Grant Final Report

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New Mexico Health Information Collaborative (NMHIC)

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Principal Investigator:
Margaret J. Gunter, PhD

Team members:
Jeff Blair, MBA (Project Manager)
Robert White, MD, MPH (Medical Director)
Shelley Carter, BSN, MPH, MCRP
Kathy England
Diane Fields
Darwin Harrison, BS, MA
Tracy Smith, BBA

Performing Organization:
Lovelace Clinic Foundation

Project Officer:
Jon White, MD

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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: Create a community-wide health information exchange (HIE) in New Mexico to allow privacy-protected provider access to electronic health information currently scattered across healthcare organizations and settings.

Scope: This was a technology/community development grant to fund the startup of a HIE in New Mexico, engage the community, and establish a governance structure for long term sustainability. NMHIC's initial scope was the Albuquerque area with a rural site in Taos, NM, with plans to expand to a statewide health information exchange.

Methods: The primary tasks for the NMHIC project included: (1) initiating community involvement, stakeholders, and governance; (2) developing the technology approach and architecture; (3) pilot demonstration projects; (4) formal evaluation; and (5) positioning NMHIC for post-project sustainability.

Results: Key NMHIC accomplishments include: establishment of a public-private community collaborative to support development of an HIE network in New Mexico; development of core technical components (Master Patient Index, record locator service, patient referral module); signed network subscription agreements with initial demonstration sites; successful demonstration of the HIE at Taos Hospital; incorporation of the RHIO Grande to extend participatory governance; and obtaining significant state and federal funding to support HIE development after the project.

Keywords: health information exchange, protected health information.

Final Report

Purpose

Since the NMHIC project was more of a community and technology development and implementation initiative, rather than a traditional research project, it does not fit perfectly into the AHRQ Final Report format. We have nonetheless used the Final Report heading structure, adapting the traditional content to fit the distinctive features of the NMHIC project.

The original overall goals of NMHIC stated in the proposal were to:

1. Create a community-wide health information exchange organization that is trusted and valued by all stakeholders (employees/patients, employers, providers, health systems and plans), improves care coordination, chronic disease outcomes, and reduces unnecessary costs.

2. Create a community-wide culture of personal responsibility for health among all stakeholders.

3. Eventually expand the health information exchange statewide and create a model that can be replicated nationally.

The original proposal listed four specific aims:

- Create the organizational infrastructure for the health information collaborative.

- Develop community-wide disease management prototypes that utilize eHealth strategies to improve care and reduce costs (i.e., diabetes, pediatric asthma, depression and low back pain) and include all stakeholders (patients, employers and providers/plans).

- Establish a rural pilot which will serve as a model for other rural areas.

- Evaluate the development, implementation and outcomes of the health information collaborative.

During the course of the grant it became apparent that the aims would need to be modified to reflect the delays the NMHIC team encountered in implementing a fully operational HIE. As was true of many of the other new HIE efforts initiated in 2004 with AHRQ and other funding, the community development work needed to create the necessary trust and consensus proved to be much more time consuming than originally anticipated by the project team. As AHRQ's Dr. Carolyn Clancy and DHHS Secretary Michael Leavitt have said at numerous conferences, we have all discovered that developing an HIE or RHIO is more about the "sociology, than the technology", and the sociology is the more difficult part. While we were successful in accomplishing all or part of each of the specific aims (e.g., generating an effective organizational

and community infrastructure; designing the basic HIE technical architecture; designing initial prototypes for diabetes and pediatric asthma web applications; developing and implementing rural HIE pilots; and process evaluation), we were not able to complete an operational HIE in the grant period so were not able to implement nor evaluate HIE-based community-wide programs.

For this reason, for the purposes of this Final Report, we have revised our aims as follows:

- Create the community/organizational infrastructure for the health information collaborative.
- Establish the initial technology approach and core architecture.
- Establish a rural pilot of the HIE.
- Evaluate the progress of the health information exchange.
- Position NMHIC for further development and sustainability in post-project period.

Scope

Background

The driving vision of our health information exchange initiative was the development of a community-driven partnership among providers, patients, payers, employers, and the public sector to change the culture of care from complete dependence to one of patient and institutional accountability, where healthcare becomes everyone's responsibility and a true community culture of health is established.

The goals and aims of this health information exchange effort were initially driven by several leaders from the business community. Faced with continued annual healthcare premium increases of 15% for large employers and 40% for small employers, they had expressed a deep frustration and dissatisfaction with the health care systems, plans and providers. They also understood that, as the recently legislated progressive Medicaid cuts were implemented in New Mexico, these annual increases would only go higher as the systems and plans cost shift to commercial insurance to compensate, a price that employers will ultimately bear.

Employers were also frustrated with the lack of information technology integration in healthcare. As they repeatedly filled out the same manual forms when their employees sought care, and as they looked at the cost efficiencies that IT had brought to their own businesses (most local bankers estimate they have experienced a 30% plus increase in productivity by implementing IT), they were demanding that health care institutions do the same. Currently, most employers have been dealing with the cost increases by passing some of them onto the employee through increased deductibles and co-pays. In the long run, however, they know that other actions must take place; specifically, their employees must assume more of the responsibility for their own care. This is particularly true for the chronic diseases that most impact their employees' ability to work. The leading causes of days lost for chronic conditions at work are alcohol/substance abuse, diabetes, low back pain, and asthma. Not only do these

diseases lead to loss of productivity and revenue due to absenteeism, they also decrease productivity when the patient is at work.

Given the growing employer frustration with increasing local healthcare costs and the negative impact of chronic disease on their employees' health, well being, and productivity, a number of business leaders approached the Lovelace Clinic Foundation (some of them sit on its Board) to assist them in addressing their concerns. The Lovelace Clinic Foundation (LCF) has a substantial local as well as national reputation in disease management program development, health services and evaluation research, health care data management, and provider and patient education. Despite the Lovelace name, LCF is a legally separate and independent entity from the Lovelace Health System, and could thus play the neutral role needed to bring together the historically competitive systems, hospitals, and health plans in Albuquerque. There was a clear fit between the concerns of the business community and the capabilities of the Lovelace Clinic Foundation, which led to an initial collaboration on the design of a community-wide health information initiative and thereafter to the proposed New Mexico Health Information Collaborative (NMHIC).

The scope of the three-year AHRQ-funded NMHIC project was the start-up and development of a health information exchange network to serve the Albuquerque, NM, area (Bernalillo County), with a rural pilot in Taos, New Mexico (led by Holy Cross Hospital). This early geographic scope was informed by the fact that New Mexico is a rural state with one large metropolitan area (Albuquerque), which is the base for the major large health systems and plans that serve the state as a whole. The objective was that the project would provide the foundation for expansion of NMHIC statewide and for eventual operational sustainability.

Methods

This grant is a technology/community development and implementation grant, rather than a research grant and, as such, the methods differ from the traditional research approach. The implementation required the following key tasks:

Community Involvement, Stakeholders, and Governance. Fundamental to the success of any health information exchange effort (HIE) is the full and active participation of the data suppliers and the users of the HIE as well as the key groups and organizations which will benefit from its impact. Community engagement included creation of a large stakeholder group; a Steering Committee to advise NMHIC on goals and direction; the creation of clinical, technical, and employer work groups to develop specific HIE guidelines for diabetes, pediatric asthma and work place health issues; involvement of state agencies and the Governor's Office; and efforts to coordinate HIE efforts with other health information technology programs in the state (e.g., telehealth, EHR promotion).

Technology Development and Approach. It is essential that each community select a technical architecture that is compatible with community needs and preferences and resource constraints. Since the concept of "sharing" data across competing health systems is innovative and therefore threatening to some stakeholder organizations, the information systems architecture selected for NMHIC is a federated system in which each data provider maintains its

own data silo. This federated approach was a more comfortable solution than a central data repository in this early phase. NMHIC provides the conduit, including the privacy and security controls, for data to move from the sources to the users of the HIE. Central to this is the development of a master patient index that provides the linkage to data in the various silos. NMHIC provides a web-based access system for retrieval of health information data.

Pilot Demonstration Projects. We partnered with a rural medical community in Taos, NM, to conduct two HIE demonstration projects: 1) build the electronic means to exchange patient-specific information between practitioners, to allow electronic referral of patients, send reports or receive results of patient care actions; and 2) use the NMHIC HIE gateway to transmit newborn hearing screening results to the New Mexico Department of Health electronically. Both of these pilots were selected in response to specific community and state agency interests.

Formal Evaluation. Midway through the project we contracted with an outside consulting firm to conduct a confidential evaluation survey to query the members of the Steering Committee concerning their perceptions about the overall issues, direction, successes and problems facing the creation of the HIE. This information provided the NMHIC team the feedback needed to adjust or revise their approach as indicated.

Positioning NMHIC for Post-project Sustainability. From the inception of the NMHIC proposal, our team was aware that it would be necessary to plan for post-project business sustainability for the emerging HIE network. Accordingly, the NMHIC team and other stakeholders worked extensively with a variety of key stakeholders, such as legislators, health systems, and employers, to educate them concerning the potential benefits of the HIE, to identify community priorities for HIE network services (e.g., lab results reporting), and to solicit the additional local, state, and federal funding that would be needed to augment the AHRQ funding during the project period and to further develop the HIE to the point of operational sustainability in the post-project period.

More detail concerning each of the above tasks and their outcomes is provided in the Results section below.

Results

This Results section is divided into a number of key subsections: Chronology of Events; Community Involvement, Stakeholders, and Governance; Technology Development and Approach; Pilot Demonstration Projects; Formal Evaluation; Summary of Key Achievements; and Positioning NMHIC for Post-Project Sustainability.

Chronology of Events

Phase 1: Foundation Building—2004-2006. NMHIC was created in 2004 by the non-profit Lovelace Clinic Foundation, an applied health research institute in Albuquerque, New Mexico. It

began with $1.5 M in federal funding from AHRQ, $447,000 from the State, and $1.4 M from local NMHIC stakeholders. This effort:

- brought together 33 public and private New Mexico health organizations and non-medical employers in a community collaborative to develop the network that will connect sources of scattered medical information;

- designed a federated network architecture that will leave patient information on the originating organization's computers, thereby avoiding a central warehouse or repository; and

- built a secure, privacy protected network prototype to exchange medical information.

Phase 2: Conducted Demonstration Projects—2006-2007. NMHIC piloted three demonstration projects:

- In 2006 NMHIC staff conducted a test that successfully matched individual patient identities across multiple healthcare facilities using 4 million patient identity entries contributed by eight different New Mexico health care organizations.

- On November 1, 2006, Taos doctors and nurses used the NMHIC exchange for the first time to coordinate medication, education, and dietary care for patients with diabetes.

- In 2007 Taos Holy Cross Hospital staff was able to demonstrate that abnormal hearing screening tests for newborn children could be reported to the New Mexico Department of Health using the NMHIC network.

In addition, in March 2007, the New Mexico State Legislature approved funding of more than $600,000 to continue development and expansion of NMHIC.

Phase 3: NMHIC Chosen to Participate in the Nationwide Health Information Network—2007-2008. The NMHIC successes in Phase 1 and Phase 2 led to award of a federal contract for $3.5 million from the Office of the National Coordinator for Health Information Technology (ONC) to participate in the Nationwide Health Information Network (NHIN) Trial Implementations. The NHIN contract provides funds for NMHIC to:

- accelerate development and expand its network services within New Mexico,

- participate as one of the nine HIE networks across the country in a trial implementation of the NHIN. This trial will:

    - include the exchange of summary patient records plus other clinical information among the nine HIE networks;

    - test standards and connections for accurately, securely, and privately moving information between regional HIE networks; and

    - demonstrate the benefits provided by the NHIN (e.g., patients temporarily needing their medical information available to doctors in a community other than their home).

Phase 4: Become Self-Sustaining—2009 and Beyond. The funds from Phase 3 are enabling NMHIC to rapidly strengthen its infrastructure, provide additional network services, and extend these services to more New Mexico hospitals, laboratories and doctors. In order for NMHIC to become self-sustaining, it must demonstrate that the value of the network services it offers will more than justify user fees, member subscriptions, and/or annual contributions from the NMHIC stakeholders (providers, payers, employers, and public health) that benefit from these services. In other communities, this transition has often taken at least 7 to 10 years, but with the community support, technical accomplishments, and funding received so far, the NMHIC HIE network believes it can reach self-sufficiency much sooner. Another essential requirement for the NMHIC HIE network to achieve self-sufficiency quickly is a clear understanding of the community's priorities for different HIE network services and the issues and concerns related to them.

Community Involvement, Stakeholders, and Governance

Creation of Stakeholders, Steering Committee and Work Groups. The New Mexico Health Information Collaborative is a statewide effort that engages stakeholders from all sectors of the community. In establishing the initial infrastructure for the HIE, Lovelace Clinic Foundation convened leaders from all possible community organizations or groups who could be affected by NMHIC and established a Stakeholder group and a Steering Committee. Many of these stakeholders provided the AHRQ-required matching funds for the three-year NMHIC grant. Nearly all of the community organizations honored their commitments in the proposal to provide matching funds to NMHIC for the full three years of the grant. Given the major costs associated with establishing a health information exchange network, which outstripped the resources provided by AHRQ and the community, Lovelace Clinic Foundation also made a significant financial contribution to NMHIC in an amount approaching $500,000 over the three years of the project.

The NMHIC Steering Committee represents 33 organizations. The Steering Committee provides community input from the constituents who contribute either data and/or funds to the exchange; who use exchange data; or who represent important employer, professional or state government groups. The Steering Committee votes on issues needing community consensus or response because it includes every constituency. Various work or advisory groups have been formed to address specific exchange topics over the course of NMHIC existence. Membership has increased over the project duration. Attendance at the ten Steering Committee meetings held

during 2005-2007 remains high, indicating continuing community support and commitment to establish an HIE in New Mexico.

Table 1. Organizations currently participating in the NMHIC stakeholder group*

NMHIC Stakeholders	Type	Steering Committee Meetings
Albuquerque Hispano Chamber of Commerce	Business Partner	
Albuquerque Indian Health Center	Provider	
Albuquerque Public Schools (secondary schools)	Educator	4
Association of Commerce & Industry of NM	Business Partner	
Bank of Albuquerque	Business Partner	
Blue Cross/Blue Shield	Payer	8
Don Chalmers Ford	Business Partner	3
First Choice Community Healthcare (safety net provider)	Provider (safety net)	3
First Community Bank	Business Partner	
Four Thought Group	Business Partner	4
Greater Albuquerque Chamber of Commerce	Business Partner	
Greater Albuquerque Medical Association	Professional Group	3
Health Extranet (provides patient eligibility information)	Business Partner	2
Health Policy Commission (state body to collect health service and policy information)	Government/Consumer	1
Heart Hospital of NM	Provider	
Holy Cross Hospital (Taos)	Provider	8
Intel Corporation	Business Partner	1
Johnson Associates (consulting firm)	Business Partner	2
Lovelace Health Plan (health insurance)	Payer	
Lovelace Health Systems	Provider	5
McCune Charitable Foundation	Charity	
Molina Health Care of NM (Medicaid insurer)	Payer	9
New Mexico Medical Review Association	QIO/Consumer	10
New Mexico Medical Society	Professional Group	8
New Mexico Mutual (insurer)	Payer	
New Mexico Veterans Affairs Health Care System	Provider	
NM Coalition for Health Information Leadership Initiatives	Professional Group	6
NM Department of Health	Government	4
NM Heart Institute (cardiology specialty physician group)	Provider	1
NM Hospital & Health System Association	Professional Group	8
NM Primary Care Association (rural safety net provider association)	Professional Group & Safety Net Provider	1
NM Retiree Health Care	Consumer Group	2
NM State Legislature	Government	
NM Takes on Diabetes (cooperative alliance of insurers and health plans)	Professional Group	8
NM Telehealth Alliance	Professional Group	8
Office of Governor Bill Richardson	Government	1
Presbyterian Health Plan (insurance)	Payer	8
Presbyterian Healthcare Services	Provider	
Project ECHO – University of New Mexico	Educator	
Public Service of New Mexico	Business Partner	4
Rio Rancho Schools	Educator	3

Table 1. Organizations currently participating in the NMHIC stakeholder group (continued)

NMHIC Stakeholders	Type	Steering Committee Meetings
RIOSNET (physician primary care alliance)	Professional Group	
Sandia National Laboratories	Business Partner	2
Sangre de Cristo Community Health Partnership	Professional Group	
SED Laboratory	Testing Lab/Provider	6
Semantic Mesa Technology	Business Partner	
Taos Medical Group	Provider	
Technology Ventures Corporation	Business Partner	
TriCore Laboratory	Testing Lab/Provider	9
United Healthcare	Payer	4
United Way	Charity	
UNM Center for Telehealth	Provider	
UNM Health Sciences Center	Educator	3
UNM Hospital	Provider	4
UNM School of Management	Educator	3
Wells Fargo Bank	Business Partner	

* Steering Committee member organizations are boldfaced for clarity

Creation of RHIO Grande. In 2005, LCF/NMHIC and several other HIT initiatives in New Mexico asked the New Mexico Department of Health (NMDOH) to facilitate cooperation and coordination among HIT initiatives in the state. This cooperation and coordination led to an agreement to expand the NMHIC Steering Committee to include these other HIT initiatives and develop a plan to transform NMHIC into a regional health information organization for the state, called the RHIO Grande. This transition plan resulted in the development of articles of incorporation and bylaws for the creation of the RHIO Grande. The expanded NMHIC Steering Committee voted to approve the articles of incorporation and bylaws on November 16, 2006. In September 2007, LCF/NMHIC was awarded the NHIN Trial Implementations contract by the Office of the National Coordinator within the Department of Health and Human Services. This award had to be made to LCF because the RHIO Grande did not yet exist as a legal entity. In addition, the federal government requested that the legal status of LCF/NMHIC not change during the duration of the NHIN contract. This contract includes a base year, plus two optional years.

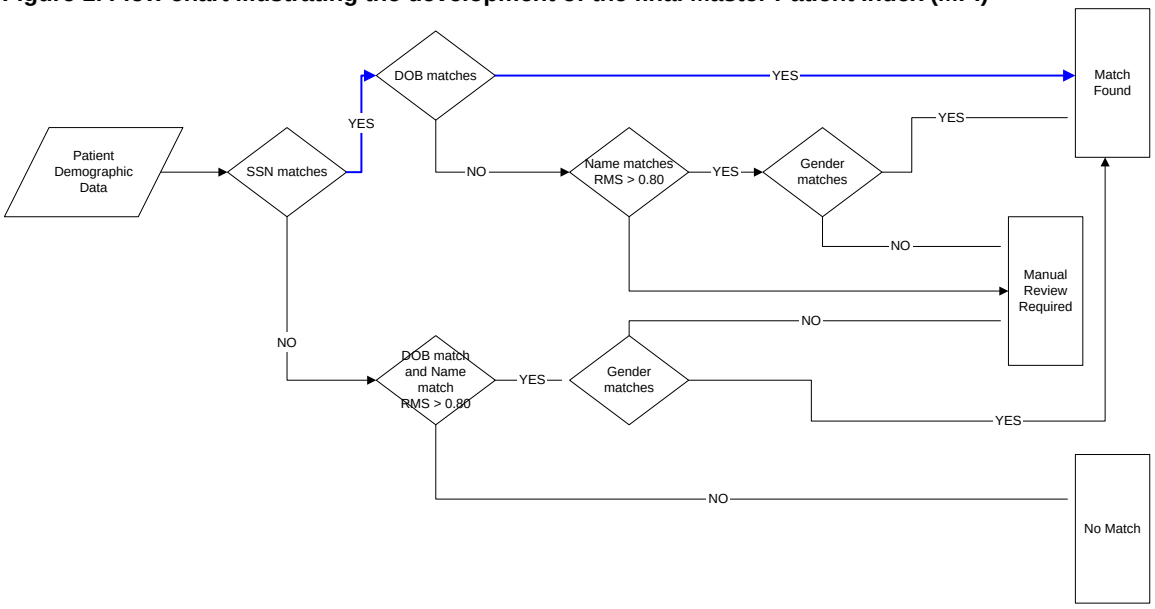
Technology Development and Approach

Selection of Architecture. Health Information Exchanges can be constructed either as a single data repository where all data providers deposit their information and information is supplied based on a need-to-know basis, or as a distributed network model where each provider maintains their own data and accessibility. In response to community preferences, we selected a Federated Distributed model for NMHIC in which each provider maintains its own data silo, and the HIE maintains a master list of patients for whom data is available in the different silos and locates and transfers data between providers and users. The structure for this model includes 1) developing and testing an algorithm for a master patient index; 2) developing and testing privacy and security protections within and across the HIE; 3) creation of a data engine to do the actual location, acquisition, and transfer of personal health information; and 4) creation of a secure web-based viewer for the end users of the data.

Development of Software Components of the HIE. During the early phase of the NMHIC project, the team deliberated extensively concerning the "make vs. buy" decision for the technical architecture. The eventual decision to create the core architecture in-house was made for several reasons, including the software development expertise and interest of our LCF technical lead, and the lack of sufficient financial resources at that time to engage a major software vendor with HIE experience. The core technical components developed included a Master Patient Index (MPI), a patient referral module, a record locator service, and the software needed to transmit newborn audiology screening results to the Department of Health for one of the Taos pilot HIE demonstrations. Since the MPI was of major interest to the community and is an essential component of any health information exchange network, its development is discussed in some detail below.

Development of a Master Patient Index. A critical component of a functioning HIE is a Master Patient Index to allow indexing and retrieval of the numerous disparate sources of data that can accessed by the HIE. Numerous methods available both commercially and for in-house development were evaluated and LCF/NMHIC elected to build its own MPI. The final MPI follows an approach that uses both probabilistic and deterministic methods. The procedure uses the root mean square of three commonly used scores (Jaro-Winkler comparator, Levenstein edit distance, longest common substring) according to the following flow chart.

Figure 1. Flow chart illustrating the development of the final Master Patient Index (MPI)



We evaluated the suitability and accuracy of this algorithm by considering five possible outcomes when searching and selecting individuals for record access: 1) no match, 2) negative match, 3) positive match, 4) questionable match, and 5) extra corrections. We tested the algorithm against two health system databases with approximately 90,000 names provided by the health systems. A random sample of 40,000 names was selected and then the algorithm was run for almost 4 billion comparisons. Using a cutoff of 0.76 on the RMS, approximately 116,000

matches were generated. In a manual review of these cases we found 32 false negatives and 93 false positives. An independent reviewer examined 115 cases and found 16 false negatives (0.99 sensitivity) and 0 false positives (1.0 specificity).

Pilot Demonstrations

NMHIC technical staff built the electronic means to exchange patient-specific information between practitioners, such as referring patients, sending reports or receiving results of patient care actions. This functionality was first piloted in November 2006 by Taos medical community practitioners who used NMHIC to convey referrals within CATCH, a program for coordinating care of patients with diabetes. NMHIC allowed them to securely process referrals to multiple sites within the community.

A second pilot followed planning and exploration discussions with Taos practitioners and the New Mexico Department of Health. This culminated in pilot testing of NMHIC in February 2007 for personnel at Taos Holy Cross Hospital to transmit normal test results from the newborn hearing screening to the Department of Health. The hearing test results of 40 babies screened in this small rural New Mexico community were transmitted by NMHIC. This process was evaluated by Taos hospital staff, NMDOH, community health care providers, and NMHIC staff in August 2007. Although the process worked satisfactorily, NMHIC connections to patient information at Taos Holy Cross Hospital were not thorough enough in 2007 to save hospital staff time. Later in 2007, DOH staff implemented a new tracking system for newborn hearing screening.

Technical Assessment and Vendor Selection

Technical Assessment. In January 2007, the LCF/NMHIC Team decided to conduct an independent technical assessment of the NMHIC network prototype components including the MPI, Data Engine (Results Review), Patient Referral and Newborn Audiology Screening modules. The purpose of this technical assessment was to obtain a realistic understanding of the capabilities, limitations and gaps of these network components before LCF/NMHIC made decisions regarding the expansion of the network, the addition of new network services and/or hiring individuals needed to go forward.

LCF/NMHIC decided that a highly qualified, independent team of reviewers was needed to perform this technical assessment. The leadership and development team from Indiana Network for Patient Care (INPC), which had developed and implemented a successful HIE network, was chosen. This team included J. Marc Overhage, M.D., Ph.D.; Shaun Grannis, M.D.; and Gunther Schadow, M.D. The on-site technical review occurred on March 23, 2007. The technical assessment report was submitted to LCF/NMHIC on May 4, 2007. The recommendations in the report indicated that:

- The NMHIC Patient Referral Module and the Newborn Audiology Screening Module could be retained as NMHIC goes forward.

- The NMHIC Master Patient Index could be retained; however, HL7 interfaces would need to be developed, and the non-probabilistic architecture would leave the MPI

vulnerable to performance degradation whenever it encounters patient demographics with poor data quality.

- The NMHIC Data Engine (Results Review) would not be an adequate foundation for further development.

The LCF/NMHIC team carefully considered the recommendations of this independent technical assessment and decided to go forward with a two-pronged strategy:

- assess the cost and timeframe to enhance the NMHIC MPI; and

- assess the capabilities and costs of HIE network components available from vendors.

Vendor Assessment and Selection. The vendor assessment and selection process began in April 2007 with LCF/NMHIC developing a Request for Information (RFI) document entitled "Framework for Understanding HIE Network Vendors." The RFI was distributed to 11 leading HIE network vendors in March and April, 2007. Ten of the HIE network vendors provided detailed written responses to the RFI during May. Conference calls were conducted (typically 1.5 hours each) with these vendors to clarify their responses and ask additional questions.

In May 2007, the federal government released two RFP's that offered significant funding for the development of local HIE networks. The first RFP, "Accelerating Public Health Situational Awareness", was offered by the CDC and the second RFP, "Nationwide Health Information Network (NHIN) Trial Implementation", was offered by HHS. Because of the RFP requirements, LCF/NMHIC had to select a technology partner (HIE network vendor) to respond to the RFP's.

LCF/NMHIC was able to make this decision quickly because it had already reviewed the detailed written responses to the RFI and conducted follow up conference calls with ten of the HIE network vendors. LCF/NMHIC selected First Consulting Group, with their FirstGateways HIE network solution, because they had:

- network experience with biosurveillance (required for the CDC RFP),

- a full HIE network product line,

- a federated HIE network architecture,

- prior experience within the first NHIN prototype,

- ability to respond quickly to the proposal timeframes, and

- user interfaces which are easy to use.

During August and September 2007, the FirstGateways solution developed by FCG was sold to another technology vendor named MedPlus. LCF/NMHIC was awarded the NHIN contract on September 30, 2007, and immediately proceeded to negotiate with MedPlus to purchase and implement the First Gateways HIE network solution. LCF/NMHIC did not receive the contract from CDC.

Formal Evaluation

Our initial evaluation plan included both formative and summative evaluation components, with the summative evaluation focusing primarily on assessing the various impacts of a fully operational health information exchange. The formative evaluation (primarily process) was intended to provide guidance to the NMHIC project team concerning any needed revisions to our approach. The planned summative (quantitative impact) evaluation would have included such indicators as who was using the HIE and how, technical evaluation of the operation of the HIE, outcome/impact indicators, and overall impact in our stakeholder community. As noted in NMHIC quarterly reports, data and privacy issues and fiscal constraints resulted in delays in NMHIC's evolution into a fully operational HIE, which did not take place during the 3-year AHRQ project period. Accordingly, NMHIC's evaluation was largely limited to a formative or process evaluation in which factors that lead to successes and barriers that prevented establishment of an operational HIE were emphasized.

A key component of this process evaluation was the ongoing assessment of stakeholder perceptions of NMHIC's evolution. As part of this ongoing evaluation during the grant period, Steering Committee members and stakeholders present at the information-sharing meetings were routinely asked to fill out a brief anonymous questionnaire to obtain feedback on their degree of satisfaction concerning how information was presented at the meetings, their opportunities to provide input, and whether or not they felt their views/suggestions would be incorporated in the direction of the project. Although the number of responders to the meeting questionnaire was relatively small (8-15 vs. the 25-30 typically in attendance), nearly all felt that the meetings were useful, well organized, and informative and that their voices would be heard in helping to guide the project (>90%).

In 2005, following discussions with University of Pittsburgh evaluation consultants, the NMHIC team decided it was important to conduct a more formal and independent mid-term assessment of NMHIC's progress as perceived by its key stakeholders and participants, so an independent outside survey firm (Research and Polling, Inc.) was contracted to conduct a formal telephone survey of beliefs and attitudes concerning NMHIC. After obtaining the required IRB approval, 32 members of the Steering Committee and Stakeholders groups were asked to participate in an anonymous survey. Twenty-four individuals completed the telephone survey during a 6-week period in mid-summer of 2006.

Leadership and communication by the NMHIC team were generally rated high, although many felt more detailed and more frequent communication would help. Adequate financial support was seen as the greatest barrier to the achievement of a functioning HIE. Privacy and other legal concerns and lack of dedicated personnel were also seen as major barriers by at least half of the respondents. However, 17 (71%) believed that the project would continue past the 3-year grant period. Five of the other seven did not feel they could predict whether the project would continue, given the early stage, and significant questions remaining about financial sustainability, the business model, and the deployed technology. Only two felt that the project would not continue past the grant period.

The overall conclusion of this evaluation was that achieving and maintaining stakeholder cooperation and trust is a far larger hurdle than technology or even privacy and security considerations in the creation of a regional HIE. Community support and agreement on goals are clearly critical to the likelihood of success.

Table 2. Characteristics of the survey responders

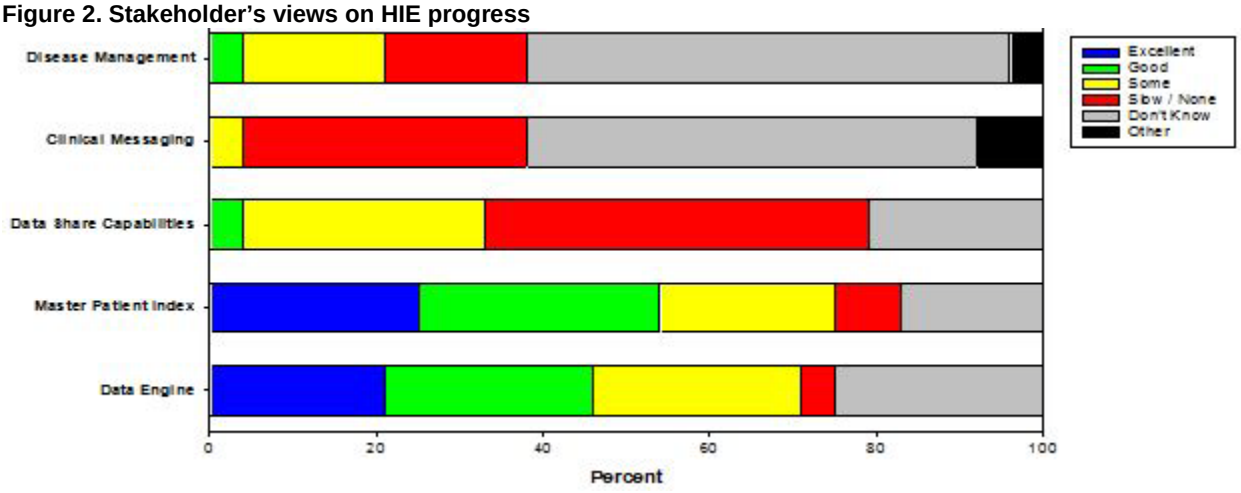
Type	Characteristic	Number
Employment characteristics of respondents	Health plans or delivery systems	9
Employment characteristics of respondents	State or local government	7
Employment characteristics of respondents	Non-profit organizations	5
Employment characteristics of respondents	Other	3
Expertise	It support	4
Expertise	Clinician	6
Expertise	Decision maker (president/CEO)	3
Expertise	Other	11

The responders identified a number of key strengths of the project including: 1) committed group of partners (cited by 15); 2) leadership (cited by 6); 3) technical expertise (cited by 6); 4) communication (cited by 4); and 5) other (financial support, work groups, cited by 1 each).

Weaknesses of the project cited were: 1) communication (cited by 8); 2) slow progress (cited by 5); 3) networking within and among partners (cited by 4); 4) no representation from consumers/patients (cited by 3); 5) other (1 citation for each: not practical, lack of financial resources, leadership, duplication of work, timing conflict with RHIO, commitment level of health plans, lack of a governance model, primarily urban focus, duplication of work).

Figure 2 shows the distribution of answers regarding progress toward the NMHIC goals. Figures 3-4 show the distribution of answers regarding perceived barriers to the creation and sustainability of a regional HIE.

Figure 2. Stakeholder's views on HIE progress



The survey indicated that stakeholders viewed the technical progress in creating the core platform (date engine and Master Patient Index) to be progressing well at the midpoint of the grant, but lagging on those aspects that depend on a functioning HIE hardware/software system.

Figure 3. Stakeholder's views on barriers to an HIE

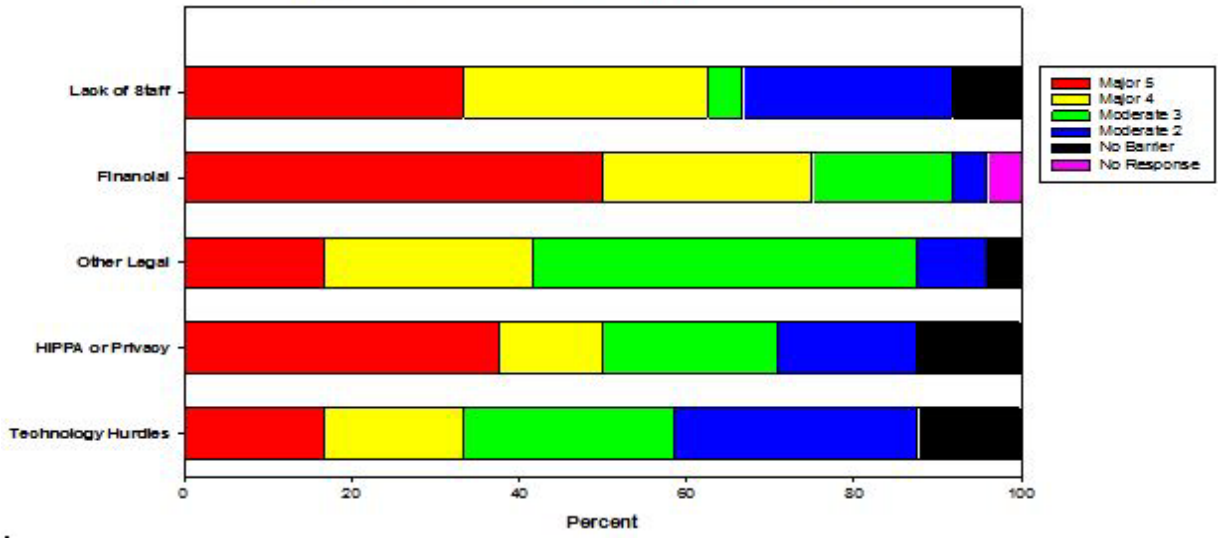
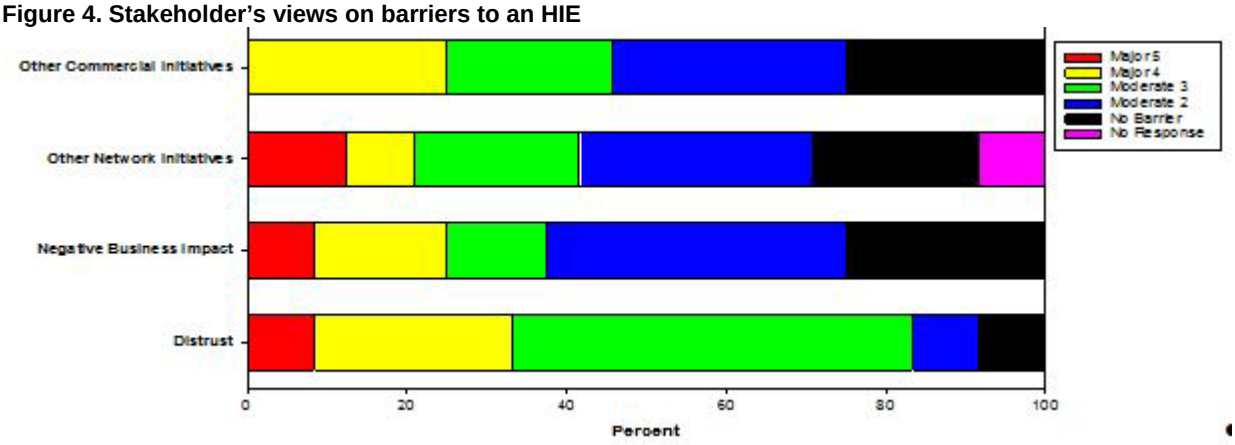


Figure 4. Stakeholder's views on barriers to an HIE



Summary of Key Achievements

Table 3. Key achievements in NMHIC's history

Date	Achievement
June 2003	LCF leaders initiated search for community HIE funding.
Fall 2003	LCF leaders met with public health and a broad spectrum of community organizations.
January – April 2004	AHRQ proposal drafted with focus on Albuquerque and Taos communities and on clinician use for chronic care and emergencies. Community commitments for matching funds and participation obtained.
July 2004	Federated HIE architecture chosen by local collaborators, and IT efforts began.
September 2004	LCF awarded NMHIC grant from AHRQ
Spring 2005	Data engine built to view laboratory, diagnosis, and demographic information from disparate sources. First funding provided by state legislature.
May 2005	Business Associate Agreements (BAA) drafted for one-time sharing of patient identity data to build a community Master Patient Index, and planning by Department of Health for NMHIC use began.
June 2005	Electronic referral application chosen in response to community interest to further engage collaborative members. The first two collaborators signed BAA's for MPI development.
October 2005	Network Subscription Agreement (NSA) developed for NMHIC exchange of clinical data.
November 2005	Record locator and prototype referral applications demonstrated. NMHIC began building an MPI. NSA's were signed by Taos Hospital and Taos Medical Group.
December 2005	DOH collaborators chose newborn hearing test reporting as NMHIC proof of concept.
Winter 2006	Seven more organizations signed BAA's for building community MPI.
May 2006	Initial MPI matching test performed. Taos Hospital agreed to pilot NMHIC.
June 2006	MPI testing completed.
Fall 2006	NMHIC state legislative request began; first NMHIC edge server configured.
Fall 2007	ONC NHIN Grant Awarded

Positioning NMHIC for Post-Project Sustainability

From the inception, both AHRQ and the NMHIC team were aware of the need to position NMHIC for post-project sustainability because a project of this scope and complexity was unlikely to reach full fruition as a viable business in the span of three years. Accordingly, sustainability was a top priority from the proposal stage. The primary focus of NMHIC's sustainability efforts was fourfold: (1) educating and engaging key stakeholders concerning what health information exchange is and its importance and benefits to them and the state; (2) seeking complementary funding during the project period to augment the AHRQ grant; (3) obtaining post-AHRQ funding from local, state, and federal sources; and (4) identifying key community priorities for HIE network services and a business model for sustainability.

Education of Key Stakeholders. In addition to a central focus throughout the project on the data suppliers and users of the system (e.g., health systems, payers, and providers), the team soon recognized the central importance of obtaining support, both financial and otherwise, from State agencies [e.g., the NM Department of Health, Human Services Department (Medicaid)], the Governor's Office, and key state legislators. Intensive efforts in this arena led to a strong collaboration with DOH, the Governor's appointment of Dr. Gunter to the NM Telehealth Commission, the change of the Commission's name and function to incorporate HIE and health information technology in general, and more than a million dollars in funding from the NM State Legislature for FY 2006 and 2008.

Funding and Business Plan Development. In addition to the FY 2006 funding from the NM State Legislature, Lovelace Clinic Foundation received a series of awards under the Health Information Security and Privacy Collaborative (HISPC) program funded by AHRQ and the Office of the National Coordinator (through RTI) to identify and address key privacy and security issues that can impede HIE development. Privacy has proved to be a sensitive issue both nationally and in New Mexico, so the work done through these contracts has been highly important in enhancing NMHIC's sustainability.

In addition, the NMHIC team submitted a number of major proposals to support and expand NMHIC after the AHRQ grant. These include a Medicaid Transformation proposal, the CDC Biosurveillance contract proposal, the NHIN Trial Implementation contract, a HISPC Multi-state Collaborative proposal, and appropriation proposals to the State Legislature in 2007 and 2008. These efforts resulted in the award of $3.5 million for Year 1 of the NHIN contract (one of only nine site awards nationally), the award of the HISPC Collaborative contract, and the appropriation of an additional $770,000 from the NM Legislature. The state funding and the NHIN funding are supporting the high costs of the technical infrastructure as well as essential data collection concerning community priorities for network services.

Prospects for Continued Development of NMHIC (June 2008)

The prospects for continued development of NMHIC look quite promising at this time. The NHIN project has provided NMHIC and LCF the funds needed to engage experienced HIE software vendors, to expand its technical staff, and to further develop its business model (as well as to participate in the national demonstration of interoperability across the NHIN sites). NHIN has also enhanced NMHIC's visibility, credibility, and image at the community, state, and national level, which bodes well for further development. By July 2008, NMHIC will have implemented the interfaces and edge servers and conducted functional testing between the data providers and the network. At this stage, the HIE network includes the state's largest healthcare provider (with numerous hospitals and providers in both urban and rural areas), the state's largest clinical laboratory, Albuquerque Ambulance, Taos Holy Cross Hospital, and the New Mexico Department of Health. The NMHIC team is excited at the prospect of finally creating an operational HIE network that will improve healthcare quality and efficiency and be sufficiently valued that users will support its network services financially on an ongoing basis. It is clear that the AHRQ funding was the essential first step in creating New Mexico's exchange, and the NMHIC team is very aware and appreciative of AHRQ's key role in initiating the national HIE movement.

List of Publications and Products

Gunter M, Fields D, Carter S. A Unique Partnership for New Mexico's Healthier Future. Presented at 11th Annual HMO Research Network Conference, April 2005, Santa Fe NM.

Gunter MJ, Fields D, Carter S. New Mexico Health Information Collaborative (NMHIC): A Unique Partnership for New Mexico's Healthier Future. Presented at 11th Annual HMO Research Network Conference, April 2005, Santa Fe, NM.

Gunter M. New Mexico Health Information Collaborative Political Challenges of Coordinating and Integrating Statewide HIT Projects. Presented at AHRQ, June 2005,

Gunter M. New Mexico Health Information Collaborative: Building A Virtual Data Warehouse. Presented at Disease Management Colloquium, Session: Tools and Technologies for Disease Management, June 2005.

Gunter MJ. New Mexico Health Information Collaborative. Presented at the HIE Crossroads of America, June 2005, Indianapolis, IN.

Gunter MJ. New Mexico Health Information Collaborative – Building a Virtual Data Warehouse. Presented at The Disease Management Colloquium, June 2005, Philadelphia, PA.

Gunter MJ. Growing a RHIO One Step at a Time: Key Lessons Learned in Fundraising and Community-Wide Collaborations. Presented at World Research Group's Conference Launching and Managing Regional Health Information Organizations, November 2005, Las Vegas, NV.

Gunter MJ. New Mexico Health Information Collaborative. Presented to The World Health Care Innovation and Technology Congress, November 2005, Washington, DC.

Gunter MJ. New Mexico Health Information Collaboration. Presented to Launching and Managing Regional Health Information Organizations: A World Research Group Healthcare Information Management Series Conference, December 2005, Las Vegas, NV.

Gunter MJ, Fields D, White R, Lydick E, Carter S, Smith TW, Harrison D. Identifying and Addressing Significant Challenges in Creating a Community-Wide Health Information Exchange. Presented at 12th Annual HMO Research Network Conference: Optimizing Practice Through Interdisciplinary Research, May 2006, Cambridge, MA.

Gunter MJ, Fields D, White B, Lydick E, Carter S, Smith T, Harrison D. Growing a RHIO One Step at a Time: Key Issues to be Addressed. Presented at 12th Annual HMO Research Network Conference, May 2006, Cambridge, MA.

Gunter MJ, Fields D, White B, Lydick E, Carter S, Smith T, Harrison D. Identifying and Addressing Significant Challenges in Creating a Community-Wide Health Information Exchange. Presented at 12th Annual HMO Research Network Conference, May 2006, Cambridge, MA.

Gunter MJ, Fields D, White R, Lydick E, Carter S, Smith TW, Harrison D. Identifying and Addressing Significant Challenges in Creating a Community-Wide Health Information Exchange. Presented at Academy Health Annual Research Meeting, June 2006, Seattle, WA.

Gunter MJ. Obtaining Governmental Funds for Your RHIO. Presented at Launching and Managing Regional Health Information Organizations. Launching and Managing RHIOs Conference, June 2006, San Francisco, CA.

Robinson S, Smith T, Davis B, Lydick E. Development of a Master Patient Index within the New Mexico Health Information Collaborative. Presented at 13th Annual HMO Research Network Conference, March 2007, Portland, OR.

White RE, Gunter M, Blair J. Resources Expended in Planning and Building a Regional Health Information Exchange. Poster presentation at HMO Research Network Annual Meeting, March 2007, Portland, OR.

Gunter M, Fields D, White B, Lydick E, Carter S, Smith T, Harrison D. Identifying and Addressing Significant Challenges in Building a Community Wide Health Information Exchange. Poster presentation at HMO Research Network Annual Meeting, March 2007, Portland, OR.

White R, Smith T, Carter S. Using a Regional Health Information Exchange to Enhance State Mandated Newborn Hearing Screening and Intervention. Presented at Academy Health Meeting, June 2007, Orlando FL.

Robinson S, Smith T, Davis B, Lydick E. Development of a Master Patient Index within the New Mexico Health Information Collaborative. Presented at Academy Health Meeting, June 2007, Orlando FL.

Lydick E, Gunter M. Stakeholder Views of the New Mexico Health Information Collaborative (NMHIC), a Regional Health Information Exchange (HIE). Presented at Academy Health Meeting, June 2007, Orlando FL.

White R, Gunter M, Blair J. New Mexico Health Information Collaborative Resources Expended in Planning and Building a Regional Health Information Exchange. Poster presentation at HMO Research Network Annual Meeting, March 2007, Portland, OR.

White RE. Can Health Information Technology Shift the Medical Care Paradigm? *J. Gen. Internal Med*; 23:495-499; 2008.