decreasing disparities in health outcomes but is based on race data collected differently than it would be in a research protocol. Similarly, we have been looking at blood pressures in an attempt to understand the relationship between medications and extent of blood pressure control. Yet blood pressures are measured in our centers on different devices – some manual and some automatic Doppler readings – and by people with various degrees of skill and training. While standards exist for blood pressure measurement, accuracy is difficult, even in the most skilled hands. Blood

pressures reading in our EHR can come from any one of over 200 staff physicians, nurses and aides.

In spite of these limitations, mining of data collected in EHRs may lead to new information, especially as much research in this country excludes the very people cared for in CHCs. Correlations of many kinds are possible, and some may lead to breakthroughs of new information. For example, the combination of lab values and medication prescriptions in the EHR may lead to the discovery of new adverse reactions. It may lead to the realization that previously recommended "monitoring" of patients with periodic lab testing for adverse reactions is overkill and costly, offering little patient benefit. It may also lead to information on the causes of disparities in health outcomes as we produce data on outcomes by race and dig deep into the possibility that differences in care (prescription profiles, visit frequency, medication compliance, insurance coverage among others) may explain some of the variation in outcomes.

The Institute, for example, is engaged in investigating the possible relationship of medication profiles for diabetic patients and the extent to which their diabetes is in good control. This followed a pilot study that revealed large differences in the average patient Hemoglobin A1c values between providers in our centers.

The use of EHRs combined with artificial intelligence (AI) is an as yet underdeveloped field. As both fields evolve, AI may be combined with electronic data to make recommendations from a vast database of symptoms, signs and lab values. Results may surprise both providers and patients with completely unexpected correlations that are beyond the human mind to calculate given the many permutations that exist in our current knowledge base.

Another type of research that is facilitated is that of clinical trials. Decision supports can identify trial candidates from characteristics in the EHRs and facilitate referral to a trial coordinator for further discussion and evaluation. This would be a major benefit to the state of clinical information available in the United States as 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.

Conclusion

The interplay between the rapid development of health information technology and the imperative to improve the care of the patients in our community is complex. While 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.

Annotated Bibliography

Adams W.G., A.M. Mann, et al. "Use of an Electronic Medical Record Improves the Quality of Urban Pediatric Primary Care." *Pediatrics*. 2003:111(3):626-32.

This study evaluated the quality of pediatric primary care, including preventive services, before and after the introduction of an electronic medical record in an urban primary care center using a pre-postintervention analysis. Clinicians using the EHR were significantly more likely to address a variety of routine health maintenance topics, though not all. Users of the system reported that its use had improved the overall quality of care delivered, was well-accepted by families, and improved guidance quality. Five of 7 users reported reduced eye contact, and 4 of 7 reported that use of the system increased the duration of visits (mean: 9.3 minutes longer). The authors conclude that use of the EMR in this study was associated with improved quality of care and that EMRs can be successfully used in urban pediatric practices.

Agrawal A. and M.F. Mayo-Smith. "Adherence to Computerized Clinical Reminders in a Large Healthcare Delivery Network." *Medinfo*. 2004:11(Pt 1):111-4.

This study evaluated clinician adherence with 15 clinical reminders across multiple ambulatory practice settings affiliated with Veterans Affairs medical centers. Overall, mean rate of adherence to clinical reminders for 451 primary care providers was 86.2%, with a range of 66.59% to 97.08% ($p<0.001$). The hepatitis C risk assessment reminder has the highest overall adherence rate (95.9%) and the tobacco use cessation had the lowest (62.9%). Mean adherence rate for all reminders was 80.34%. The authors conclude that understanding variation in adherence to clinical reminders is important in directing future efforts to use clinical reminder to improve quality of care.

Baker A.M., J.E. Lafata, et. al. "A Web-Based Diabetes Care Management Support System." *Journal on Quality Improvement*. 2001:27(4):179-90.

The authors report on a nonrandomized, longitudinal study of impact of a web-based diabetes care management support system on primary care providers and other staff in a large multispecialty group practice. The system featured clinical practice guidelines, patient registries, and performance reports with an existing electronic medical record. The effect of system usage frequency was evaluated on the likelihood of a patient's receipt of appropriate tests and examinations. Controlling for several variables, the study found that the patients of physicians using the system were more likely to receive lipid profile testing (OR=1.01, 95%CI) and retinal exams (OR=1.01, 95%CI). Patients of physicians who initiated 12 system sessions were 19% more likely to receive lipid profile testing than patients of physicians who never used the system. No relationship was found between system use and glycated hemoglobin testing.

Bindels R.P., A. de Clercq, et. al. "A test ordering system with automated reminders for primary care based on practice guidelines." *International Journal of Medical Informatics*. 2000:58-59;219-33.

The authors describe a real-time automated reminder system developed in the Netherlands to change the test ordering behavior of family physicians, focusing on the appropriateness of test requests. The system generates critical comments about the rationality of test requests at the moment a FP orders a test that is not consistent with national or regional guidelines. Steps taken to validate the system are described.

Bindels R., A. Hasman, et. al. " The efficacy of an automated feedback system for general practitioners." *Inform Prim Care*. 2003:11(2):69-74.

The author describes a randomized trial, based in the Netherlands, of the effect of an automated system of clinical guideline alerts for diagnostic test-ordering on general practitioners. Twenty-four GPs reviewed a sample of their earlier test request forms, requested changes if deemed necessary, and encountered system-generated feedback about non-adherence to guidelines. The number and fraction of diagnostic tests ordered that were not consistent with guidelines decreased as a result of system comments. GPs accepted 362 of 729 reminders.

Burt C.W. and E. Hing. "Use of Computerized Clinical Support Systems in Medical Settings: United States, 2001-2003." *Advance Data from Vital and Health Statistics*. No 353. Hyattsville, MD: National Center for Health Statistics. 2005.

This report presents findings from the National Ambulatory Medical Care Survey and the National Hospital Ambulatory Medical Care Survey, sample surveys of physicians and hospital emergency and outpatient departments, respectively, on the use of electronic clinical systems. Electronic medical records were found to be used 17% of physician offices, 31% of hospital emergency departments, and 29% of hospital outpatient departments. Seventy-three percent of physician offices use electronic billing .

Chin, T.L. "Improving care in rural areas: An intranet makes it easier for clinicians to offer quality care to patients in West Virginia." *Health Data Management*. 1997:5(12): 52-3.

In this case study, the author describes the development of wide-area network based in Huntington ,WV that connects five rural clinics and two urban hospitals. He discusses the input and retrieval of medical data in the network, development strategy, problems encountered, financial arrangements, and security.

Committee on Enhancing Federal Healthcare Quality Programs, Institute of Medicine. *Leadership by Example: Coordinating Government Roles in Improving Health Care Policy*. National Academies Press. 2002.

This report examines how the federal government can leverage its position as regulator, purchaser, provider, and research sponsor to improve the quality of health care. The Committee proposes a national quality enhancement strategy focused on performance measurement of clinical quality and patient perceptions of care, including recommendations for developing and pilot-testing performance measures, creating an information infrastructure, and a proposed research agenda.

Dickinson, J. "General practice research using computers." *Australian Family Physician.* 1992:21(3);330-1.

In this essay, the author, based in Australia, discusses the role of computer-based health care information and primary care providers in conducting research. He stresses the potential benefits of computerized information in making audit, quality assurance and practice research easier and more relevant to primary care physicians.

East J., P. Krishnamurthy, et al. "Impact of a diabetes electronic management system on patient care in a community clinic." *American Journal of Medical Quality.* 2003:18(4):150-4.

The authors report on a study to evaluate the effectiveness of a computerized diabetes registry program as part of a comprehensive quality improvement program at a free community clinic. Diabetes care management objectives were compared between 82 patients of physicians who participated in the quality improvement program and 63 patients of nonparticipating physicians. Completion of management objectives increased 26.1% in the intervention group vs. 2.6% in the control group. The authors recommend the use of this system to improve compliance with care management guidelines.

Gerbert B., A. Bronstone, et. al. "Decision support software to help primary care physicians triage skin cancer: a pilot study." *Archives of Dermatology.* 2000:136(2):187-92.

The authors describe a study of the impact of decision support software intended to help primary care physicians proficiently triage skin lesions suggestive of basal and squamous cell carcinoma. Twenty primary care physicians practicing in a health maintenance organization or city health clinic participated in surveys and experimental use of decision support system, which was preloaded with clinical information related to 15 digitized test legions and clinical decision tree support. Without using the decision support software, physicians chose the wrong triage decision 36.7% of the time, and using the decision supports they chose the wrong response 13.3% of the time. Not using decision support software, they failed to correctly perform a biopsy or refer patients with cancerous lesions 22.1% of the time, compared to 3.6% of the time using the decision support software. The authors conclude that such software could improve primary care physicians' triage decisions for potentially cancerous skin lesions.

Goverman, IL. "Orienting health care information systems toward quality: how Group Health Cooperative of Puget Sound did it." *Journal of Quality Improvement.* 1994:20(11):595-605.

The author details the project organization, methodology, oversight and management in the development of a health information technology system at a large health maintenance organization. The author describes a major effort to reorganize information systems with a focus on quality of care, which ensured that all related projects supported an organizational goal of "total quality."

Harwell T.S., J.M. McDowall, et al. "Measuring and Improving Preventive Care for Patients with Diabetes in Primary Health Centers." *American Journal of Medical Quality*. 2002:17(5):179-84.

The authors report on the impact of quality improvement efforts and an electronic system for monitoring diabetes care. Preventive services and clinical outcomes were assessed for patients at baseline and follow-up. Cross-sectional analyses revealed increases in some, but not all, preventive measures and found no improvements in outcome.

Health Information Technology Leadership Panel. *Final Report*. Prepared by the Lewin Group. March 2005.

In this report, this federally-appointed panel identifies three imperatives for health information technology: 1) widespread adoption of HIT should be a top priority for the US healthcare system; 2) the federal government drive adoption of HIT; and 3) the private sector should collaborate in the development of HIT. The panel presents six conclusions in support of these imperatives.

Hippisley-Cox J, M. Pringle, et al. "The electronic patient record in primary care—regression or progression? A cross sectional study." *British Medical Journal*. 2003:326(7404);1439-43.

This study sought to determine whether paperless medical records contained less information than paper based medical records and whether that information was harder to retrieve. A cross sectional study with review of medical records and interviews with 53 British general practitioners were conducted. Compared with paper-based records, more paperless records were fully understandable (89.2% v 69.9%, P=0.0001) and fully legible (100% v 64.3%, P < 0.0001). Paperless records were significantly more likely to have at least one diagnosis recorded (48.2% v 33.2%, P=0.05), to record that advice had been given (23.7% vs 10.7%, P=0.017), and were more likely to contain details of specialty referrals (77.4% v 59.5%, P=0.03). When a prescription had been issued, paperless records were more likely to specify the drug dose (86.6% v 66.2%, P=0.005). Paperless records were found to compared favorably with manual records.

Kawamoto K., C.A. Houlihan, et. al. "Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success." *The British Medical Journal*. 2005:330;765-768.

The authors report the findings of a literature search conducted to identify the features of clinical decision support systems that are important for improving clinical practice. Studies were assessed for statistically and clinically significant improvements in clinical practice and for the presence of 15 support system features. Multiple logistic regression analysis conducted on 70 selected studies identified four features as independent predictors of improved clinical practice, including: automatic provision of decision support as part of workflow; provision of recommendations rather than assessments; provision of decision support at the point of decision-making; and computer-based decision support.

McGlynn EA, S.M. Asch, et.al. “The Quality of Health Care Delivered to Adults in the United States.” *The New England Journal of Medicine*. 2003:348;2635-2645.

The authors report on a telephone survey of a random sample of adults in 12 metropolitan areas who were asked about selected health care experiences. The medical records of those surveyed were obtained through written consent and the information was used to evaluate performance on 439 indicators of quality of care for 30 acute and chronic conditions and for preventive care. Participants received 54.9 percent of the recommended care. Little difference was found in the proportion of recommended preventive care (54.9%), acute care (53.5%), and chronic care (56.1%) provided. The authors conclude that lack of adherence to recommended care poses a serious threat to the health of the public.

Onofrei M., J. Hunt, et. al. "A first step towards translating evidence into practice: heart failure in a community practice-based research network." *Informatics in Primary Care*. 2004:12(3);139-45.

The authors report on a cross-sectional study to determine the validity of an electronic health record in identification of patients with left ventricular dysfunction in nine primary care clinics. All patients with a heart failure diagnosis in the problem list were identified. Left ventricular ejection fraction data were identified through local cardiology and hospital echocardiology databases, as well as search of paper charts. The validity of an EHR problem list entry of heart failure was found to be poor. The authors caution that inaccurate EHR problem lists may have clinical consequences.

Osheroff, J.A., E.A. Pifer, et.al. Improving Outcomes with Clinical Decision Support: An Implementer’s Guide. Health Information and Management Systems Society. Chicago, IL. 2005. (www.himss.org).

This book addresses methods to help organizations determine their clinical decision support (CDS) program goals and clinical objectives, catalogue local information systems capabilities to achieve those goals, select approaches to address goals with specific CDS interventions, develop, validate and deploy interventions, and monitor CDS program effectiveness. It includes examples and worksheets to illustrate the steps in the CDS support process, links to supportive materials, and a glossary of terms.

Poon E.G., T.K. Gandhi, et. al. "I wish I had seen this test result earlier!: Dissatisfaction with test result management systems in primary care." *Archives of Internal Medicine*. 2004:164(20): 2223-8.

This study aims to identify problems in current test result management systems and possible ways to improve these systems. In a survey of 262 physicians working in 15 internal medicine practices (response rate, 64%), physicians were asked about systems they used, the amount of time they spent managing test results, delays in reviewing test results, and overall satisfaction with their management of test results. We also asked physicians to rate features they would find useful in a new test result management system. Overall, 83% of respondents reported at least 1 delay in reviewing test results during the previous 2 months. Only 41% of physicians reported being satisfied with how they managed test results. The most highly desired features of a test result management system were tools to help physicians generate result letters to patients, prioritize their workflow, and track test orders to completion. The authors conclude that tools should be implemented to improve test result management in office practices.

Protti, D. "Lessons to Be Learned from England about the Potential of GP Computer Systems to Improve Patient Safety." *Electronic Healthcare*. 2004:7(3);76-80.

The author reports on 26 stakeholder interviews to determine views on key issues on GP use of computer systems to help ensure patient safety, and ten themes that emerged. He describes the findings of a Delphi technique used with a 22-member expert panel to identify important issues for safety when using computer systems. The author then descibes assessing computer systems in simulated test cases and the findings of a survey to determine GP knowledge, use and training needs related to computerized health information. It is concluded that computer use in general practice has many advantages, but that there may be hazards associated with their use, particularly over-reliance on the system.

Rimer B.K., M. Conaway, et. al. "The impact of tailored interventions on a community health center population." *Patient Education and Counseling*. 1999:37(2);125-40.

This study sought to determine whether increasingly intensive, tailored print and telephone interventions were increasingly effective in promoting adherence to cancer screening among patients in a community health center. At the bivariate level, a significant effect was found among the most intensive group and borderline significance at the multivariate level. The authors suggest that lack of effect on mammography is attributed to regular administration of mammograms. There were some important subgroup differences, specifically women who received tailored print information and counseling reporting Pap tests when they believed the materials were “meant for me.”

Ross S.E., J.Todd, et al. "Expectations of patients and physicians regarding patient-accessible medical records." *Journal of Medical Internet Research*. 2005:7(2); e13.

The goal of this study was to compare the attitudes toward shared outpatient medical records, including online access, among socially disadvantaged patients in community health centers, insured patients in academic medical centers and a broad range of physicians in outpatient practice. Response rates to a written questionnaire were 79% for patients and 53% for physicians. While academic and community health center patients were equally likely to endorse shared medical records (94% vs. 96%) and Internet-accessible records (54% vs. 57%), community health center patients were more likely to anticipate the benefits of a shared records (mean number of expected benefits 7.9 vs. 7.1, $p<0.001$) as well as problems. Predictors of patient endorsement of Internet-accessible records are presented. Physicians were significantly less likely than patients to anticipate benefits.

Schellhase K.G., T.D. Koepsell, et. al. "Providers' Reactions to an Automated Health Maintenance Reminder System Incorporated into the Patient's Electronic Medical Record." *Journal of the American Board of Family Practice*. 2003:16(4):312-7.

This study sought to learn how to make automated health maintenance reminders (HMRs) more effective by measuring clinicians’ self-reported use of HMRs and attitudes toward an HMR in an electronic medical record through a survey of 43 users. Seventy-five percent of clinicians reported not observing or paying attention to the HMR when reviewing a chart, and 62.8% reported they either ignored or forgot to address an alert. Only 20% reported regularly reviewing health maintenance needs of the patient before the clinical encounter, and 56% reported seldom or never acting on HMR information during an encounter that was not health maintenance. The authors stress the need to find practical ways to get clinicians to use HMRs.

Sequist T.D., T.K. Gandhi, et. al. "A Randomized Trial of Electronic Clinical Reminders to Improve Quality of Care for Diabetes and Coronary Artery Disease." *Journal of the American Medical Informatics Association*. 2005:12(4): 431-7.

The authors report on a study to evaluate the impact on an integrated patient-specific electronic clinical reminder system on diabetes and coronary artery disease (CAD) care and to assess physician attitudes toward the reminder system. Primary care physicians at 20 ambulatory clinics, including four community health centers, were enrolled. Clinics were randomized so physicians received either evidence-based electronic reminders (5 for diabetes and 4 for CAD) in the EHR or usual care. Electronic reminders increased the odds of recommended diabetes care (OR 1.30, 95% CI) and CAD (OR 1.25, 95% CI), although the impact of individual reminders was variable. Three of nine reminders effectively increased rates of recommended care. The majority of physicians (76%) thought that reminders improved quality of care.

Spina, J.R., P.A. Glassman, et. al. "Clinical Relevance of Automated Drug Alerts From the Perspective of Medical Providers." *American Journal of Medical Quality*. 2005:20(1);7-13.

The authors, through a survey and follow-up focus group involving > 20 primary care providers in a large healthcare system, assessed attitudes about the usefulness of automated drug alerts. Of 108 alerts, 1 was critical, 17 represented significant drug interactions, and 66 involved duplication of medication. Of 84 potentially relevant alerts, providers classified 9 as useful. Drug interaction alerts were more often deemed useful than drug duplication alerts (44.4% vs. 1.5%, $p<0.001$).

Steele A.W., S. Eisert, et al. "Using Computerized Clinical Decision Support for Latent Tuberculosis Infection Screening." *American Journal of Preventive Medicine*. 2005a:28(3):281-4.

The authors report on a nonrandomized, prospective intervention study to determine the impact of computerized clinical decision support and guided web-based documentation, features were integrated into existing electronic medical records,
on screening rates for latent tuberculosis infection screening at two community health centers. Among 4,135 patients registered during the post-intervention phase, 73% had at least one CDC-defined risk factor, and 6610 met the alert criteria for potential LTBI screening. Adherence to LTBI screening guidelines improved significantly from 8.9% at baseline to 25.2% during the study phase (183% increase, $p<0.001$). The authors conclude that computerized clinical decision support increases screening of high-risk patients for LTBI.

Steele A.W., S. Eisert, J. Witter, et. al. "The Effect of Automated Alerts on Provider Ordering Behavior in an Outpatient Setting." *PloS Medicine*. 2005b:2(9):864-870. (Available at:www.plosmedicine.org)

The authors conducted a pre- and pos-intervention study at a safety net primary care clinic to determine the effect of computerized drug-laboratory alerts on provider drug- and laboratory test-ordering behavior. They found decreases in provider drug-ordering, mostly limited to cases with presentation of abnormal laboratory values (5.6% vs. 10.9%, $p=0.03$) and significant increases in laboratory test orders with the presentation of alerts (39% vs. 51%, $p<0.001$).

Tamblyn R., A. Huang, et. al. "The medical office of the 21st century (MOXXI): effectiveness of computerized decision-making support in reducing inappropriate prescribing in primary care." *CMAJ* 2003:169(6):549-56.

This study assessed whether inappropriate prescribing could be reduced when primary care physicians had computer-based access to information on all prescriptions dispensed and automated alerts for potential prescribing problems. The number of new potentially inappropriate prescriptions per 1,000 visits was significantly lower (18%) in intervention group than in the control group, but had a more selective effect on discontinuation of inappropriate prescriptions.

Tierney, W.M., J.M. Overhage, et. al. "Effects of Computerized Guidelines for Managing Heart Disease in Primary Care." *The Journal of General Internal Medicine*. 2003:18:967-976.

This study assessed the effects of computer-based cardiac care suggestions in a randomized, controlled trial targeting primary care physicians and pharmacists. A total of 706 patients with heart failure or ischemic heart disease cared for at an academic primary care practice were followed for one year after the installation of the electronic guideline system. The intervention had no effect on physicians' adherence to the care suggestions (23% for intervention patients vs. 22% for controls). The authors suggest that future studies examine the benefits and costs of different methods of affecting clinician behavior.

Yarnall K.S., B.K. Rimer, et. al. "Computerized Prompts for Cancer Screening in a Community Health Center." *Journal of the American Board of Family Practice*. 1998:11(2);96-104.

The authors describe the development and implementation of a computerized health maintenance tracking system in an urban community health center, and a study of its use by physicians. Initial compliance rates in filling out the forms were higher than subsequent rates (mammography 95% vs. 65%; Papanicolaou test 82% vs. 57%; breast exam (77% vs. 53%) and smoking cessation (55% vs. 38%), despite multiple reminders. Clinicians indicated in a follow-up survey, that time demands presented a barrier to system use. The authors conclude that computerized health maintenance systems can be useful, but because clinicians still only address maintenance needs of their patients about half the time, additional interventions are needed.

Response to:

"The Community Health Care Research Agenda for Implementation of Information Technology as a Tool to Improve Health Quality and Safety"

José E. Camacho, Executive Director
Texas Association of Community Health Centers, Inc.

General Observations

The paper is written by a provider with substantial experience in the implementation and use of an electronic health record. The paper does an excellent job of identifying research needed to assist centers with identifying issues associated with Health Information Technology (HIT) and quality improvement. I believe the research agenda needs to be refocused at a more basic level. The drive toward the adoption of standards and the architecture of a nationwide Health Information Network (HIN) is moving rapidly and health centers need to understand and be incorporated into their standards and structure as an initial step to understanding its various applications.

Issues

1. While Health Information Technology may be an important tool for quality improvement, the research agenda initially requires a more basic focus: the steps necessary to assure that the interests of community health centers are reflected in the development of a National Health Information Network (NHIN).

Four contracts have been recently awarded for the development of prototypes for a NHIN structure according to a recent press release from HHS:

> "These contracts complete the foundation for an interoperable, standards-based network for the secure exchange of health care information. HHS previously has awarded contracts to create processes to harmonize health information standards, develop criteria to certify and evaluate health IT products, and develop solutions to address variations in business policies and state laws that affect privacy and security practices that may pose challenges to the secure communication of health information."

Although health centers have access to a large volume of data on costs and services, there is a wide chasm between centers who are IT savvy and those who lag far behind others in the use of IT. This variation in health center knowledge and adoption of IT must be understood in the context of a NHIN, if centers are expected to remain relevant in the health community. Therefore, health centers must first assure that a NHIN takes into account the health center business model before we address the various uses of HIT, such as the improvement of quality patient care and safety. It is also important for health centers to understand what problems cannot be solved by implementation of HIT. While the author's vision of the future health center is interesting, we must remember that the implementation of HIT within a health center will not solve the greater problems of access and computer literacy for the impoverished population we serve.

2. The paper acknowledges that there exists limited research on the use of HIT at health centers. Health centers need to understand the level of adoption of HIT within the health center system. This information is necessary to create a framework for understanding the future planning and investment required by centers for the adoption of an electronic health record (EHR) and/or the costs associated with interoperability.

The Office of the National Coordinator for Health Information Technology (ONC) has recently announced a partnership with the George Washington University & Massachusetts General Hospital/Harvard Institute for Health Policy through a contract on the HIT Adoption Initiative. The partnership is aimed at better characterizing and measuring the state of EHR adoption and determining the effectiveness of policies aimed at accelerating adoption of EHRs and interoperability. Health centers need to either run a parallel study or, optimally, be associated with the research in order to obtain the data necessary.

3. Health centers have generally experienced a negative business case as a result of initial implementation of some forms of Health Information Technology *e.g.,* adoption of PECS patient registries in the collaborative. There is a great need for health centers to better understand the financial reality of not adopting a comprehensive HIT strategy or as the paper states, "the business case related to adoption of various forms of HIT." This understanding may help develop the incentives necessary for health centers to accelerate the adoption and rapid deployment of HIT and is critical to the development of realistic and strategic center plans. The paper acknowledges this point, particularly in the case of community health centers, the "health care system simply does not have sufficient resources to engage in this expensive new technology without tracking its return on investment…" and concludes that "the rush to expand technology must be developed on a solid base of evidence that critically examines the cost/value of HIT development against other potential care improvement intervention." The question is, do we need to develop that "base of evidence" for health centers?

REACTION PAPER – FISCELLA

Dr Calman's insightful comments clearly reflect his experience working on the ground with the nitty, but critical, details involved in implementing HIT in CHCs.

My aim is to step back and take a birds eye view of the bigger picture. Simply stated: how do we achieve the vision of the future that Dr Calman so eloquently describes? How do we create new models of care envisioned by the Institute for Health Improvement and the future of Family Medicine Project? What HIT do we need to make those visions a reality? How do CHCs avoid the inverse care law, the wrong side of the provider digital divide, and losing under pay for performance? Most importantly, what fundamental changes are needed in federal policy, CHC culture and practice to realize these visions? What data are missing? What research is needed to guide us in getting from here to there.

We currently have before us two competing models for HIT implementation. On one hand, we have the VA health system. On the other hand, we have the private practice model. In less than a decade, the VA transformed its health care quality. It went from the butt of jokes to industry leader using well-designed and implemented HIT to support a culture of quality.

We also have tens of thousands of private practices who have been slowly, but surely, acquiring literally hundreds of different EHR systems. Most of these ventures result in one of two outcomes. For many it is disaster – nothing more than costly, failed experiments. For others, the course has been rocky, but ultimately rewarding in terms of ROI. For these, EHRs eventually pays for itself and then some. But in most cases, EHRs are little more than expensive systems for upcoding visits and cutting staff. Fully 50% of the ROI for EHRs for small practices is realized through upcoding. Only a select few practices have been successful in way we mean - using HIT to promote quality. These findings should be a red flag to the federal government who largely pays CHC bills – directly through 330 grants or indirectly through Medicaid reimbursement. It should also be a red flag for CHCs who will realize much less ROI than private practices who benefit much more from upcoding of visits billed through private insurance and Medicare.

We - meaning the federal government, represented by HRSA and congress, NACHC, and thousands of health centers - face a crossroads. Our path will affect quality of care we provide to the underserved and costs for decades to come. We can either follow the lead of the VA, Kaiser, and many developed countries that have used HIT to transform quality and minimize total health care costs or we can continue on the current course of fragmentation and focus on practice ROI. In either case the federal and state governments will ultimately pick up the tab. The difference is outcomes and the opportunity to reduce health disparities.

While the research questions related to HIT implementation articulated by Dr Calman are vital, we also need to step back from the trees and look at the shape forrest is taking: what research do we need to inform critical federal policy related to financing and coordinating HIT for health centers? What lessons can we take from the closed VA system and apply it to diverse, community-operated centers across the country? What are the key obstacles to practice redesign and what changes in federal policy and health center culture and practice are needed to overcome these obstacles? Can one HIT system serve the needs of most CHCs? What are the benefits and costs of such an approach? What economies of scale can be realized through federal/NACHC coordination of efforts including technical support? How can we best leverage infrastructure and lessons learned from the Health Disparities Collaboratives to transform quality using HIT? How can we best learn from each other? What funding streams will best enable CHCs to acquire the most appropriate HIT? What systems of ongoing federal and state reimbursement are needed to support practices of the future particularly care outside patient visits? How might CHCs and the nation benefit from national HIT for CHCs?

Quantitative change in the number of CHCs is not enough. We need the resources necessary for qualitative transformation. We must not mistake the foothills for the Himalayas. We must think big - starting with a grand vision using critical research to inform us along each steps of the process - beginning with federal policy. Transformation of quality within CHCs with the aid of HIT represents our best shot at reducing health disparities. We mustn’t let this opportunity slip by. We must make our voices heard using credible research.

The Community Health Center Research Agenda for Implementation of Information Technology as a Tool to Improve Health Quality and Safety

Neil Calman, MD and Diane Hauser, MPA
The Institute for Urban Family Health
New York City

Reactor:

Jeremy Nobel, MD, MPH
Department of Health Policy and Management
Harvard School of Public Health
Boston, MA

Research Questions for Health Information Technology in CHCs

Strategic Planning for Health Quality and Safety Improvements

1. How do CHCs determine whether an investment in health information technology is the best way to improve the quality and safety of health care in their communities? How do CHCs balance the capital, implementation, and training costs of HIT against other priorities as they engage in strategic planning?

- Is HIT the best use of the limited funds available to a health center for quality improvement linked to the centers clinical strategic plan?
- How can we predict the public benefit that will accrue from the implementation of HIT – in the care of any single disease entity or preventive measure?

Reactor Comments:

- *Collaboration among clinics and clinic networks is likely to be critical to achieving the scale required to make appropriate IT investments in hardware, software, people and processes. There is an important need to understand both opportunities and challenges related to effective collaboration from legal, organizational, political, operational and financial perspectives.*

Selecting Health Information Technology to Improve Quality and Safety

2. How do CHCs determine what type of health information technology to implement in order to achieve the best quality and safety outcomes? How do CHCs evaluate different systems for their potential to improve quality and safety?

Reactor Comments:

- *Must bear in mind that what is currently in the published literature is based on work done with HIT in academic medical centers. Findings and understandings related to thereto, may only be tangentially relevant to CHC's realities.*
- *Similarly, vendor statements as to utility and value of their products must be assessed for their generalizability to the CHC setting. How can the differences between CHCs and other care delivery be best understood, categorized and taken into consideration in HIT deployment scenarios?*

HIT Implementation

3. What methods of HIT implementation show the most promise for use in CHC environments? Which HIT implementation models are mostly likely to result in health care quality and safety improvements

Reactor Comments:

- *Completely agree that organizational capabilities and capacity might well be the best predictor of effective HIT design and deployment. How do we better understand those organizational issues in this regard? As important, what can we know about how to develop specific organizational capacities to increase likelihood of successful IT deployment?*

Monitoring HIT Use and Impact

4. How do CHCs monitor the use of technology investments to ensure that quality and safety goals are being met?

Reactors Comments:

- *To the extent we can, how do we build continuous evaluation capabilities into the HIT itself, so "learning systems" are part of day to day experience and benefit, delivering new insights to both clinical users and administrators on a "real time" basis.*

Use of System Reports to Improve Quality

5. What types of health data are most useful and how can they best be used to improve the safety and health outcomes of patient care?

Reactors Comments:

- *Given the remarkable way that work flow and might shift in response to new insights into higher quality delivery opportunities, the economic model's (e.g. reimbursement, training, operations, etc.) for sustainable clinic functioning must match new care delivery paradigms. What do we need to better understand to be prepared for this?*

The Potential of HIT in CHCs

6. What will health information technology look like in 2020 and how can CHCs plan to get there?

Reactor Comments:

- *Very attractive vision! In addition to all this, how do we extend the "reach" of clinical information beyond the brick and mortar of the clinic facility so that patients have access on a 24X7 basis to support needed for risk factor management and chronic disease management? For instance, interactive web sites that provide culturally competent health information within a personalized context, or cell phones that delver messages reminding patients to take their meds.*

The Role of CHCs in Advancing Clinical Knowledge

7. How can CHCs use technology to advance the state of knowledge in clinical practice?

Reactors Comments:

- *Clearly an opportunity to bridge the gap between what we know from carefully controlled clinical trials and the even more important assessment of "field effectiveness" of preventive, acute and chronic approaches to care. How do we make" insight generation" a by- product of good HIT, and not a separate activity?*

The CHC Research Agenda for Implementation of IT as a Tool to Improve Health Quality and Safety

Reactor: Ralph Silber, CEO, Community Health Center Network

There is a great need for research on the measurable impact of HIT on health quality, safety, and efficiency in the community health center setting. Even the research conducted in other practice settings that is cited in the paper's literature review does not provide compelling evidence of dramatic improvements in care that are attributable to HIT adoption. I agree with the authors' point of view as reflected in the first question - we should not assume that investments in HIT are the most appropriate use of every CHC's limited resources as they make decisions about how to improve the health of their community. The authors' second and third questions correctly focus on which types of HIT will have the biggest impact on quality and what implementation methods would be most effective. We need to become more precise in our ability to define different types of HIT and the value of each technology.

In addition to the excellent research questions posed in the paper, I would add the following:

1. What are the organizational "prerequisites" for successful HIT adoption and how do we assist CHCs to accomplish them?

2. How do CHCs plan and implement the changes in business and clinical operations that are necessary to maximize the benefits of HIT adoption?

3. What are some of the business models (e.g., pay for use, pay for performance, collaborative approaches) that will make HIT adoption more financially viable for CHCs?

4. Given those aspects of CHCs' mission, organizational infrastructure, and operations that are significantly different than other primary care delivery systems, how do we best adapt learnings from HIT adoption in other settings?

5. Research should focus on the potential of HIT to improve not only quality and safety, but also efficiency.

6. To the extent that successful HIT adoption in CHCs will result in uninsured patients receiving more services (e.g., screening, pharmaceuticals, specialty referrals), what will be the financial impact on CHCs and how can we begin to develop policies to mitigate this financial impact?

7. What is the value of achieving connectivity to other health providers used by CHC patients and how can this best be achieved?

k/staff/Ralph/CHC Research Agenda