

HealthLink Miami Valley
Fiscal Agent: Wright State University
Center for Healthy Communities
140 E. Monument Ave.
Dayton Ohio 45402
937-775-1114

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One Patient, One Record: Improving the Quality of Care through the Shared Community Health Record project, (SCHR)

Request for Application

Response
(RFA-07-006)

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for

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This information was submitted as part of a request for proposals to funders cited above. Standard forms, fiscal information and appendices submitted with this application are omitted from this copy. A complete original is on file at the Center for Healthy Communities and can be accessed by contacting Katherine Cauley, Ph.D. at the above listed address.

1. Abstract & Summary:

The One Patient, One Record: Improving the Quality of Care through the Shared Community Health Record project, (SCHR) will study the implementation of health information technology in multiple ambulatory care settings in Dayton, Ohio. Wright State University has developed a federally funded web based health information technology solution that also permits health information exchange across provider organizations. This solution is called HIE[™] and is a software application built incrementally toward the Continuity of Care Record (CCR). HIE[™] currently provides patient centric electronic health information on medications, diagnoses, procedures, immunizations, notes, health care providers, scanned documents and demographic data on both individuals and household in a standards based format. Wright State University is implementing HIE[™] as a health information technology solution in two primary ambulatory care settings, (1) the Dayton Public Schools clinics (35 schools and one mobile clinic) and (2) the Victor J. Cassano Health Center (providing ambulatory care to the low income population). Health information technology and exchange is not currently in use in either setting. The combined patient population of these two organizations is estimated at 32,000.

The phenomena to be studied here is the **path of adoption** for clinical records in a **safety net setting** and the effect that health information technology and exchange has on **quality of care**. Quantitative and qualitative data will be collected from users to evaluate adoption, and secondary data from charts will be used to assess quality measures. This study will address the following questions: 1) What are the facilitative and inhibitory factors that effect adoption of a shared record? 2) Is there a describable “path” to effective clinical adoption, especially in safety net settings? 3) Does the use the shared record improve quality of care particularly for diabetes management and reduction in over exposure to immunizations? 4) Does the shared record improve rates for EPSDT examinations? 5) Does the shared record improve access to care, specifically increases in S-CHIP enrollment? Improved health outcomes will be effected by providing communities with paradigms for health IT adoption in safety net settings that improve quality of care and identify best practice for ambulatory health IT adoption.

The evaluation plan for this study is focused on progress toward study completion and generalizability of findings to other settings. Dissemination of results will focus on peer review publications and national presentations.

Relevance to public health:

The results of this study will add to the body of knowledge that supports ubiquitous, accurate, and complete patient centric health information made electronically available to healthcare providers at the point of care. The use of such information will improve individual and population health, disease and event surveillance, disease and wellness management. Since this study focuses on vulnerable populations, public health will gain models for collecting granular information on diabetes management and immunization medication management.

2. Specific Aims

The broad long term objective of this project is to use an electronic shared community health record (SCHR) to improve quality of health care for vulnerable populations who seek access from multiple ambulatory safety net organizations for episodic care. The aim of the SCHR project is to (1) demonstrate a shared community health record as the vehicle for improvement in quality of healthcare for safety net populations and (2) to conduct prospective qualitative research related to the path of adoption and use of HIE for safety net and small or solo practices. This will be done at the community level by identifying facilitative and inhibitive factors to community wide use of an electronic shared community health record, and at the provider level through the study of individual user behavior. The Dayton community is relatively

typical of many areas throughout the US in that the local health care industry has been slow to move to electronic health records and the exchange of patient centric clinical data across provider organizations. While Montgomery County providers have normal adoption rates for practice management and electronic billing services, real and perceived concerns about cost, disruption in workflow, as well as business practices that identify data as proprietary, remain significant barriers to adopting electronic health records and engaging in health information exchange. For those larger provider organizations such as major hospital systems that have begun to implement proprietary enterprise health information technology (HIT) systems, the above barriers are compounded by significant interoperability challenges that provide ongoing roadblocks to health information exchange.

Nevertheless, safety net providers working primarily with health uninsured members of the community are becoming members of the **HealthLink RHIO** which administers *HIEx™* (HealthLink Information Exchange) a shared community health record. The Center for Healthy Communities at Wright State University has developed this web based health information technology solution that also permits health information exchange across provider organizations facilitating transitions in care. *HIEx™* is a software application built incrementally toward the Continuity of Care Record (CCR). *HIEx™* currently provides patient centric electronic health information on medications, diagnoses, procedures, immunizations, notes, health care providers, scanned documents, and demographic data for both individuals and households. *HIEx™* will provide the health information technology solution for health and human services providers including to date, the Dayton Public Schools clinics (35 school based and one mobile), a hospital owned community health clinic serving 18,000 patients annually, a practice-based research network, a Medicaid managed care organization and several social services organizations.

Improved quality of care measures related to use of the shared community health record are anticipated for a cohort of children who receive care from *HIEx™* member provider groups. These measures include demonstrating: 1) decreased over-exposure to vaccines; 2) increased completed annual physical examinations; and 3) increased enrollment in the Childrens' Health Insurance Program. Further improved quality of care measures related to use of the shared community health record are expected to be shown for a cohort of adult diabetic patients who receive care from *HIEx™* member provider groups through improved adherence with guideline based care as in HP2010 objectives 5.1 (diabetes education), 5.11 (annual urinary microalbumin measurement), 5.12 (annual glycosylated hemoglobin measurement), 5.13 (annual dilated eye exam), 5.14 (annual foot exam), and 5.15 (annual dental exam) and other measures. Finally, improved quality of care related to the use of a shared community health record will be demonstrated through improved medications management for both cohorts of patients.

The key to improved quality of care through the use of an electronic shared community health record is wide spread community participation. The SCHR project will work to increase provider participation through a series of electronic communications, and to study the factors that facilitate and inhibit ambulatory care providers' participation in health information exchange.

3. Background and Significance

Background leading to present application:

The high cost of electronic health record (EHR) systems and their current inability to interoperate have created an identified need in our community for an electronically shared

community health record. Since 1990, safety net organizations have been advocating a shared record to improve the efficiency and effectiveness of social services. During the mid to late 1990s Montgomery County hired a vendor to develop “AgencyLink” a system for sharing data about safety net users. Because the technology was evolving so rapidly there were many revisions and with “the perfect being the enemy of the good”, it was never implemented. During this period many non-profits invested in their own local area network and Microsoft® Access-type data base systems consolidating the information into multiple data silos. To date these independent systems cannot “talk” with each other electronically. A central web based record is the most effective solution in a stratified technology sector that includes systems of various vintages and platforms.

When the HealthLink Miami Valley (HLMV) community wide coalition to better coordinate access to and quality of care for underserved members of the community was started in 2000, one of the first projects was to develop a registry of health uninsured, knowing that these families and individuals had no “payer” record, and typically accessed multiple providers for episodic care. Over the past three years HLMV, administered through the Center for Healthy Communities at Wright State University Boonshoft School of Medicine, has re-visioned itself as a Regional Health Information Organization (RHIO), the **HealthLink RHIO**. At the nexus of the **HealthLink RHIO** is *HIEx™*, a software application that was developed using federal (HRSA) funds to provide a central data repository for a shared community health record. The core data set for *HIEx™* is built on the Continuity of Care Record (CCR), currently the only national standard for clinical health information exchange (ASTM E2369-05). The CCR provides accurate clinical, demographic and administrative data for a specific patient. *HIEx™* currently houses demographics, contacts, referrals, notes, scanned documents, medications, immunizations, diagnoses, procedures, and eligibility data stored at both the individual and household levels. Additionally, **HealthLink RHIO** has partnered with an Ohio based commercial company, HTP, Inc., which provides software applications to facilitate insurance inquiries for eligibility and transaction routing services for all *HIEx™* users. HTP, Inc. developed the transaction services operated through the UHIN RHIO for the state of Utah, and has had a customer base primarily of decentralized health information technology and exchange systems. *HIEx™* is the first central data repository to use HTP, Inc. services, serving as a model for non-distributed health information technology and exchange. As demonstrated in the study by Poon & Jha (2006), that adoption of functionalities with financial benefits generally exceed adoption of those with safety and quality benefits, particularly in reasonably new HIT markets, we anticipate including the functionalities provided by HTP, Inc. will contribute to organizational utilization of *HIEx™*. *HIEx™* offers a best practice community solution for sharing individually identified health and human services data across multiple provider settings by housing the CCR in a secure central data repository that sources all bits of data, uses role based access, provides security through a virtual private network (VPN) and secure socket technology, and a full HIPAA audit trail. *HIEx™* also implements the Unified Medical Language System (UMLS) which provides a standard language to populate the clinical data elements specified by the CCR. This includes presentation and integration of SNOMED-CT®, ICD-9 codes, RXNORM and other systems to represent the concepts that provide meaning to the language of biomedicine and health. *HIEx™* uses .NET and other Microsoft® technologies to provide an open source solution that facilitates the capture and presentation of individual and household level data for authorized users in health and human services. Wright State University owns the non-proprietary code for *HIEx™*, which has been built with an open source philosophy. A defensible patent is pending to protect the intellectual property, ensuring that the product can continue to be offered as a public utility.

HIEx™ is offered on a subscription basis to health and human service organizations in the greater Dayton Ohio area. Formal data sharing and business associate agreements must be in place to legally establish the relationships supporting the shared community health record.

HIEx™ is currently accessible to 70 users including:

- Community health workers to help families and individuals access health care
- School nurses to manage daily health related functions in educational settings
- Physicians in ambulatory care settings to record medications, and diagnoses
- Social workers and nurses in child welfare, health and other human services

The most recently developed functionalities in *HIEx™* are the clinical data elements, tools with which health care providers have become more fully involved. While soliciting their participation, many questions have emerged from ambulatory care settings about specific implementation issues; some of which have been documented in the literature. However, anecdotal evidence suggests that the perceived viability of the shared community health record is not just in the functionalities it offers but also in the information it can provide from other data sources. For-example, while Dayton Public School nurses maintain the child's school health record, their interest in becoming *HIEx™* members was specifically related to wanting access to relevant data from other providers such as the public health department or the child's pediatrician. Similarly, providers at a hospital-owned community health clinic recognize that patients they treat have also received care from other providers and access to that data can increase quality of care. Using *HIEx™* when one of the children from Dayton Public Schools presents for treatment at the Cassano Health Center, the physician can access the child's record through *HIEx™*, view the data and add their treatment plans, observations, prescriptions and any other diagnostic or procedure information. If the same child presents at the Kettering Medical Center or Grandview Hospital emergency department (also data sharing partners), they can access the child's record, add any information about their treatment, etc. *HIEx™* can also interoperate to access other systems using web services and can accept CCR messages from other electronic health records.

As more health and human services providers become *HIEx™* members, it will be important to document the extent to which perceived expectations about the benefits of health information exchange through the shared community health record are realized as well as to study adoption at both the organizational and individual provider levels. A review of current literature follows which helps both to support and guide the projects outlined in section five below.

Evaluation of Existing Knowledge

The meta-analysis of literature related to the impact of health information technology on quality, efficiency and cost described in the article by Chaudhry, Wang, et. al (2006) reports that the preponderance of literature demonstrates health information technology (HIT) contributes to quality of care in three areas: increased adherence to guideline base care, enhanced surveillance and monitoring, and decreased medication errors, which includes improved medications dosing. Additionally, much of the evidence related to quality is focused on primary and secondary care. One of the studies reviewed in the meta-analysis by Garrido, Jamieson et. al. (2005) identifies decreased utilization of care as the most significant finding with respect to the impact of HIT on efficiency. After a general review of over 800 articles and a specific review of 257 articles for the meta-analysis, Chaudhry and Wang concluded that studies which documented the impact of HIT on cost of care were limited and inconclusive. Several limitations to the study are important to note as they begin to identify significant gaps in current literature. Many of the studies were conducted through just four academic institutions limiting generalizability. The majority of the studies addressed experiences with systems focused

primarily on clinical decision support, and only 1% of the systems reviewed by the studies in the meta-analysis had the capabilities for interoperability across provider organizations.

A more specific review of the literature demonstrates that the majority of research to date has been retrospective. For example, Miller and West have conducted two retrospective qualitative studies on adoption in Community Health Centers (Miller, 2007) and in solo or small practices (Miller, West et al. 2005). Both studies articulated the high cost of systems (\$44,000 and 54,000 per FTE during the first year) and suggest that the quality benefits are related to template usage for specific diseases. The unanticipated consequence in the 2005 study was that improved coding increased reimbursement. The study also re-iterated that the barriers to improving EHR value for most ambulatory care providers are cost, difficulty in effecting changes, and lack of regional electronic data exchange. In a study reviewing differences in acceptance of EHRs between house staff and physicians Hier and Rothschild, et. al. (2005) concluded the primary barrier to physician adoption was time. EHR use among family physicians was significantly more likely in large, urban practice settings among younger physicians (Menachemi, Perkins, et. al. 2006). In a study of EHR implementation in four physician practices, a lack of local training and support services was identified as a barrier to adoption (Baron, Fabens, et. al. 2005). In one of only a few prospective studies (Ventres, Kooienga et al. 2006) an ethnographic analysis of the effects of an electronic health record on the physician-patient interaction was conducted. Fourteen factors that influence how EHRs are used were identified and clustered into four thematic domains. Outcomes of the study reviewed primarily issues related to the impact of the EHR on the doctor-patient relationship.

Two studies that review limited health information exchange of clinical data come from Waterbury Connecticut and a program that serves patients in both Utah and Idaho. The Waterbury Health Access Program (WHAP) worked with a consortium of providers serving vulnerable underserved patients in a community-wide initiative which included implementing a common electronic medical record (EMR) system. While the structure of the database and health information exchange is a bit less centralized than the shared community health record in *HIEx™* described in the SCHR project, there are many similarities from which to draw in the WHAP initiative. The primary challenges to implementation have been concerns about HIPAA and privacy protection, multiple vended systems with limited interoperability, and physician acceptance (Carr, Bangalore, et. al. 2006). The Intermountain Healthcare project used electronic health records to facilitate implementation of a chronic care management model. Insuring access to care, using best practices and facilitating communication among providers were identified as contributing to the success of this project (Dorr, Wilcox, et. al. 2006). While many of the aspects of this project are applicable to the work of the SCHR project the primary difference is that all of the providers settings involved in the project were members of the same overall provider organization.

Overall, the primary gaps in the knowledge base published on health information technology are (1) the lack of studies on interoperable systems that share data across organizations, (2) the focus on retrospective (not prospective) studies of EHR implementations (adoption), (3) the limited focus of quality based studies on specific functionalities like CPOE, and on HEDIS measures, and (4) the lack of studies that focus on redesigning workflow in small physician practices (Hussain and Kelton 2006), and (Garrido, Jamieson, et. al. 2005). The SCHR project will contribute to closing these gaps in the literature, and will make a specific contribution related to the path of clinical adoption in health information exchange across provider organizations that address care transitions.

4. Preliminary Studies/Progress Report

Initially funded with a Community Access Program grant from the Health Resources and Services Administration awarded to the Center for Healthy Communities, a division of the Department of Community Health at the Wright State University Boonshoft School of Medicine, *HIEx™* has been developed using an open source philosophy, best industry practices and approved national standards. The Continuity of Care Record (CCR) provides the framework for building the shared community health record that documents health and human services interventions and maintains ambulatory clinical and social services data by individual and by household across multiple care settings. This design for health information exchange incorporates the UMLS, the Redbook Online and the SHOTS program to provide clinical decision support and integrates diagnostic and billing codes with the clinical data in the shared community health record. Working primarily with safety net organizations serving health uninsured members of the community, there have already been some significant successes since the system went live in July of 2004.

Increased Medicaid Enrollment

Most health and human services safety net organizations in the community are involved in the **HealthLink RHIO**, and identify themselves as HealthLink portal agencies which means they routinely have all clients/patients complete a portal questionnaire assessing their access to health care services and prescription drugs. Community health workers (CHWs) employed by the Center for Healthy Communities in the Dayton community serve over 15,000 people annually. Portal questionnaires are sent either on paper or electronically to the CHWs, who contact clients and begin building the client record in *HIEx™*, the shared community health record. This step documents the source of a client referral, demographics, and Medicaid eligibility data. *HIEx™* then tracks services utilization, and when appropriate, automatically populates public sector applications such as Medicaid, scanning required verification documents directly into the record. Additionally, *HIEx™* tracks workflow and Medicaid application, enrollment, denial and pending status. The Center for Healthy Communities has been able to document that Medicaid enrollment rates were 200% higher for applicants working through CHWs and *HIEx™* than for applicants who mailed in Medicaid applications. Through *HIEx™*, duplicate applications filed from multiple care settings were documented. More recently, aggregate data from *HIEx™* have been used, to provide a preliminary determination of the number of health uninsured in Montgomery County.

Data Consolidation into a Common Shared Record

Previously, Dayton Public Schools nurses used paper records and a local area network to maintain data related to health issues for their students. The data were limited to information gathered at school registration and data from the school health clinics but building to building communication was challenging and there was no opportunity for accessing data from providers outside the school system. Using *HIEx™*, the school health records were all transferred to the electronic shared community health record. Additionally, health data from the Medicaid managed care organization, CareSource was batched into *HIEx™* providing a more complete clinical picture of Dayton Public School children who were also CareSource members. Now, as school nurses begin to access a child's record through *HIEx™*, they have a more comprehensive picture of services provided throughout the school system and for Medicaid enrollees, information about immunizations and medications relevant to care provided during the school day.

Increased Completed EPSDT Examinations

Dayton Public Schools has a mobile health clinic that is used primarily to complete early periodic screening diagnosis and treatment (EPSDT) examinations for Medicaid patients. In the past while multiple exams were scheduled for a given day, there were multiple no-shows and an inaccurate understanding of which children were Medicaid eligible resulting in a lack of reimbursement for numbers of exams and unnecessary use of administrative resources for eligibility checks. In a pilot project using *HIEx™* prior to the mobile unit arriving at a specific school, CareSource screened all children in the building for Medicaid eligibility, and only those children who were Medicaid eligible were scheduled for exams. The outcome is a 100% increase in the number of exams completed, and increased reimbursement rates for the Dayton Public Schools. Additionally, school nurses will be able to identify students who are not yet enrolled in Medicaid and to assist in getting the enrollment process underway. The potential impact is significant, since —close to 30% of children eligible for Childrens' Health Insurance Program (CHIP) are not enrolled in Ohio.

The above early successes document specific examples of demonstrating the utility of *HIEx™* to providers who had identified specific problems to be solved. As the current *HIEx™* member organizations move to implementation of *HIEx™* and adoption of the shared community health record on a more comprehensive level, and additional health and human services providers begin using *HIEx™*, we will study the path of adoption in safety net settings both qualitatively and quantitatively identifying knowledge and attitudinal factors, workflow processes and practice setting variables, and quality outcome measures for children and adults during transitions in care.

5. Research Design and Methods

Progress to date

Currently four major provider organizations are members of the **HealthLink RHIO**, which administers *HIEx™*, the electronic shared community health record—Center for Healthy Communities, Dayton Public Schools, Cassano Health Center, and CareSource. Initially, most of the client/patient records resident in *HIEx™* were created by community health workers. Health and human services organizations routinely refer health uninsured community members to the CHWs employed by the Center for Healthy Communities who assist them in accessing health care. Community health workers populate the database with demographic, eligibility, and services utilizations information as well as contacts and referrals. When Dayton Public School nurses began to test out *HIEx™*, preliminary data demonstrated over 16% of their 16,000 students were already in the database. Information from the school health record, including immunizations and diagnostic codes that had been previously held in a non-web based AS400 system was imported into *HIEx™*, and existing records were reconciled while over 13,000 new records were created. When CareSource began working with the health information exchange, we discovered that 52% of children enrolled in the Dayton Public Schools received health care services from providers paid through CareSource, a Medicaid Managed Care organization. For those children additional information including primary care provider, Medicaid identification number, parent name, date of birth and address, and date of last physical examination were added to the *HIEx™* records. As a result of the CareSource data we were able to demonstrate that a significant number of Dayton Public School children who are enrolled in Medicaid through CareSource receive care at Cassano Health Center, a hospital based community health clinic. Cassano Health Center is the most recent member of the **HealthLink RHIO** preparing to pilot the use of *HIEx™* with some initial cohorts of patients with the expectation of migrating to a full electronic health record using the shared community health record, *HIEx™*.

The above describes the progression toward utility that served as the motivation for various health and human services providers to become members of the **HealthLink RHIO**, who administers the shared community health record, *HIEx™*. Initially, demographic and services utilization data helped HealthLink portal agencies document their uninsured client/patient population. Next the public schools found a way to increase Medicaid reimbursements, and CareSource identified a way to reduce administrative costs, and increase well child physicals. At that point, a critical mass of information was resident in *HIEx™* and it became an attractive resource for Cassano Health Center. As demonstrated in the Florida study of regional health information systems, we anticipate modeling by these early *HIEx™* organizational members to be a contributing factor in wide-spread community adoption and demonstration of a “seamless services chain” (Nykanen, Karimaa 2006). While there has been some exchange of data to date, each is still in a preliminary stage of adopting the implementation of *HIEx™*. Over the next three years, the SCHR project will document and study participation in *HIEx™* demonstrating both facilitative and inhibitive factors for using the shared community health record (SCHR) among ambulatory care safety net providers serving vulnerable populations as described below.

Project #1: Community Level Participation in the Shared Community Health Record

Over the past eighteen months, through a series of non-systematic educational sessions, newsletter articles, press releases and individual meetings, the majority of ambulatory health and social services safety net providers have been made aware of *HIEx™* as a resource to facilitate real time data exchange across organizations. To date anecdotal data from the seven provider organizations including the four major groups mentioned above demonstrate that participation in the shared community health record was motivated by a specific area of need for which *HIEx™* was seen as a solution. Now that *HIEx™* has a solid core of functionalities including modules for social services and case management, clinical data, decision support, and eligibility inquiries we will begin a more systematic communications strategy and a qualitative study to document facilitative and inhibitive factors related to the decision to participate in the shared community health record through *HIEx™*. **It is important to note at the outset that we are not studying adoption of an EHR, we are studying adoption of a shared community health record which includes, using the components of the continuity of care record, an EHR and more being used as a common shared record across provider organizations.**

Participants

Participants in this community level exploration will be all health and human services providers in Montgomery County as identified through comprehensive mailing lists developed and maintained through the Center for Health Communities over the period 1992 to present in support of the work of the community health workers who assist members of the community in accessing resources related to broad determinants of health. Participants will include local hospitals emergency department and ambulatory care clinics, governmental and non-governmental social services organizations, out-patient physician practices, community health centers, WIC, Catholic Social services screening and outreach programs, and the like. We anticipate that there will be at least fifty such organizations who will participate.

Methodology

All health and human services providers currently have access to and use of electronic communication tools such as email, so the majority of communication with project participants will be through email. In August, 2007 an initial invitation to participate in the project will be electronically sent to all potential participants. Those who agree to participate will be enrolled in the study for a period of three years, and those who do not agree will be contacted for an interview to learn about factors contributing to their decision not to participate. In September, 2007 enrollees will complete an entry survey on line assessing relevant factors related to their

potential for membership in the **HealthLink RHIO** and use of *HIEx™*, the shared community health record. For a period of three years, enrollee interaction with the SCHR project will be monitored. Each participating organization will receive through an email communication every quarter, educational information about *HIEx™* and those who are using it, including information about functionalities and upgrades, success stories of current users and other information of likely interest to the recipient. These communications will be electronically tracked using the return receipt function in email to confirm those that are opened and those that are not opened per provider organization. As additional requests for information come in from enrollees, the frequency and type of requests will be documented by date and catalogued as well as the responses from the project team. As organizational members agree to come on line with *HIEx™*, the progression of adoption will be chronologically monitored and catalogued as well. Development stages will include demonstrations and trainings, signing HIPAA agreements, beta testing for a specific project, and expanded use of *HIEx™*. At the point of having an executed information sharing agreement, an organization will be considered to be a full participant in *HIEx™*. At that time, a representative of the organization will be interviewed as a follow-up to the initial entry survey described above. On an annual basis the data will be analyzed both quantitatively and qualitatively documenting common factors that contribute to adoption and continued use of the shared community health record.

Instruments

1. A review of current literature provides a number of models for surveys related to potential and actual adoption of EHRs by health care providers. While existing surveys will inform the creation of the initial entry survey of study participants at the organizational level referenced above, specific questions related to adoption of a shared community health record will be developed for use in this project.
2. A set of questions to be used in a structured interview at the point of an organization opting out of participation in the study will be developed.
3. A set of questions to be used in a structured interview at the point of signing an information sharing agreement for membership in *HIEx™* will be developed. Previous retrospective studies of success factors in EHR adoption will inform the development of interview questions, however additional questions will be developed more directly related to the prospective study of adoption and utilization of the shared community health record.

Quantitative Data Analysis

Community level participation in the shared community health record will be tracked quantitatively through the measurement of the frequency of opened emails in response to quarterly educational communications, quantified by organization. We believe that this will provide measure of level of interest in *HIEx™*. Similarly, the frequency of requests for more information will be quantified by organization as another measure of level of interest. Responses to the initial entry survey of enrolled participant organizations will be scored, coded, and a scale developed that will classify the organization along a continuum of highly likely to not at all likely to become members of *HIEx™*.

Scores on the “likely to become a member” scale will be correlated with the frequency of opened e-mails and frequency of requests for more information, using Pearson’s correlation coefficient and the strength of the correlation (r^2) and its significance will be determined. We hypothesize that a positive relationship will exist between higher “likely to become a member” scores and frequency of use scores.

Qualitative Data Analysis

Types of inquires from participant organizations will be classified into categories such as access to data, accuracy and timeliness of data, cost of service, down time, functionalities of the

system, legal issues, operations issues, privacy and security of data, technology and connections issues, training and technical assistance, etc., and quantified by organization and across organizations.

Using the N6 ethnographic content analysis program, a qualitative content analysis of interview data collected at the point of opting out of the study and at the end of the three year period for provider organization who are not members of *HIEx™* will be completed for each organization and themes identified related to decisions not to become members of *HIEx™*. Similarly, for participants who become users of *HIEx™*, a qualitative content analysis will be performed with interview data collected at the point of having executed an information sharing agreement, and themes identified related to decisions to become members of *HIEx™*.

The themes identified through qualitative analysis will be compared with information obtained through the surveys of both those who decide to participate and those who decline to participate in the project. We expect that the qualitative data will reinforce and strengthen what we learn from the surveys about factors that may be either facilitative or inhibitory toward the adoption of a shared community health record.

Limitations

The primary limitation to the study outlined in Project #1 above is the lack of directly applicable instruments to be used in identifying facilitative and inhibitive factors to adoption of a shared community health record. A second limitation is the expected low number of study participants who become *HIEx™* members in the three year project period. The third limitation is the potential for difficulty with generalizability. While we expect to demonstrate results and a methodology that can be replicated in other communities as health information exchange becomes more common, the limited research to date suggests there will likely be highly variable paths towards adoption of health information exchange influenced, perhaps in part by common facilitative and inhibitive factors, but also influenced by political and economic issues which many be more difficult to quantify.

Project #2: User Level Participation in the Shared Community Health Record

Once a provider organization has become a *HIEx™* member, a determination of role based access for individual users is completed, and decisions are made about the process of implementation. Organizations may begin using *HIEx™* for a specific project such as screening for Medicaid eligibility prior to providing EPSDT examinations, as did the Dayton Public Schools. Individual users who use *HIEx™* for a specific purpose, but who do not expand their use, will be defined as “compliant.” It is possible, however, that once individual users begin interacting with the shared community health record they may find additional utility and begin expanding their use. In this case, we would define their use of the system as “compliant plus.” Conversely, an organization may decide to start using certain functionalities of *HIEx™*, but not all individual users may choose to participate. In this case, individuals who are not using functionalities identified by their organizations would be defined as “non-compliant.” For example, in the pilot project at Cassano Health Center reviewed below, not all providers who treat patients in the identified cohort may choose to document their work in the shared community health record. It will be important to observe individual user participation in the shared community health record within each organization and to explore both qualitatively and quantitatively during the implementation process the factors that contribute to those who choose to use and those who choose not to use *HIEx™*. A similar study of how EHRs are used identified fourteen factors clustered into four thematic domains will be carefully reviewed for components that may be replicable in the SCHR project (Ventres, Koonienga et. al. 2006). As an anecdotal example of the type of qualitative data to be reported, a physician explained, “I now have a computer on the

desk in my exam rooms, but now I have no room on the table to write notes in the paper record.” Data such as these statements will be analyzed to articulate the “voices” of the participants. At the conclusion of the study, project staff will be able to define the elements that might describe the path to adoption most likely among safety net providers and other community based health care settings. Coupling this data with quantitative analysis such as user log tables will provide a rich perspective on clinical adoption of the shared community health record.

Participants

For organizations described above that have signed or will sign an information sharing agreement and become members of *HIEx™*, all individual users who agree to continue participation, defined as being assigned role based access and a user password, will be participants in Project #2.

Methodology

Beginning in August, 2007 with the current *HIEx™* users and moving forward throughout the project period as organizations come on board, there will be periodic review of *HIEx™* utilization at the individual user level by project staff using the HIPAA audit trail. When an organization has determined a specific use for *HIEx™*, the review will simply be to determine who is using the system as prescribed, and who is not. Through this periodic utilization review, any additional use, outside of the specific use determined by the organization will also be documented at the individual user level. For organizations who adopt *HIEx™* for multiple purposes, review of utilization of *HIEx™* functionalities defined by modules in the shared community health record, will be completed at the individual user level and by clusters of users as determined by their assigned role based access. These analyses will be done using the HIPAA audit trail function of *HIEx™*. The audit trail stamps all views or entries into a record by time, date, user name, and actions taken in the record. For example, for a specific user, the number of times they access the Medications module in a defined period of time can be quantified.

Additionally, beginning in August, 2007 with the current *HIEx™* users and moving forward throughout the project period as organizations come on board, each individual user will complete an initial use survey assessing relevant factors related to their potential utilization of *HIEx™*. At three month intervals for the first nine months of organizational membership in *HIEx™* and annually thereafter during the project period, a sample of users and non-users will be interviewed to determine facilitative and inhibitive factors to use. A review of current literature including the study testing the Success Factors Profile for clinical computer innovation (Lorence, 2004), and the Lee and Cain study (2005) identifying factors contributing to successful adoption may provide useful components to help develop these interviews.

Instruments

1. The HIPAA audit trail in *HIEx™* will serve as the instrument providing data for the actual use analyses described above.
2. A review of current literature provides a number of models for surveys related to potential and actual adoption of EHRs by health care providers. While existing surveys will inform the creation of the initial use survey of study participants referenced above, specific questions related to adoption of a shared community health record will be developed for use in this project.
3. A set of questions to be used in the series of quarterly structured interviews in the first nine months of implementation and thereafter annually during the project period will be developed. Previous retrospective studies of success factors in EHR adoption will inform the development of interview questions, however additional questions will be developed more

directly related to the prospective study of adoption and utilization of the shared community health record.

Quantitative Data Analysis

For each user within each organization, a user log table will be created which documents overall frequency of use, and frequency of use of specific modules within the system.

Use level will be classified per user as high (in the upper quartile of number of uses per defined time period), moderate (in the 2nd and 3rd quartiles of number of uses, or low (in the lowest quartile of number of uses). Use type will also be classified per user as compliant (use of the system only for the purpose identified by the organization), compliant plus (use of the system for the identified purpose, plus use of other functionalities as identified by the user), and non-compliant (little or no use of the system for even purposes identified by the organization). Level of use (high, moderate, low) and use type (compliant plus, compliant, non-compliant) will be analyzed using Spearman R.

Responses to the initial use survey of individual users will be scored, coded, and a scale developed that will classify the individual along a continuum of highly likely to not at all likely to use *HIEx™*. Scores on the “likely to use” scale will be correlated with the level of use using Pearson’s correlation coefficient, and the strength of the correlation (r^2) and its significance will be determined. We hypothesize that a positive relationship will exist between higher “likely to use” scores and level of use.

Qualitative Data Analysis

Using the N6 ethnographic content analysis program, a qualitative content analysis of interview data collected during the quarterly and annual interviews of individual users and non-users, and themes identified related to decisions to become users or remain non-users of *HIEx™* will be conducted.

The themes identified through qualitative analysis will be compared with information obtained through the initial use surveys. We expect that the qualitative data will reinforce and strengthen what we learn from the surveys about factors that may be either facilitative or inhibitory toward individuals’ choices whether or not to use a shared community health record.

Limitations

The primary limitation to the study outlined in Project #2 above is the lack of directly applicable instruments to be used in identifying facilitative and inhibitive factors to adoption of a shared community health record. A second limitation is difficulty with generalizability.

Projects #3, #4, #5, and #6: Improved Quality of Care through Use of a Shared Community Health Record

While all current organizational *HIEx™* members are interested in the outcomes, for each of the studies described below, one of the *HIEx™* organizational members has identified quality of care measures that they expect to be improved by having access to a shared community health record. Each of the studies will be initiated from just one of the *HIEx™* organizational members, however, demonstrating the expectations put forward will be dependent on full participation from all organizational members identified below.

Project #3: Decreased Over-exposure to Vaccines for Children Enrolled in the Dayton Public Schools

Participants

While the study does not call for any direct interaction with children enrolled in the Dayton Public Schools, Project #3 involves accessing and analyzing personal health information for Dayton Public School children who have a health record resident in the shared community health record, *HIEx™*. Permission to access these records for purposes of de-identified aggregate reporting related to quality measures is secured by the Dayton Public Schools in their routine privacy release which informs parents that personal health information will be maintained in a shared community health record for purposes of treatment, payment and operations as specified under HIPAA regulations.

Methodology

Problem to be addressed: In order to be enrolled in school, children must have documentation of completed immunizations appropriate to their age. The *view only* access to the Ohio Immunization Registry, which captures about 35% of completed immunizations statewide is only available to physicians, and not available to school nurses or other health care providers. Often, parents do not recall which immunizations have been completed and do not have the immunization record provided for them at point of care. So when they are told at school registration that the child cannot be registered without documentation of completed immunizations, often, the child is re-immunized.

At the point of registration beginning in August, 2007, Dayton Public School nurses will use *HIEx™* to collect demographic, eligibility, immunizations and medications information relevant to the child's school health record. Based on preliminary studies, 16% of children registering in the Dayton Public Schools will already have a record resident in *HIEx™* created as a result of their having received services at other safety net provider organizations in Montgomery County. When a record already exists, the school nurse will review and update existing information as well as add new information. In June, 2007, and moving forward on a bi-monthly basis through electronic query of *HIEx™*, CareSource will identify all newly registered Dayton Public School children who are Medicaid enrollees through CareSource and will add to the shared community health record clinical data extracted from claims data related to immunizations and medications, as well as primary care provider, date of most recent physical examination and Medicaid identification number. Also starting in June, 2007, and moving forward, we will work with the Montgomery County Combined Health District to coordinate data from immunizations provided through child health clinics with the school health record, Cassano Health Center will enter into the shared community health record immunizations provided for Dayton Public School children treated in Cassano Health Center, and pediatricians who are part of the practice based research network will work to coordinate data from immunizations provided for Dayton Public School children treated in their practices with the shared community health record. Most of the Dayton Public School children are Medicaid eligible, and most Medicaid pediatric patients will be enrolled through CareSource. However, in Montgomery County close to 30% of children eligible for Medicaid are not enrolled. Capturing data from the Combined Health District community health centers, from Cassano Health Center and from pediatricians who serve health uninsured will insure that immunization records for the majority of uninsured children are also included in *HIEx™*.

In mid October, each year, a "lock out" date is set in the Dayton Public Schools. Any child who does not have documentation of current immunizations as of the lock out date is sent home and not allowed to return to school until such documentation is provided. Using the mid-October lock out date as a point in time, a random sample of *HIEx™* records for children enrolled in the

Dayton Public Schools will be selected for analysis to determine the extent of over-exposure to vaccines in October, 2007. This analysis will be compared with baseline data collected from the Dayton Public Schools' child health record in mid-October of 2006 prior to utilization of *HIEx™*, to determine if there is a significant difference in rates of over exposure to vaccines. An annual comparison will also be made in October of 2008 and 2009.

Data Analysis

Over-exposure to vaccines will be determined by selecting a random sample for review of Dayton Public School child health records as they existed in the AS400 system in October, 2006 as a baseline, and of *HIEx™* records for children attending Dayton Public Schools as they exist in October 2007. Documentation of at least one duplication of vaccines in a record is defined as over-exposure to vaccines. The rate of overexposure to vaccines will be calculated for each sample by dividing the number of over-exposed records by the total number of records in the sample. These two proportions will be analyzed by t-test to determine significance. Sample size is determined based on the level of change in overexposure rates we expect to see as a result of better information sharing through a shared community health record. If we assume a 10% decrease in the rate of overexposure to immunizations at a confidence interval of 0.95 would require a sample size of approximately 200 in each group.

Limitations

The primary limitation for this project is that the baseline measure for over exposure to vaccines may be incomplete. A second limitation for this project is we cannot insure that we will have all of the immunization data related to Dayton Public Schools children for the 2007 measure because all health care providers in the Greater Dayton™ area are not yet members of *HIEx™* and active in health information exchange through the shared community health record.

Project #4: Increased Number of Completed EPSDT Examinations

Participants

Participants in this project will be children who are enrolled in the Dayton Public Schools and who are enrolled in Medicaid.

Methodology

Children enrolled in Medicaid are required to have an annual well child physical examination. CareSource, the Medicaid Managed Care organization with a penetration rate in Montgomery County of 80%, has an interest in insuring that their enrollees are compliant with this requirement. Often families delay going to the doctor until the child is ill. In an attempt to insure that children have a physical examination each year, the Dayton Public Schools operates a mobile clinic and serves as a Medicaid provider to complete EPSDT examinations for children enrolled in Medicaid. Typically, the mobile clinic is scheduled for a school building and school nurses work to get as many children scheduled for physicals as they can. The no-show rate is extremely high, and verifying Medicaid eligibility to insure reimbursement quite difficult. Using *HIEx™*, prior to the mobile clinic being scheduled for a building, an eligibility inquiry will be made for all children in the building. Parents of those enrolled in Medicaid will receive notification from the school nurse about the availability of this resource, and examinations will be scheduled. For children not enrolled in Medicaid, school nurses will work with community health workers from the Center for Healthy Communities to assist families in applications to Medicaid or identifying other resources in the community for health care.

Data Analysis

Using *HIEx™*, EPSDT examination completion rates for children enrolled in the Dayton Public Schools who are also enrolled in Medicaid will be calculated for the academic years August

2007-June 2008 and August 2008-June 2009 by dividing the number of children for whom EPSTD exams were completed by the total number of children enrolled in Medicaid. As a baseline for comparison, EPSTD examination completion rates for children enrolled in the Dayton Public Schools who are also enrolled in Medicaid will be calculated for the academic years August 2005-June 2006 and August 2006-June 2007. A comparison between the average proportion of exam completion of the two baseline years and the average of the two intervention years will be analyzed by t-test to determine significance. If an average 10% increase in the rate of EPSTD exams completed, at a confidence interval of 0.95, a sample of approximately 200 in each year will be required.

Limitations

The primary limitation to this project is that there are no controls other than knowledge of Medicaid enrollment in place to account for other variables that may impede completion of EPSTD exams.

Project #5: Increased Enrollment in SCHIP

Participants

While the study does not call for any direct interaction with children enrolled in the Dayton Public Schools, Project #4 involves accessing and analyzing personal health information for Dayton Public School children who have a health record resident in the shared community health record, *HIEx™*. Permission to access these records for purposes of de-identified aggregate reporting related to quality measures is secured by provider organization of *HIEx™* in their routine privacy release which informs clients/ patients that personal health information will be maintained in a shared community health record for purposes of treatment, payment and operations as specified under HIPAA regulations.

Methodology

As the mobile health clinic moves from school building to school building completing EPSTD exams as described above, and Medicaid enrollment status is confirmed for children attending the Dayton Public Schools, children who are not enrolled in Medicaid will also be identified. School nurses, working with community health workers will be able to focus attention on working with eligible families to complete the Medicaid application process, and secure the required verifications to submit the Medicaid application. School nurses will contact parents of potentially Medicaid eligible children and refer them to community health workers from the Center for Healthy Communities who will assist them in completing the application, and through *HIEx™* track the progress from application to enrollment. In cases where children are not eligible or the application is denied, school nurses and the community health workers will follow up with families either to re-apply or find alternative resources for health care.

Data Analysis

An estimated seventy per cent of Dayton Public School children are eligible for Medicaid. For each of the academic years ending June, 2006 and 2007 as baseline years, and June 2008, and 2009 as comparison years, a total number of children who attend Dayton Public Schools who are enrolled in Medicaid will be calculated using data from *HIEx™*. The rate of Medicaid enrollment for each year will be calculated by dividing the number enrolled by the total number eligible. A comparison between the average proportion of eligible children enrolled Medicaid in the two baseline years and the two intervention years will be analyzed by t-test.

Limitations

Recent changes in required verifications for Medicaid applications have resulted in unusually low overall enrollment levels during calendar year 2006, compared with previous years.

However, it is expected that these requirements will continue through the project period, so that this particular condition will apply to both comparison years and baseline years and allow valid comparisons between years. Additionally, during calendar year 2006, community members who were assisted with Medicaid applications by community health workers demonstrated a significantly higher enrollment rate when compared with community members who mailed in their applications without assistance. Consequently, it might be expected that the intervention of community health workers with more Dayton Public School families would tend to increase enrollment in Medicaid, irrespective of the use of *HIEx™*, making it more difficult to assess the contribution of *HIEx™* to any increase in enrollment. To control for this, we will assess how many children who become enrolled in Medicaid during the intervention years were assisted with Medicaid application by community health workers, compared with how many children who became enrolled without community health worker assistance.

Project #6: Improved Documentation of Adherence to Guideline-Based Care

Participants

Participants for this project will be cohort of patients at the Cassano Health Center with a diagnosis of diabetes.

Methodology

The Cassano Health Center is a hospital-owned community health center established to fill a gap in service created when a 100-year-old hospital serving a large portion of health uninsured in the community closed its doors. Cassano Health Center serves over 18,000 patients annually and is a “one stop shop” facility offering an on site pharmacy, laboratory services primary care services and twelve different specialty care services. Cassano Health Center is also a training facility rotating third and fourth year medical student clerkships and medical residents through the facility on a regular basis. Building on research that demonstrated integrating condition specific templates with an EHR improved history and physical exam assessments with geriatric patients, (Fung, 2005) , as Cassano Health Center begins to work with *HIEx™*, the shared community health record, the place to start will be with more accurate documentation of adherence to guideline based care with diabetic patients. Currently, each patient of Cassano Health Center has one paper chart into which information is recorded from the multiple providers serving patients in the facility. The current method of monitoring adherence to guideline based care with diabetic patients is by noting completion of HP2010 objectives 5.1 (diabetes education), 5.11 (annual urinary microalbumin measurement), 5.12 (annual glycosylated hemoglobin measurement), 5.13 (annual dilated eye exam), 5.14 (annual foot exam), and 5.15 (annual dental exam) as well as weight, waist circumference, BMI and blood pressure measures, whether or not ACE/ARB medications have been prescribed, results of HbA1c, BUN/Creatinin, TSH and Lipid tests, and whether or not influenza and pneumovax vaccinations have been administered on a cover sheet that is supposed to be kept in the paper chart. Often the cover sheet for diabetic patients gets separated from the chart, or is misfiled in the chart, or procedures are not noted on the coversheet. Short of extensive chart audits to find the various pieces of documentation related to adherence to guideline based care, or a review of multiple payer records which would not capture information for those 30% of patients at the health center who are self pay, there is really no way of efficiently reporting on adherence to guideline based care for diabetic patients.

A convenience sample of 100 diabetic patients will be identified from Cassano patients. Their paper charts will be converted to the shared community health record, *HIEx™*. A second convenience sample of 100 diabetic patient charts will be identified as a quasi-control group. Physicians who treat patients whose charts have been converted to *HIEx™* will be trained in how to record guideline based care for diabetics in *HIEx™*. Over a period of twelve months

beginning January 2008 view and entry access to *HIEx™* by the trained physicians will be monitored. At the end of twelve months a comparison between the selected charts resident in *HIEx™* and 100 charts identified as the quasi-control group will be completed to determine if there is any difference in the level of documentation of adherence to guideline based care for diabetic patients.

Data Analysis

Using *HIEx™* the number of Cassano Health Center records for diabetic patients documenting completion of at least 90% of items related to guideline based care will be determined. Through a chart review of the identified paper records for diabetic patients, the number documenting completion of at least 90% of items related to guideline based care will be determined. We will compare the proportion of charts demonstrating completion of at least 90% of items related to guideline based care between the two groups to see if using *HIEx™* improves documentation of adherence to guidelines.

Limitations

This project is limited by a number of variables which could influence adoption of the shared community health record for which we are not controlling. It is not possible to do a “blind” study in which the clinicians treating diabetic patients are unaware of which group an individual patient is assigned to. Physicians in the practice will probably treat both patients whose charts have been converted into the shared community health record and clients who maintain paper charts. Differences of levels of utilization of the shared community health record among physicians could impact the study in a variety of ways. For example, the act of documentation in *HIEx™* may also cause physicians to be more diligent in recording information for their patients with a paper chart, which would tend to decrease differences in the rate of documentation. Physicians who demonstrate lower utilization of the shared community health record may be more or less diligent in documentation in the paper chart, again obscuring any differences that could be attributed to a shared community health record. To help correct for this limitation, in June 2007 we will audit approximately 50 charts of diabetic patients at Cassano Health Center to determine a baseline documentation completion rate for guideline based care. Using this baseline, we will be better able to assess the effect, if any, of the electronic shared community health record on documentation completion.

Project Management Team

The Project Management Team responsible for completing the work outlined above includes: the Principal Investigator, Kate Cauley, PhD, and Director of the Center for Healthy Communities; the Project Director, Mary Crimmins, MA, CPHIT, CPEHR and Research Associate and *HIEx™* Project Manager at the Center for Healthy Communities; the IT Director, David Roberts, BS, and IT Engineer, Software Designer/Programmer for the Center for Healthy Communities; and the Research Director, Carla Clasen, RN, MPH and Co-Director and Research Coordinator for the Center for Healthy Communities. The Project Management Team will meet on a monthly basis and be responsible for integrating and coordinating all aspects of the project including dissemination of findings.

There will be three additional work groups each meeting on a monthly basis organized to complete the work of the project. Under the direction of the Research Director, the Research Team will include: the Child Data Consultant, Jack Pascoe, MD, MPH, Professor, Department of Pediatrics Boonshoft School of Medicine, Wright State University, and Director of the Dayton Community Practice Based Research Network; the Adult Data Consultant, Tom Hardy, DO, and Vice President of Medical Affairs for Grandview Hospital and Ambulatory Care Centers; the Quality Measures Consultant, Robert Cain, DO, Director of Residency Training for Grandview

Medical Center and principal in the research of the American Osteopathic Association related to disease management and quality measures; the Training/Workflow Coordinator, Jerry Carr, MBA, and President of the Miami Valley Health Improvement Council; and the Web Mistress, Ann Marie Halfpap, Research Support Technician for the Center for Healthy Communities. Research Team members will oversee and coordinate all interaction with study participants, data collection and analysis, and IRB approval processes.

Under the direction of the IT Director the IT Team will include the IT Professional, and the IT consultants from the Dayton Public Schools, Cassano Health Center, CareSource the Combined Health District and future *HIEx™* organizational members. The IT Team will be responsible for continuing *HIEx™* development completing all components of the CCR, completing required modifications and customizations for *HIEx™* organizational members, and working to establish interoperability across electronic record systems as needed. The IT Director will serve as the liaison from the project to the Office of Computing and Technology Services at Wright State University where the servers for *HIEx™* are housed and supported.

Under the direction of the Project Director the Field Team will include the Dayton Public Schools Consultants, Marianne Urban, RN, MS, Director of Health Services, and Theresa Zryd, MD, MPH, Associate Professor, Department of Family Medicine, Boonshoft School of Medicine, Wright State University, and Medical Director for the Dayton Public Schools; Tom Herchline, MD, Associate Professor, Department of Internal Medicine, Boonshoft School of Medicine, Wright State University, and Allene Mares, MPH, Health Commissioner, Combined Health District Montgomery County; Mark Floro, BS, Director and Lynn Wright, RN, Care Coordinator of Cassano Health Center; and Pam Morris, BA, President and CEO, and Bob Gladden, MS, Vice President, Decision Support and Informatics of CareSource. The Field Team will track and monitor implementation and adoption processes in all *HIEx™* organizational members. Much of the work of the project will be mapped and monitored using a project management feature available on *HIEx™*.

Summary/Evaluation and Dissemination Plans

While research in the areas described above is limited to non-existent, we anticipate demonstrating some significant preliminary findings including:

- A description of factors which serve to facilitate and inhibit adoption of electronic health records and health information exchange through the shared community health record, *HIEx™* among health and social services safety net organizations serving vulnerable populations
- A descriptive analysis of the path to clinical adoption of electronic health records and health information exchange through a shared community health record among individual provider users from safety net organizations serving vulnerable populations
- A demonstration of the utility of electronic health records and health information exchange through a shared community health record in increasing numbers of completed EPSDT exams, and enrollment in the Children's Health Insurance Program for public school children, and documentation of adherence to guidance based care for adult diabetic patients in community health centers
- A demonstration of the utility of electronic health records and health information exchange through a shared community health record in decreasing the incidences of over-exposure to vaccines for public school children.

Evaluation of the SCHR project will be documented through successful completion of the studies described in the Research Design and Methodology section of the Project Narrative. Results of these studies can be used to inform other communities and the *HIEx™* application as

an iteration of the CCR standard may be disseminated to other communities for test use and replication.

Dissemination of findings will be completed at the local, state and national level through newsletter articles, postings on the Center for Health Communities web site, presentations at state level and national professional association meetings and conferences, and submission of articles for publication to peer reviewed journals.

Bibliography

- Baker, E. L., M. A. Potter, et al. (2005). "The public health infrastructure and our nation's health." Annual Review of Public Health **26**: 303-18.
- Baron, R. J., E. L. Fabens, et al. (2005). "Electronic health records: just around the corner? Or over the cliff?" Annals of Internal Medicine **143**(3): 222-6.
- Carr, K., D. Bangalore, et al. (2006). "Leveraging the benefits of Health Information Technology to support healthcare delivery model redesign." Journal of Healthcare Information Management : JHIM **20**(1): 31-41.
- Chaudhry, B., J. Wang, et al. (2006). "Systematic review: impact of health information technology on quality, efficiency, and costs of medical care." Annals of Internal Medicine **144**(10): 742-52.
- Dorr, D. A., A. Wilcox, et al. (2006). "Implementing a multidisease chronic care model in primary care using people and technology." Disease Management : DM **9**(1): 1-15.
- Drury, B. M. (2006). "Ambulatory EHR functionality: a comparison of functionality lists." Journal of Healthcare Information Management : JHIM **20**(1): 61-70.
- Ford, E. W., N. Menachemi, et al. (2006). "Predicting the adoption of electronic health records by physicians: when will health care be paperless?" Journal of the American Medical Informatics Association : JAMIA **13**(1): 106-12.
- Fung, C. H. (2006). "Computerized condition-specific templates for improving care of geriatric syndromes in a primary care setting." Journal of General Internal Medicine : Official Journal of the Society for Research and Education in Primary Care Internal Medicine **21**(9): 989-94.
- Gans, D., J. Kralewski, et al. (2005). "Medical groups' adoption of electronic health records and information systems. Practices are encountering greater-than-expected barriers to adopting an EHR system, but the adoption rate continues to rise." Health Aff (Millwood) **24**(5): 1323-33.
- Garrido, T., L. Jamieson, et al. (2005). "Effect of electronic health records in ambulatory care: retrospective, serial, cross sectional study." BMJ (Clinical Research ed.) **330**(7491): 581.
- Geibert, R. C. (2006). "Using diffusion of innovation concepts to enhance implementation of an electronic health record to support evidence-based practice." Nursing Administration Quarterly **30**(3): 203-10.
- Heidt, E. L. (2006). "Health information technology and physician-patient interactions: impact of computers on communication during outpatient primary care visits." Journal of the American Medical Informatics Association : JAMIA **13**(2): 236; author reply 237.
- Hier, D. B., A. Rothschild, et al. (2005). "Differing faculty and housestaff acceptance of an electronic health record." International Journal of Medical Informatics **74**(7-8): 657-62.
- Hussain, K. A. and G. M. Kelton (2006). "Utilization of health care quality markers in a family medicine outpatient setting." Family Medicine **38**(7): 490-3.
- Kemper, A. R., R. L. Uren, et al. (2006). "Adoption of electronic health records in primary care pediatric practices." Pediatrics **118**(1): e20-4.
- Lee, J., C. Cain, et al. (2005). "The adoption gap: health information technology in small physician practices. Understanding office workflow can help realize the promise of technology." Health Aff (Millwood) **24**(5): 1364-6.
- Lorence, D. P. and R. Churchill (2005). "Clinical knowledge management using computerized patient record systems: is the current infrastructure adequate?" IEEE Transactions on Information Technology in Biomedicine : a Publication of the IEEE Engineering in Medicine and Biology Society **9**(2): 283-8.
- Magill, M. K., R. L. Lloyd, et al. (2006). "Successful turnaround of a university-owned, community-based, multidisciplinary practice network." Annals of Family Medicine **4** **Suppl 1**: S12-8; discussion S58-60.

- Menachemi, N., D. L. Ettel, et al. (2006). "Charting the use of electronic health records and other information technologies among child health providers." BMC Pediatrics [electronic resource] **6**: 21.
- Menachemi, N., R. M. Perkins, et al. (2006). "Examining the adoption of electronic health records and personal digital assistants by family physicians in Florida." Informatics in Primary Care **14**(1): 1-9.
- Miller, R. H. (2007). "The Value Of Electronic Health Records In Community Health Centers: Policy Implications." Health Affairs **26**(1): 206-214.
- Miller, R. H., C. West, et al. (2005). "The value of electronic health records in solo or small group practices. Physicians' EHR adoption is slowed by a reimbursement system that rewards the volume of services more than it does their quality." Health Aff (Millwood) **24**(5): 1127-37.
- Nykanen, P. and E. Karimaa (2006). "Success and failure factors in the regional health information system design process--results from a constructive evaluation study." Methods of Information in Medicine **45**(1): 85-9.
- Pizziferri, L., A. F. Kittler, et al. (2005). "Primary care physician time utilization before and after implementation of an electronic health record: a time-motion study." Journal of Biomedical Informatics **38**(3): 176-88.
- Poon, E. G., A. K. Jha, et al. (2006). "Assessing the level of healthcare information technology adoption in the United States: a snapshot." BMC Medical Informatics and Decision Making [electronic resource] **6**: 1.
- Rosenbloom, S. T., X. Qi, et al. (2006). "Implementing pediatric growth charts into an electronic health record system." Journal of the American Medical Informatics Association : JAMIA **13**(3): 302-8.
- Schade, C. P., F. M. Sullivan, et al. (2006). "e-Prescribing, efficiency, quality: lessons from the computerization of UK family practice." Journal of the American Medical Informatics Association : JAMIA **13**(5): 470-5.
- Strating, D., J. MacGregor, et al. (2006). "Bridging information "islands": designing an electronic health record that meets clinical needs." Healthcare Quarterly **9**(2): 94-8.
- Teram, E., C. L. Schachter, et al. (2005). "The case for integrating grounded theory and participatory action research: empowering clients to inform professional practice." Qualitative Health Research **15**(8): 1129-40.
- Thomas, P., J. McDonnell, et al. (2005). "Increasing capacity for innovation in bureaucratic primary care organizations: a whole system participatory action research project." Annals of Family Medicine **3**(4): 312-7.
- Ventres, W., S. Kooienga, et al. (2006). "Physicians, patients, and the electronic health record: an ethnographic analysis." Annals of Family Medicine **4**(2): 124-31.