

Grant Final Report

Grant ID: 5UC1HS016146

Accessing the Cutting Edge: Implementing HIT to Improve Quality in Rural East Kern County

Inclusive Dates: 09/30/05 – 05/31/09

Principal Investigator:

Kiki C. Nocella, PhD, MHA

Team Members:

Jami J. Young, MPA

Kim J. Horowitz, MD

Lyndee Knox, PhD

Joe Brisson

Performing Organization:

Tehachapi Valley Healthcare District dba Tehachapi Hospital

Project Officer:

Erin Grace

Submitted to:

The Agency for Healthcare Research and Quality (AHRQ)

U.S. Department of Health and Human Services

540 Gaither Road

Rockville, MD 20850

www.ahrq.gov

Abstract

Purpose: To develop a health information exchange in a rural region of California.

Scope: The project had four primary goals: To implement a rural Health Information Exchange in Tehachapi California; to establish an administrative and governance infrastructure to guide development of the HIE and lead sustainability planning for the HIE; to pilot a tele-ophthalmology service for Tehachapi residents; and to implement a Personal Health Record (PHR) for patients living with diabetes.

Methods: In this study, mixed-methods, non-experimental design was engaged. Quantitative data was captured for HIT utilization statistics and qualitative data through key informant interviews.

Results: The realities of implementing Health IT strategies are more difficult than that of a design or plan put on paper. There were many valuable lessons learned through the process of adoption and utilization of Health IT that will be helpful for expanding or for organizations newly engaging in such a process. Some lessons include building the option to push selected data collected from the HIE into the existing EHR for workflow integration and ease of the provider; discussion of in-house server or ASP model for EHR selection; and not all support services are created equal, isolated rural locations may not receive response times adequate enough to operate certain Health IT software.

Key Words: rural, small, Health Information Exchange (HIE), Regional Health Information Organization (RHIO), Health Information Technology (HIT), telemedicine, telehealth, Personal Health Records (PHR), Electronic Health Records (EHRs)

The authors of this report are responsible for its content. Statements in the report should not be construed as endorsement by the Agency for Healthcare Research and Quality or the U.S. Department of Health and Human Services of a particular drug, device, test, treatment, or other clinical service.

Final Report

Purpose

The Health Information Technology implementation project in Southeast Kern was funded from 2004 to 2008 to develop a regional Health Information Exchange (HIE) with relevant electronic data to exchange in a rural community. By doing so, tele-ophthalmology services and a Personal Health Record were developed and implemented; ambulatory electronic health records were implemented in provider offices and rural health clinics. The overall project had three specific aims:

1. To build an infrastructure that will include a shared clinical data repository that will be used throughout the region linking the outpatient setting, inpatient setting, telemedicine and other modalities.
2. To develop a local workforce that is educated in how to make use of technology to enhance quality of care and is using technology to enhance knowledge and care provided and to retrieve patient data.
3. To develop a prototype for using technology in a rural setting to enhance care of patients with chronic disease, initially focusing on diabetes mellitus and after on heart disease.

Within these three specific aims, the primary goals of the project were to:

1. Establish an administrative and governance infrastructure to guide and sustain development of the HIE, PHR and teleconsultation services over time (the East Kern County Information Technology Association (EKCITA)).
2. Design and implement a rural HIE for the Tehachapi area linking the local hospital, rural health centers, private primary care practices, pharmacies, radiologists and laboratories.
3. Implement a tele-ophthalmology service for Tehachapi residents.
4. Implement a Personal Health Record (PHR) for patients living with diabetes.

Scope

Background

Kern County is the 3rd largest and the 7th poorest of California's 58 counties. It covers 8700 square miles of desert, low, flat farmlands, and barren fields where oil derricks stand idle amid patches of sagebrush and tumbleweed, with a third of the county separated from the rest by the

southern end of the Sierra Nevada mountain range. Of the estimated 625,000 residents, 44% are concentrated in Bakersfield. The remainders live in remote areas including 100 small towns and unincorporated communities. Economically dependent upon oil production, agriculture and military spending, Kern County has suffered with the ups and downs in the petroleum industry, disastrous crop freezes and military base closures. Kern County's unemployment rate is twice that of the state. The ethnic mix is 38% Hispanic, 7% African-American, 4% Asian and 49% White-non-Hispanic. The County Health Status Profile for 2005 indicated that the overall health status in Kern County is poor. Below are some sample statistics:

- Persons under 18 below poverty, 53rd of 58 (with more than 25% below poverty)
- Deaths due to all causes, 46th out of 58,
- Deaths due to diabetes, 47th out of 58
- -Deaths due to coronary artery disease, 56th out of 58
- Deaths due to breast cancer, 44th out of 58
- Drug induced deaths, 45th out of 58
- Incidence of AIDS, 53rd out of 58
- Incidence of Chlamydia, 57th out of 58, syphilis, 42nd of 58
- Infant mortality, 46th of 58 (52nd for black, 38th for Hispanic, and 48th for white)
- Births among adolescent mothers, 54th of 58

The health care challenges were severe throughout the county. This grant was focused on Southeast Kern County, which is mostly separated from the rest of the county by the southern Sierra Nevadas. It has one small town situated in the mountain pass (Tehachapi) and two small towns on the eastern side (California City and Mojave). Many of the residents are 50 miles from the nearest medical specialists and over 95% of inpatient care is gained outside the area. The implementation project builds on the AHRQ planning grant from 2004 and will go a long way to enhance the health care, and hopefully health status, in the area, using Health IT as the foundation. We will be addressing both personal and population health needs and enhancing Health IT and Health IT literacy.

Context

Prior to being awarded the Health IT Implementation Grant, Tehachapi Hospital was the recipient of AHRQ's Health IT Planning Grant. The goal of the planning project was "*to bridge the gaps between healthcare settings and providers and between rural and urban areas through the use of information technology and innovative training models.*" The planning grant provided a reason for rural and urban leaders to have substantive conversation about health, quality and technology where building capacity among the providers for joint efforts was key; and was

imperative that every step taken built on the trust that was slowly growing and provided additional reasons for the providers in the region to work together on issues of quality and HIT.

Setting

In this 5000-square-mile region of one of the most impoverished counties in California there is one hospital (Tehachapi Hospital), three hospital-based rural health clinics (Tehachapi, California City, and Mojave), and fourteen primary care practices. Some of the primary care practices have a full time physician with mid level support. Others have only a part time physician and full time mid level presence. Still others are only open part time. None of the practices accept unfunded patients, and none of them provide prenatal care.

A culture exists in this region where the primary care physicians have an office-based practice, specialty and inpatient care all goes out of the region and patient convenience is not a primary consideration. Specialists don't want to drive to the region and seniors don't want to drive—and often cannot drive—the 50 miles to the urban areas. Timeliness and efficiency are two of the six IOM key aims. With a fragmented infrastructure and lack of local specialists as described above, there is significant opportunity for improving both.

Methods

A mixed-methods, non-experimental design was used to evaluate the AHRQ funded project. Quantitative data from the HIE, the tele-ophthalmology, and the PHR systems were analyzed for content and utilization. Interviews were conducted with eight key-informants about system development and governance, clinician use and satisfaction with the system, barriers and facilitators to development and use, and future plans.

Quantitative data were analyzed for frequency using SPSS. Qualitative data were analyzed using content and theme analyses. Expert member checks were performed with key-informant participants to assess the validity of interpretation of the qualitative data.

Outcomes for the four primary goals are reported in the following section. The statuses of other activities, also funded through the AHRQ award, are provided in a summary table in the Appendix.

Results

Goal 1: Establish an Administrative and Governance Infrastructure to Guide and Sustain Development of the HIE, PHR and Teleconsultation Services Over Time

The East Kern County Information Technology Association or EKCITA was established in 2006 during the second year of the AHRQ Implementation project. It consists of 5 board members, with representation from the local hospital, private practice physicians, and the community.

The group is chaired by Rex Moen, a respected community leader who is also a field deputy for a California legislator. During the initial year, a provider group of 2-7 physicians and 2 midlevel providers met weekly to conduct a feasibility and assets assessment for the planned HIE, identify and select HIE and EHR vendors and products, develop buy-in for the project and identify and bring in potential stakeholders for the rural HIE, develop a plan for the HIE, identify EHR and HIE products and vendors, oversee implementation and maintenance of the HIE and its future development, and develop and implement a sustainable business plan for the HIE and associated services.

EKCITA was established as a freestanding 501(c)(3) in the State of California and received its IRS designation as a 501(c)(3) in 2008. It is only the third HIE in the nation to have received its IRS designation and of those, is the sole not-for profit operational HIE in California.

Goal 2: Design and Implement a Rural HIE for the Tehachapi Area Linking the Local Hospital, Rural Health Centers, Private Primary Care Practices, Pharmacies, Radiologists and Laboratories

The HIE developed through EKCITA is a customization of an open source web-based software product called Openhre that can be downloaded from the Internet at www.openhre.org. EKCITA partnered with its developer, Browsersoft, to modify the product for use by the healthcare community of Tehachapi. Currently, EKCITA's HIE interfaces information systems (Admission, Discharge, and Transfer data; laboratory data; encounter data; and radiology reports) from the local hospital (Tehachapi Valley Health District), encounter data, prescription history, and allergies from the EHR (e-MDs) used by its three rural health clinics and two primary care clinicians in private practice in the community to exchange the specified information. From the listed data above, the HIE also hosts a master patient index and record locator service, in order to locate patients in a "just in time" fashion vs. storing records centrally. Legal agreements and interfaces are currently being developed with Quest, and other reference laboratory services, as well as with SureScripts which will provide access to most of the major pharmacies.

Data are replicated and uploaded from the hospital, primary care practices and other participating sources once every 24 hours, but as utilization of the HIE increases, the system has the capacity to upload and update records once every 5 minutes.

All health care organizations and providers in Tehachapi have agreed to participate in the HIE. Three rural health clinics, two private practices, and the region's Hospital are exchanging data through EKCITA. An additional three primary care practices have web links to EKCITA, but have read only access to the system because they do not have EHR capabilities. An additional two primary care practices that are EHR enabled will be connected to the system within the next six months, as soon as interfaces between their EHR systems and the HIE can be built.

Prior to development of the HIE, foundational IT infrastructure had to be put in place in the community. EHRs (e-MDs) were implemented at three of the RHCs and two of the small practices as the first step in establishing electronic data to be exchanged in the HIE. Two additional participating practices already had EHRs in place in their offices. Each practice received approximately \$13,000 per licensed provider in software and training to offset some of the costs of implementing an EHR in their organization.

A six-month facilitated consensus building process¹ led by the project PI was used to select the EHR product (e-MDs²). The process began with a 4-hour meeting where a HIT preferences and functionality survey was conducted. The survey, developed based on the EMR Functional Requirements Survey developed by CERNER (www.providersedge.com/.../BPHC_EMR_Functional_Specs-Cerner.pdf), was administered to all group members. Facilitated discussions were then held on areas of convergence/divergence among group member on their ratings on the 25 dimensions of the survey (see online survey at website above). During this meeting, group members also received orientation to EMR functionality, also based on the dimensions of the survey.

During this initial meeting, the group collaboratively defined a method for selecting vendors to review. The group decided to use ambulatory EHR ranking lists established by the AAFP, HIMSS, and Family Practice Management Survey as a point of departure, to select 4 large, 3 medium and 4 small sized vendors to ensure a distribution in price and product capability.

The group also constructed an 11-item Vendor Selection Ranking Tool to rate each vendor invited to demonstrate. The tool included: software license price of the first user, price of additional users, maintenance fees, training and implementation fees, lease options, server placement, support, association ranking scores, and response to query for materials.

A major topic of discussion was the use of a local server or Application Service Provider (ASP) model. The group chose a vendor that could support an in-house server model due, in part, to the tradition and culture of medicine that mandates control over the data and also due to providers' belief that "offsite" systems would be unreliable and patient records might become unavailable when needed because internet service in the area "went down" frequently. In hindsight, the group now believes reliability of the internet is not an issue, and would have preferred a more centralized ASP option over on-site because of apparent benefits including: lower costs; time to manage system; greater ease in upgrading system; and greater availability of technical support through the ASP alternative. This was an important lesson learned in the project and may have implications for future HIE projects.

The system also has interfaces with and receives pharmaceutical information from Surescripts and PALS and has an interface pending for Quest that will be completed by the end of 2009. Data exchange could not be established with LabCorp for reasons beyond the project team's control.

Both the Kern County Department of Public Health and local Emergency Medical Services have expressed interest in participating in EKCITA, but additional funding will be needed to create necessary interfaces.

To begin using the system, providers and health care organization representatives must register for the system and go through a clearance and credentialing process before they are given access to the system. This registration and clearance process takes approximately 10 minutes and can occur through an on-site visit by the EKCITA staff or through a telephone

1. Utilized an empowerment approach to consensus building that involved in-person weekly meetings with self-nominated clinic leaders (physicians, nurses, mid-levels). This included facilitated discussions, training, and development of a consensus tools for evaluating EMR products and vendors

2. Medapps was first choice of group, but fell out during due diligence review which involved review of company financials, background checks. This product was preferred because of its high degree of flexibility and the fact that it could be customized in any way to meet the needs of the particular practice. NextGen was also favored, but was too expensive.

consultation. After the new member joins the HIE, they receive a 15 minute training session in person or on the phone regarding the functionality and use of the system.

Providers access the system through a secure website located at: <https://www.ekcita.openhre.org>. After successful login, the provider/staff person enters the patient’s name on the HIE query screen. The HIE then generates a list of possible “identities” or aliases for the patient with an “accuracy of match” rating for each utilizing a statistical algorithm. The provider/staff and patient then jointly identifies the patient names/alias that belong to the patient. The patient completes an on-line consent for the provider to utilize the system, and a temporary record consisting of the combined information from selected identities is created.

As a security measure, users are logged out of the system after two minutes of inactivity, and queries can only be made from approved IP addresses, individual password, and the target patient’s name.

Training, for the supporting EHR product, e-MDs, as well as the HIE, has been a critical component of the EKCITA HIE implementation and demonstration project. An average of 60 hours of training on e-MDs was provided to office administrators, 24 hours to front office staff, 40 hours to back office staff, and 60 hours to providers. Certification, registration and training on the use of the HIE requires only 20 to 30 minutes and can occur in person, or via telephone and on-line. Currently, a total of nine providers and 31 staff persons completed training on e-MDs. A total of 60 providers (N=12) and staff (58) completed the training and registration process for the EKCITA HIE.

As of August 2009, the EKCITA HIE contains a significant amount of patient data including encounter data for 59,711 patient visits, 4532 radiology reports (but not images), and 1,318,747 laboratory observations. It contains data for 47,688 unduplicated patient “identities,” 42,337 of which were originated from the TVHD hospital data systems, 2191 from the TVHD rural health centers, and an additional 436 and 2724 respectively from the two community based family physician partners.

Despite the large amount of data contained in the system, utilization of the system to date has been light. A total of 26 patients have given active consent for their data to be viewed through the HIE. Five providers (or their staff) have viewed a total of 55 patient records through the system. The average number of patient records accessed per user is three.

Table 1. Contents and utilization of the EKCITA HIE

Content	Data elements or number
Number of data elements moved by EKCITA HIE Patient visits	59,711
Number of data elements moved by EKCITA HIE Radiology reports	4,532
Number of data elements moved by EKCITA HIE Laboratory observations (HL-7/OBX)	1,318,747
Discrete patient names/records	47,688
Discrete patient names/records Originating from: Hospital	42,337
Discrete patient names/records Originating from: Rural health centers (3)	2191
Discrete patient names/records Originating from: Private practice	3160
Active patient consents obtained to view health data in HIE	26
Physician/staff querying system	5
Average number of queries per provider	3
Total queries made to system	55

There are a number of explanations of the low utilization rate including the requirement that patients give active consent before their data can be viewed through the HIE, and the lack of seamless integration between EHRs and the HIE for purposes of viewing information.

The active consent requirement created a significant barrier to robust use of the system. While obtaining consent is a simple process, it must be completed on-line with the provider or administrator and even the short amount of time this requires of 4 to 5 minutes, is often too burdensome to undertake in a busy practice environment. The EKCITA board is currently considering changing the policy to a passive consent rather than active consent model. The passive consent approach to use of health information contained in HIEs is in use in other parts of the country such as San Antonio, Texas' HASA systems and appears to be associated with higher rates of utilization for these systems.

The lack of integration of practice EHR systems and the HIE creates an additional barrier to its use. To enter and view the HIE system, providers must navigate out of their EHR screen/environment which requires interruption of the provider's workflow. EKCITA has been unable to address this issue to date because of the unavailability of the EHR vendor.

Compliance with security standards such as a 2-minute automatic log-out time and lengthy passwords has also impeded utilization according to respondents.

Finally and most importantly, development and implementation of the EKCITA HIE as with other HIEs occurs in phases. The start-up work required to create and implement an HIE in this rural community was more extensive than originally thought. A considerable amount of time and effort were needed simply to establish the foundational infrastructure needed to support a functional HIE such as implementing EHRs and programming interfaces between various health information systems and the HIE. The challenges inherent in these tasks were at times magnified because of the rural setting. For example, IT support was difficult to access, many of the local practices as well as the hospital were using out moded or no health information technology. Internet access could be inconsistent, necessitating use of resident software rather than ASP models, which added to the time and cost of maintaining the HIE. Finally, hospitals function as a principal driver of HIE adoption and utilization within their communities. In urban settings, typically there are multiple hospitals in the area that can share in the development, promotion and eventually ensuring the sustainability of the HIE. In rural communities such as Tehachapi, there is usually a single hospital, itself often under resourced, and often unavailable to take on this role without support. Each of these factors must be addressed when implementing an HIE in a rural setting, and as a result increases both the cost as well as time required to implement and build robust use of the system.

A certain level of readiness must be reached within the system and the community before utilization can be aggressively promoted. Assuming the availability of additional funding to complete the remaining interfaces and system integration, the EKCITA system is within a few months of attaining this next level and would be ready for broader utilization.

Provider/Staff Satisfaction with the System. Providers and administrators interviewed about their HIE were all enthusiastic about the potential of the HIE to improve care for patients in Tehachapi. Each viewed the current project as a demonstration to prove that a functional HIE could be developed for and implemented in a rural community.

Clinically, the providers and administrators indicate they can see the great potential of the HIE but had not yet been able to realize this potential for the reasons mentioned earlier including issues with internal HIS that need to be addressed before the organization is ready to fully

participate in the HIE, the lack of an interface that allowed them to move seamlessly between their EHR and the HIE, lack of full implementation of their EHR into the practice environment, and the lack of bidirectional flow of data.

The biggest concern of all individuals interviewed was that of sustainability. Each were confident that a viable business model for EKCITA can be developed, that might include support from public health, the hospital and membership fees paid by providers/health organizations, but felt these only became options when the clinical benefit from the HIE moves from potential to realized. One community based clinician estimated costs for implementing an EHR in the practice environment ran upwards of \$50,000 for a practice averaging 400 patient visits a month. While the provider has been very pleased with the EHR product (e-MDs) and has gone completely paperless, he/she indicates the start up costs created a significant financial burden for the practice.

From a clinical perspective, each indicated that the system required additional capabilities before its real potential to assist them in the care process could be realized. Specifically, each felt the system needed to provide the option of bi-directional data flow, and that the process for viewing data contained in the HIE needed to be integrated with their existing EHR systems. Each also indicated they had experienced significant challenges with their own internal information systems (EHRs or others).

A summary of the various lessons learned during the EKCITA HIE project is below:

- Initial fears include concern about data security, concerns by the providers that they will lose patients, and concerns about the privacy and ownership of patient data
- Competing demands of insufficient internal resources in health information including lack of EHRs must be addressed prior to or concurrently with the start-up of the HIE
- The business model for HIEs as well as pathway to robust utilization of an HIE in rural communities, that typically have a single hospital, are likely different than in urban communities where there are multiple hospitals that usually drive initial usage and help establish the early clinical utility of the HIE
- Access to the Internet in rural communities can currently be difficult and inconsistent. This presents unique challenges to establishing HIEs in rural communities that must be addressed
- Rural communities often lack local resources for IT support for EHRs and the HIE. This is a serious barrier that must be considered and addressed in order to build a robust HIE
- IT vendors may not provide weekend or evening support services. In small and rural practices this can be a serious barrier to use of EHRs and an HIE as clinicians often manage their systems directly, and are busy seeing patients during the times when IT help desks are open
- Local firewalls can create significant problems for participating in an HIE. Adequate technical support must be available to address these barriers

- There are significant costs to providers and organizations for implementing EHRs and participating in an HIE. In rural communities where financial resources can be particularly sparse, this can present a serious barrier
- Data must be “at the door” for an HIE to grab it. Much of the work of developing an HIE has to do with getting data to the door, and building the appropriate interfaces with participating programs/systems
- Hospitals have multiple Health Information Systems. In rural environments, these systems may be old, fail to meet HL 7 standards, be proprietary and may not “talk” to each other even within the hospital, most of which do not talk to each other and many do not meet HL 7 standards
- Health Information Technology (HIT) vendors can be uncooperative and prevent development of the interfaces that can allow an HIE to access data contained in their systems
- Small HIT companies, often used in rural communities, may see an HIE as a competitor rather than a complementary or supportive system
- Requiring active consent by a patient to have his or her information accessible through an HIE creates an unnecessary and potentially fatal barrier to the robust use of an HIE. Automatic consent with active opt-out option is a more effective approach and ensures that the system is robust enough to be relevant and useful to patient care
- Changes in leadership in key stakeholders can create significant barriers to implementation of an HIE
- A significant amount of time needs to be spent in explaining the concept of an HIE, providing examples of success stories, and generally educating the clinical and patient population before initiating a project
- Participatory engagement and leadership approaches are essential to obtaining buy-in for an HIE in rural communities. These processes can be slower than more top-down approaches to product development but are crucial to ensure all important stakeholders come to the table
- Different stakeholders have different data needs from the HIE. These needs should be built into the design of the HIE
- Even small upgrades to EHRs and other systems interfacing with the HIE can have significant implications for the HIE and can be a major source of unexpected costs and data interruption
- Developing agreements and interfaces with contracting labs and other health information systems constitutes the majority of time and cost of an HIE

- Agreement to participate and actual utilization of the HIE are two different processes and must be carefully orchestrated. The system must contain sufficient data, these data must be easily accessible, and the health care community must be adequately informed and motivated to access them in order for an HIE to “tip” into robust use within a health care community. This will likely require longer planning and demonstration periods and associated funding to allow for sufficient development of the HIE system prior to roll-out, a significant investment in foundational infrastructure such as EHRs and Health Information Systems for rural hospitals, a significant investment in marketing to local consumers, and implementation of local and national standards to aid in the transfer and use of patient data from diverse information systems to allow the system to reach a level of readiness
- A sustainable business model that includes funding from HIE participants is only possible when the system is already in robust use, and its contributions to patient care clearly evident

Estimate of Costs Associated with Development and Maintenance of the EKCITA HIE.

The estimated direct cost of developing and implementing EKCITA’s HIE \$563,000, including approximately \$363,000 representing the cost of HIE software if a commercial rather than open source product was used. This estimate does not include substantial matching funds and in-kind contributions made by Tehachapi Hospital, the providers, the software vendor, the principal investigator, and community volunteers. Some of the costs associated with its development and implementation included:

- IT technical assistance in modifying or programming HIE program, building interfaces between systems and the HIE and getting data “to the door” so it can be exchanged.
- IT technical assistance to develop work-arounds for outmoded systems and uncooperative vendors.
- IT support for establishing networks and secure Internet connections
- Development of documentation for the system
- Purchase and installation of hardware that is able to accept electronic medical records. Equipment such as electronic sig tablets, cameras to take pictures of patients to upload to the system, fax modems to do e-prescribing, scanners and printers, and a server and backup server or server service for the HIE
- Selection, purchase and installation of foundational infrastructure such as EHRs
- Time and meeting expenses to build support and awareness in the community
- Staff time to negotiate data sharing agreements with other vendors
- Travel costs to different areas of rural community to build support

- Technical assistance and hardware needed for T1 line connectivity
- Staff time for maintaining the HIE system and associated infrastructure such as EHRs
- Staff time for training
- Staff time for HIE coordination, management, marketing, and membership

On-going maintenance costs of the system are estimated at between \$120,000 and \$150,000 a year to fund a .5 FTE IT support person to support EHRs and interfaces at participating sites, an estimated \$25,000 a year for system maintenance by the HIE vendor, a .5 to 1 FTE staff person to support general administrative support, system registration and training and system marketing.

Goal 3: Implement a Tele-Ophthalmology Service for Residents for Diabetic Retinopathy Screening and Macular Degeneration

A tele-ophthalmology service was implemented between the EKCITA Information Technology Association and an ophthalmologist in Bakersfield, California to address the needs of patients with diabetes and to screen for and manage patients with macular degeneration. The specialist in Bakersfield was selected based on analysis of referral patterns from the Tehachapi area.

To establish the service, EKCITA purchased and installed the ARIS system at a cost of \$40,000 that was used to capture and transmit retinal images to the specialist in Bakersfield for review. At the time, this system was considered state of the art although the PI indicates there are now more elegant and cost effective solutions for tele-ophthalmology available.

EKCITA provided prepayment for 300 consultations to the specialist in order to demonstrate the feasibility and effectiveness of tele-ophthalmology for this rural community.

Providers involved with EKCITA were informed of the service and invited to refer their patients to the service. In addition, information about the service was also provided to the community through flyers in local doctors' offices and health fairs and advertisements placed in local newspapers.

The equipment was housed at the hospital and the hospital provided staff to take the images and manage communication with the specialist.

Twenty-six clinicians in the Tehachapi service area referred patients for tele-ophthalmology consults. The average number of referrals per clinician was 6.3 with a range of 1 to 54. Ten clinicians made a total of 5 or more referrals through the service. A specialist reviewed a total of 165 images through the telemedicine service. One hundred thirteen (61%) of the patients were female, seventy-one (39%) were male. Ninety-four (53%) were adults (ages 18 to 64), eighty-four (48%) were elderly (65 years and older). Only three (2%) of the images were technically unacceptable and could not be reviewed. The specialist identified abnormalities in 34 (21%) of the images and referred these patients for further assessment and intervention. Forty-nine (27%) of the patients in the demonstration had been diagnosed with diabetes mellitus. Of these, 28 (64%) reported they had never had a retinal scan until today. Only 6 (3%) of patients reported having a diagnosis of macular degeneration. Of these 4 (66%) said they had not had their annual retinal scan. Thirty or 21% of participants reported annual incomes of less than \$20,000.

Table 2. Tele-ophthalmology utilization, findings and patient satisfaction

	Total Number	Percentage
<i>Images transmitted</i>	189	100%
<i>Findings/Diagnosis</i> Normal	122	74%
<i>Findings/Diagnosis</i> Abnormal	34	20%
<i>Findings/Diagnosis</i> Negative	5	3%
<i>Findings/Diagnosis</i> Technically Unacceptable	3	2%
<i>Findings/Diagnosis</i> Don't Know	1	0.5%
<i>Age</i> 18-64	94	53%
<i>Age</i> 65 and older	84	48%
<i>Sex</i> Female	113	61%
<i>Sex</i> Male	71	39%

Patient and Provider Satisfaction. One hundred and thirty-eight (98%) of the patients who participated in the demonstration project reported being satisfied with telemedicine encounter. Three clinicians and one patient who were interviewed about their experiences with the service rated the service very highly giving it a 9 out of 1 to 10 scale. Unfortunately, despite its apparent success and utility, the service had to be discontinued at the end of the AHRQ funding period because there is currently no billing code through CMS that can allow the hospital to bill for its time and cost to take and transmit the images to the specialist.

In addition to the inability to bill for the service, some, but not all, physicians in the community had some initial hesitation about sending their patients to the hospital to have the images taken, concerned they might lose their patient to hospital's rural health clinics. Some, but not all, clinicians would have preferred to have had their own equipment on site rather than needing to utilize a centralized resource.

A summary of lessons learned from the rural tele-ophthalmology demonstration is provided below.

- Billing was a major barrier in tele-ophthalmology for this rural demonstration. Currently there is no mechanism for billing for the origination and transmission of retinal images separately from the specialist consultation. This prevented the hospital from providing the origination and transmission services after the initial demonstration period
- Location and portability of the equipment can be important. Some clinicians may fear competition and loss of patients if they utilize an off-site scanning resource. Others are not concerned about this and prefer a centralized model where they do not have to use and maintain the equipment themselves.
- It is critical to maintain existing referral patterns. Most of the providers in the region utilized the Bakersfield physician and as such, efforts to utilize an Academic Health Center three hours away were not embraced.

- Easy access to the service increases access to specialty care in this area, and increases patient awareness, motivation and follow-through in obtaining these services

Challenges and Facilitators. Two significant barriers were encountered in implementing a sustainable tele-ophthalmology solution for the region. The most significant was the inability of the specialists to bill for the services directly unless they owned the equipment. Prepaying for services as part of the AHRQ funded activities solved this. Once the grant funds were expended the local providers were unwilling to continue with the prepayment solution.

An equally significant barrier involved the location of the equipment. The system was originally located at the hospital, but community based providers were uncomfortable referring their patients to the hospital to have the ophthalmology images taken. They were concerned that they might lose their patients to the practice that housed the imaging equipment. The project did not have sufficient funds to provide equipment to each practice, so in lieu of this, EKCITA agreed to relocate the equipment to the various providers' offices on a rotating basis. Each time the equipment was moved it had to be recalibrated so this solution proved to be inefficient and cumbersome.

Due to the problems with billing and with equipment location, the service is no longer being used.

Goal 4: Design and Implement a Personal Health Record for Patients Living with Diabetes

EKCITA also designed and implemented a Personal Health Record (PHR) as part of its AHRQ-funded activities. The system was adapted from FollowMe, a PHR platform developed by Access Strategies. EKCITA's PHR, MyHealthKeeper, was developed as a diabetes self-management tool for patients in the Tehachapi area. My Health Keeper can be accessed at www.myhealthkeeper.org.

The web-based system was offered free to residents of Tehachapi through the life of the grant. Any individual in the Tehachapi area could log-on and create a PHR that tracks key indicators for diabetes such as glucose measures and blood pressure, as well as medication and allergy lists and a host of other health information, all entered by the patient through the web interface.

The system generates graphs and other visual aids that allow the patient to track fluctuations in key health indicators such as glucose levels and blood pressure, and indicates when a patient's values fall outside normal limits. Users can grant log-in access to their providers who can log on to the system to view biometric and other data entered by the patient. Eventually, EKCITA intends to create an interface between the PHR and the HIE in which patients can allow data contained in their PHR to be replicated within the HIE system. This interface has not been built yet and is outside the scope of the AHRQ funded project.

MyHealthKeeper was advertised through flyers distributed at doctor's offices and health fairs, advertisements in the local newspaper, announcements at the diabetes support group and word of mouth. Adoption and utilization of the system by Tehachapi residents has been relatively low with only 58 registered individuals and 8 active users by the end of project year 2008. The reasons for the low utilization rates are not clear, but it is believed to be a factor of the "untethered" nature of stand-alone PHRs.

List of Publications and Products

Nocella KC, Horowitz KJ, Young JJ. Against All Odds: Designing and implementing a grassroots, community designed, RHIO in a rural region. *Journal of Health Information Management* 2008 Spring 22(2):34-41.

Appendix

Status of Project Aims and Tasks

Table A1. Specific Aim 1: To build an infrastructure that will include a shared clinical data repository that will be used throughout the region linking the outpatient setting, inpatient setting, telemedicine and other modalities

Objective	Status	Comments
Develop a web-based shared clinical data repository that can include patient information from Tehachapi Hospital as well as from the rural health clinics and physician offices and throughout southeast Kern county.	Completed	See body of report
Develop a hospitalist program at Tehachapi hospital to integrate HIT into inpatient care and close the gap between inpatient and outpatient settings	Dropped	There was considerable opposition to this within the provider community that was unable to be resolved and so it was dropped.
Implement teleconsultation and tele-CME at Tehachapi hospital, the two rural health clinics, and individual physicians' offices.	Completed	See body of report
Provide medical information from the hospital to the providers' desktops via high speed IT connections (HIE)	Completed	See body of report

Table A2. Specific Aim 2: Develop a local workforce that is educated in how to make use of technology to enhance quality of care and is using technology to enhance knowledge and care provided and to retrieve patient data

Objective	Status	Comments
Develop a provider HIT Leadership Team	Completed	This is the EKCITA board of directors
Develop an Integrated Technology Association (ITA).	Completed	This is the EKCITA
Develop HIT-based educational programs for the region using e-mail "eHealth Alerts."	Partially complete	Data "cubes" or the code to generate cross tabs for diabetes and a variety of demographic and health status indicators is being developed and is expected to be complete by the end of the year

Table A3. Specific Aim 3: Develop a prototype for using technology in a rural setting to enhance care of patients with chronic disease, initially focusing on diabetes mellitus and after on heart disease

Objective	Status	Comments
Contract with software vendor and develop a web-based personal health record (PHR) for diabetic patients and enroll patients in the program	Completed	See body of report
Collect and analyze standard diabetic care indicators of enrolled patients for purposes of provider education, evaluation and future quality improvement interventions	Deferred	Deferred because of low utilization of the system to date
Train 3 provider/patient teams in how to teach chronic disease self-management sessions in their communities and deliver sessions annually	Completed	Self-management training was delivered to more than 90 patients in the Tehachapi area
Deliver provider training on management of chronic disease through tele-CME, "eHealth Alerts" and special training on translating evidence from EKCITA into practice	Partially complete	See discussion of "data cube" above