



State and Regional Demonstration in Health Information Technology: Colorado



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HEALTH IT

Final Contract Report

State and Regional Demonstration in Health Information Technology: Colorado

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Preface

This project was one of six State and Regional Demonstrations in Health Information Technology (IT) contracts funded by the AHRQ Health IT Portfolio. The goals of the projects were to identify and support data sharing and interoperability activities aimed at improving health care for patients and populations on a discrete State or regional level. These States and their respective health information organizations (HIOs) are as follows:

- Colorado: Colorado Regional Health Information Organization (CORHIO)
- Delaware: Delaware Health Information Network (DHIN)
- Indiana: Indiana Network for Patient Care (INPC)
- Rhode Island: *currentcare*
- Tennessee: Mid-South e-Health Alliance (MSeHA)
- Utah: Utah Health Information Network (UHIN)

For more information about these projects, including a cross-project summary of lessons learned, please visit <http://healthit.ahrq.gov/stateandregionalhie>.

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Executive Summary

Summary of Accomplishments

The Colorado Regional Health Information Organization (CORHIO), using the Agency for Healthcare Research and Quality (AHRQ) State and Regional Demonstration Project funds, was able to develop a nonprofit, independent entity to promote exchange of health information in Colorado. Policies, procedures, and the technical and legal infrastructure were developed and deployed to allow secure, federated, exchange of information between four large health care organizations over the Internet utilizing Federal standards and protocols to the extent that they existed. A robust enterprise master patient index (eMPI) for nearly 2,500,000 registrants (1,400,000 individuals) was developed and much experience gained around how to build and utilize an eMPI.

Summary of Lessons Learned

Building a coalition of stakeholders into a nonprofit corporate entity in Colorado was a slow and laborious process. The development of that entity has facilitated building a cogent business plan, taking advantage of new funding opportunities and capacity to take a leadership role within our State and region regarding health information exchange (HIE). This success is predicated on the shared involvement of both public and private sector health care leadership.

The eMPI is a core component of any HIE and provides the basis for a record locator service. The accuracy of linking patient identities across institutions will determine how the institutions and providers look at aggregated data. Partner participation is key to improving the accuracy of the data by getting it right at the source. Improving the eMPI is a multilateral process that can optimize care through all partners. This particular technology component is still in its infancy as a reliable resource. AHRQ contribution to the development and improvement of this technology has improved the state of knowledge necessary to effectively employ this important HIE component.

With significant assistance from other federally funded efforts both public and private, legal and policy barriers, for the most part, can be addressed successfully through collaborative engagement and firm deadlines for completing the work. Narrowing the scope to focus on the products and services where a business case exists significantly improves chances of success in these areas.

Use of the Point of Care System was limited during the production period. Factors that impacted this limited usage include (1) the end-user having to initiate a process of searching for records and 2) cumbersome password management. Despite an intuitive and relatively fast interface for patient searches, busy emergency department (ED) clinicians would not spend the time to search. A self-searching, automated system that launched the eMPI and record locator service upon patient consent, found matching records, and then prompted the ED end user with potential matches could have better integrated with ED workflow. Given the desire for a tight level of security, password control was set to occur at a central point. There was no self-service process for automated password reset functionality. These factors significantly hampered increased usage by clinicians while providing assurances for privacy and security personnel that the system was appropriately utilized in a method that assured compliance with HIPAA and other privacy and security laws, regulations, and policies.

Background and Purpose

Description of the Purpose and Scope of the Report

The purpose of this final report is to document progress made during the course of the Agency for Healthcare Research and Quality (AHRQ) State and Regional Demonstration (SRD) Project contracted to the University of Colorado at Denver in October 2004 and completed through the efforts of the Colorado Regional Health Information Organization (CORHIO) in January 2010.

The landscape of health information exchange (HIE) has changed dramatically both in Colorado and across the Nation during the past 5 years. Concepts alluded to in our original proposal have been more fully developed; entire industries have been born from the HIE opportunity to promote improved quality, efficiency, and safety in the health care provided to Americans. From the outset, Colorado was convinced that health care reform was required but would not happen solely with improved HIE capacity. It is but a tool. This report describes the efforts of our Colorado community to achieve that tool and where CORHIO as an organization has become an essential piece of the health care reform debate and opportunity in our State and across the Nation.

Background on the Project and Local Environment

Formation of the Project

In 2004, four Colorado-based health care providers joined a consortium to apply for the AHRQ SRD project funds. Having been successful with the Foundation for eHealth Initiative funding some months earlier, this project was to permit development of a functioning exchange between Denver Health, Kaiser Permanente, The Children's Hospital, and University of Colorado Hospital. The Chief Medical Information Officers, Chief Information Officers and other interested informatics-skilled individuals developed the initial proposal. Over the course of the project, more than 75 individuals from those institutions contributed to the development of this HIE.

Project Goals and Objectives

The project proposed to move health information between the various sites in a federated model; a record locator service would retrieve the data from each institution as needed using a query/response tool that would be developed as part of the demonstration project. Key to this record locator service was to be the development of a master patient index that unduplicated and matched patients across the four institutions. The technical challenges to be addressed included the following:

- To provide confidentiality, authentication, and integrity functionality for messages within a system.
- To adhere to electronic health data interchange and infrastructure standards.
- To maximize the amount and value of information available to health care providers at the point of service.

- To establish a governance structure that benefits from the diversity of end users and those who have institutional responsibility for compliance with regulations, and security, privacy and integrity of data collected within their domain—the data guardians.

The purpose of the project was to address these technical challenges through a scope of work across the consortium:

- To establish a statewide information technology infrastructure to exchange data at the point of service to those with a right or need to know.
- To evaluate national standards, assess costs and benefits of specific technologic approaches to adopting those standards, develop methods for their implementation, and through requirements and specification documents define a detailed path for infrastructure implementation. Given a constrained budget, change management strategies that limited additional financial expense needed to be closely integrated as we developed this statewide health information infrastructure demonstration site.
- To participate in a learning community that shares lessons with other statewide or regional health information collaboratives, and uses public domain, open-source developed methods. It was presumed that an Internet-based architecture, with Web-service tools, would support exchange; by developing in an open-source manner, interfaces would be shared and reused. Similarly, specifications for a physical environment (hardware and software) and the messaging would be shared.

At the onset, the project proposed to develop numerous products of local and national significance:

- A legal framework for health data interchange across a wide range of provider settings, delivery models, and organizational structures.
- A modified informed consent process for data sharing with consent documentation stored in the registration system.
- A secure, verifiable portal environment for authorized data exchange.
- A strategy for authentication of all users.
- An approach to encryption of data in transit.
- A robust data exchange platform with standard messaging protocols.
- A semantic warehouse or tool to convert idiosyncratic codes to normalized data (e.g., LOINC, SNOMED, ICD, NDC). This tool reconciles differences in standards, coding schemas, or nomenclature from distinct IS vendors used by member institutions.
- A unified master patient index (UMPI) that references and links unique identifiers in any participating institution and can develop pointers to clinical records.
- A de-duplication process for the UMPI.
- A Web browser for clinicians (and ultimately for patients) with information available on a need-to-know basis.
- Complete audit trails of all usage, with prescribed penalties for unauthorized usage.
- Assessments of (1) costs and benefits, (2) methods, and (3) change management strategies as related to national standards, specific technologic approaches to adopting

those standards, and requirements and specification documentation for infrastructure implementation.

- Information sharing (“Lessons Learned”), consensus statements, and reports from Colorado and in collaboration with other funded States.

Data to be exchanged included laboratory results, radiology/imaging results, medication lists and dispensing history, problems list, and electrocardiogram images and reports.

Processes

The following descriptions are really a blend of two significant phases in the development of CORHIO. The AHRQ-funded project was the inception point for HIE in Colorado as a statewide project. As such, the focus and participation of Denver-centric partners during the AHRQ-funded stage set the governance and organizational groundwork for a more broad-based effort that included many more communities than just the Denver Metro community. CORHIO is now more focused broadly across the State and has been identified as the State-designated entity for the purpose of receiving Office of the National Coordinator of Health Information Technology funding from the HITECH Act. Where appropriate these will be discussed below.

Identifying Partners and Other Stakeholders

The original partners and stakeholders for the application were as previously mentioned Denver Health, Kaiser Permanente, The Children’s Hospital, and University of Colorado Hospital. Soon after receiving the contract, an effort was made to identify a neutral convener to support broader engagement. The Colorado Health Institute (CHI), a nonprofit information clearinghouse, was approached and devoted significant resources (personnel and facilities) to facilitate engagement of other partners. This included producing a white paper that catalogued and described the state of HIE across the State.

Multiple groups and organizations were invited to a series of meetings to determine how to proceed to a more formal structure. The work of CHI brought the various parties to the table, created a consensus process for moving forward, and ultimately set in motion efforts to develop a nonprofit organization called CORHIO. The original four partners were invited to be founding members of the board; some accepted that role, and others declined. Important partners included many of the ultimate members of the board (see Appendix), those working on HIE across the State and those working to improve health care organizational processes as well as State and governmental agencies. This public–private partnership has offered a neutral framework for disparate organizations to work collaboratively to improve the health of all Coloradans.

Identifying Data Elements for Sharing

Defining what data elements were to be shared across CORHIO required an analysis of the capabilities of the four initial institutions. By speaking with clinicians (emergency department [ED] physicians) a list of important data elements was created. For clinicians treating adult ED patients, the most important element was viewing prior electrocardiograms (EKG); for clinicians treating pediatric ED patients it was viewing radiographic images. Knowing these maximally useful data points, the technical group set off to address these requests. Due to lack of a ready interface with the storage environment for EKG and radiologic images and the cost and

incomplete deployment of PACS systems across the partners, neither of these was immediately available. Efforts were made to address these but the budgetary constraints and life cycle for informatics products within the partner institutions precluded complete exchange of these data types during this project. Assessments done with primary care physicians suggested different requirements—laboratory results, radiographic reports, and medication history.

After speaking with the technical experts at each of the institutions, CORHIO began to focus on what was feasible. Not all institutions had EKG reports available to share; the bandwidth issues of sending true radiographic images (PACS – picture archiving and communication system) were beyond the resource capacity of this project. The initial data set (as proposed in the contract application: laboratory results, radiology/imaging results, medication lists and dispensing history, problems list, and electrocardiogram images and reports) were considered appropriate as a starting point for this project.

Developing Data Sharing Agreements

Data sharing agreements were an early item for development work. From the outset, network and data privacy and security personnel, compliance officers, legal counsel, and others were invited to meet and discuss development of business associates agreements and ultimately a data sharing agreement. This was a fairly tedious process with many iterative reviews. A master data sharing agreement was the ultimate target, and the legal counsel representing CORHIO engaged in multiple reviews by each institutional legal counsel.

The basis for this agreement was primarily focused on the work of the Connecting for Health foundational documents on privacy and specified purpose for data sharing.

CORHIO's experience is that data sharing agreements are relevant and purposeful only if there is a reasonable business reason to share information. Much of the discussion and deliberation centered around how the relationships would benefit the participating organizations and the patients they served. There had to be a concrete architecture and business case for the deliberations to remain focused and useful rather than circular.

CORHIO was fortunate to have a partner legal resource who participated as part of the Nationwide Health Information Network Data Use and Reciprocal Support Agreement activities and found the Colorado efforts to be thorough and thoughtful. This contributed to the confidence with which CORHIO continues to utilize this agreement for future purposes.

Developing Partnerships and Programmatic Linkages

The broad partnership development happened as a consequence of the efforts of the CHI. Through those efforts we had access to many State entities—executive branch (Governor's policy advisors, Health Care Policy and Financing Agency [HCPF—Medicaid/SCHIP] and the Colorado Department of Public Health and Environment [CDPHE]). There were efforts to address concerns about the immunization registry and biosurveillance. Early discussions and auxiliary grants/contract included ways to support those programs, but AHRQ funds were primarily directed to the main mission of point of care exchange. During the course of the contract, CORHIO played an organizing role with the Colorado Hospital Association as they supported syndromic surveillance efforts for the Democratic National Convention held in Denver in 2008. A grant from the CDC supported efforts to integrate CORHIO resources with the Colorado Immunization Information System as it was undergoing change and relocation in

CDPHE. Similarly, CORHIO worked with HCPF on the development of plans for an unsuccessful application regarding the Medicaid Transformation activities funded by Centers for Medicare & Medicaid Services.

Early adopters or aspirants were invited to multiple planning sessions prior to the formal process of establishing a nonprofit organization in Colorado and recognized as a 501(c)3 by the Internal Revenue Service. CHI was also the fiscal agent for the Health Information Security and Privacy Collaboration (HISPC), which required developing these same community partnerships and linkages with established programs in the health care community.

Implementing Data Sharing

Through the efforts supported by HISPC funding, Phyllis Albritton (originally hired as a consultant and now CORHIO Executive Director) worked with the four original partner organizations to establish the data sharing policies required for exchange through a collaborative partnership of the privacy/security experts at these organizations. Additional partners included several hospital systems, the Department of Health Care Policy and Financing of the State of Colorado (the State Medicaid and CHIP agency) and the Colorado Department of Public Health and Environment. These were predicated on work of Connecting for Health and incorporated the experience and expertise of these individuals. Often, each partner had developed internal processes to assure HIPAA and other privacy/security compliance within their institutions. These processes, due to their highly sensitive and workflow-dependent nature, had to be adequately incorporated into the thinking and development of policies that met the needs of all partners. In certain cases, such as the auditing and patient consent areas, agreement among the partners exceeded legal requirements and were necessary to assure confidence in the established data sharing arrangements.

These processes were also iterative with the technical workgroups. In each case where the Policy Committee came to agreement on an appropriate policy, that policy had to be compared to the technical state-of-the-art to assure that there was a reasonably simple process to implement the policy. These efforts were meant to encourage system use. For example, an online tutorial of system policy requirements, appropriate use, patient consent, and authentication standards had to be completed by system users so that CORHIO could assure that users understood the limitations of system use. Another area new to the HIE space but necessary for privacy/security assurances was automatic auditing that could be verified on a regular basis. This requirement has subsequently been included in the updated HIPAA regulations as a standard requirement for HIE systems.

Simultaneously, a data sharing agreement that makes reference to established CORHIO policies was developed by CORHIO's and the four partners' legal counsels. These were lengthy and iterative discussions that needed to be driven by a common mission. Much of the development addressed the "what ifs" of HIE benefits and risks to both patients and providers. The agreement was significantly robust and early drafts were shared with the HISPC Interoperability Agreement workgroup to inform that group's analysis and development of standard data sharing templates. Institutional commitment to sharing the data and completing the project was a key component of developing a successful data sharing agreement. Thus, the legal agreements supported this commitment rather than driving the framework for data exchange.

A requirement by the partners entered CORHIO into a new phase of development by engaging cyber-liability insurance—a relatively new line of business for insurance. This line of

insurance required significant investment to determine the appropriate size, scope, and cost of this product based on the use of the technology and number of patients or citizens affected. It is expected that this area of insurance will continue to develop as HIE becomes a more regular course of business in health care. The cost of this coverage was significant, but as it becomes more regular and certification criteria are established, it is hoped this investment will diminish.

Formation and Usefulness of the Technical Advisory Panel

The Technical Advisory Panel was an important aspect of getting CORHIO developed in each of the institutions. It was originally conceived as a method to get top-level leaders in each institution informed about the project. With monthly meetings of the chief information officers and chief medical information officers, we could discuss recent developments, review strategy, decide on direction, and have each institution feel intimately involved in the cross-institutional effort.

Attempts to expand this group into a broader technical work group were unsuccessful. Part of this was probably due to limited time to properly facilitate engagement but more important was that without a clear use case and direct involvement, the level of interest and influence on day-to-day decisionmaking was more theoretic than applied. As a lesson, maintaining interest in this complex area requires real world examples where benefits and risks are felt in the near-term rather than as abstract ideas.

Selecting Technology

CORHIO went through several phases of technology development. As originally stated in the application, we believed that a build process was required, given that there were no readily available software systems to provide these services. Several vendors did present early with proposals on how to use their technologies to solve our problems. None of these met the proposed criteria and early CORHIO efforts involved working with EMC (formerly Interlink) to provide software development and integration.

As we proceeded, it became clear that there were too many issues to really develop a strong system *de novo*. The key factor was our focus on a robust enterprise master patient index (eMPI) to properly unduplicate patients across the health care services spectrum provided by these initial four partners. As we investigated open source solutions, partnering with a built system from New Mexico and potential building with EMC, it became clear that the requirements were greater than our capacity and resources would permit. We began an extensive review of available products and settled on five serious vendors in response to a Request for Proposals. Sun Microsystems (Sun) had a product that included a master patient index as well as complete security architecture and methods for exchange of HL7 compliant messages. The product was called JCAPS—Java Composite Application Platform Suite.

JCAPS was the solution that CORHIO decided to invest in for initial implementation and future growth. With a wide implementation platform (over 3,000 hospitals and health care organizations), this appeared to be a compatible tool to build the record locator service and be extensible for future clinical messaging needs. As CORHIO evolved and began to focus on its sustainability model, capacity to obtain and provide JCAPS environment technical services were considered challenging. The JCAPS product underwent a thorough review by an evaluation committee composed of board members and representatives from the partner institutions. While

the project was judged to have achieved its point of care mission, there was concern that JCAPS may not directly align with the needs of CORHIO and technical support would not be sufficiently responsive during the anticipated growth phases in the next project period. A second round of RFP responses was received; as this report is being written, several vendors are being evaluated for replacing the platform provided by Sun. The lessons of those Sun efforts are embedded in the requirements and evaluation criteria for this new software vendor and integrator.

Privacy and Security

Privacy and security have been core principles for CORHIO. Based on the tenets proposed by Connecting for Health from the Markle Foundation and regulations in the Health Insurance Portability and Accountability Act, as well as extensive review of State and Federal laws related to privacy and security issues, CORHIO developed policies for each partner institution to adhere to (by reference) through the data sharing agreement. Most of these developments occurred in collaboration with funding from AHRQ for the Health Information Security and Privacy Collaborative (HISPC). Initiated in 2006, lasting three phases over 30 months, CORHIO was responsible for conducting stakeholder engagement meetings and working toward an implementation plan during phase 1. During this phase, specific work was done on policies for exchange. The subsequent phases permitted CORHIO to focus more on patient/provider education and adoption of standard policies for exchange with other States.

Policies developed through work of both the SRD contract and HISPC subcontracts allowed CORHIO to address a broad range of issues. Stakeholders including the four partner institutions, several other hospital organizations and the State Medicaid agency and department of public health were present to contribute to the process. Many of the policies were designed after review of similar policies at two other AHRQ-funded SRDs, the Mid-South eHealth Alliance (Tennessee) and the Indiana Health Information Exchange.

The core CORHIO policies developed included the following:

- Access and auditing
- Appropriate use
- Disclosure authorization
- Patient identification
- Security protocols
- User authentication

The policies were developed through a collaborative effort of the partners' compliance officers, State agency privacy officers, and the CORHIO board members who formally approved the policies in November 2008. These policies are currently under re-evaluation per the requirements to update policies every 2 years and/or when changes, such as the enactment of additional HIPAA privacy/security standards, occur to the national or State privacy/security framework.

Developing and Implementing the Evaluation Plan

An evaluation plan was developed over several years with a final plan submitted in December 2008. The plan included comments from AHRQ and its National Resource Center for Health IT contractor, National Opinion Research Center (NORC)*, and was approved by the Colorado Multiple Institutional Review Board. The focus of that plan was to evaluate key components of CORHIO including (1) eMPI, (2) reduction in duplicate testing, and (3) use of the point of care services where available. Key challenges were defining a framework that would be acceptable for conducting the evaluation across the various SRD sites. Several meetings were held with SRD and NORC participation until settling on (1) quality and safety, (2) organizational effectiveness and efficiency, and (3) formative areas of outcome measurement focus. Many of the hoped for quantitative measures were impossible to measure as we determined feasibility of some of the desired criteria. Through an iterative process, we determined that there were two areas that required the most focus: (1) the eMPI and (2) the point of care exchange. Given the relatively slow uptake within the ED and the transition from the CORHIO functions (as defined by the AHRQ contract) and those to be undertaken within the sustainability model context, some aspects needed to be refocused and directed to the feasible outcome measures in a changing CORHIO environment.

The following table describes the various evaluation plan components:

Table 1. eMPI Evaluation Plan Components

	MPI Value	Outcome Measures
I. Quality and Safety	Improved data integrity through reduction in duplicate MRNs.	Qualitative
II. Organizational Effectiveness & Efficiency	More efficient or effective processes for identifying and correcting duplicate MRNs.	Qualitative
III. Formative	Ability to accurately identify duplicate records	<ul style="list-style-type: none"> • Accuracy of the potential duplicates identified by CORHIO MPI • Number of additional duplicate records identified by CORHIO MPI • Qualitative: The degree to which institutions are updating their own MPIs based on feedback from CORHIO MPI

* NORC (under the AHRQ contract) was tasked with providing technical assistance support to these contracts and coordinated periodic in-person and on-the-phone meetings so the project teams could provide updates and other input as necessary.

Table 2. Point of Care Exchange Evaluation Plan Components

	Point of Care (POC) Value	Outcome Measures
I. Quality and Safety	Better informed medical decisions	Card study: whether POC session contained useful outside data
II. Organizational Effectiveness & Efficiency	Duplicate testing	<ul style="list-style-type: none"> • Card study: whether POC session information resulted in more efficient use of diagnostic or therapeutic resources • Cross-sectional study: Use of high-cost tests (CT, MRI) in patients who present with selected conditions.
	Faster disposition of ED patients	<ul style="list-style-type: none"> • Card study: whether POC session resulted in <ul style="list-style-type: none"> ○ Avoiding a request for outside records ○ More efficient use of clinician time ○ Faster disposition
III. Formative	A substantial number of patients presenting to EDs have clinical data at outside institutions.	Proportion of ED encounters for which outside clinical data is available from CORHIO partners
	Users will find user interface for POC system to be easy to use and workflow concordant	<ul style="list-style-type: none"> • Description of development and usability testing process • Card study: space for user to write in suggestions/difficulties using POC system • Qualitative assessment of usability post-deployment
	Use of the POC system will be substantial and sustained.	<p>Usage statistics (assessed two ways: monthly [trends] and over the entire course of the evaluation period [cumulative summary])</p> <ul style="list-style-type: none"> • Proportion of potential users who have logged in at least once • Number of patient search queries per potential user • Number of clinical data requests per potential user
	Data exchanged will be substantial	<p>For each clinical data request</p> <ul style="list-style-type: none"> • Number of outside CORHIO partners with clinical data • Number of data elements in each category <ul style="list-style-type: none"> ○ Laboratory ○ Radiology report ○ Problems / ICD-9 codes ○ Medications

Developing and Implementing the Sustainability Plan

Work on a sustainability model began during the first year of this contract. Over the course of the next several years, several attempts were made to develop a cohesive plan to project at what point the project deliverables would transition into a viable sustainability model. Early efforts looked at the AHRQ-funded State and Regional Demonstration model in Utah developed by the Utah Health Information Network, using an administrative messaging model as the driving force for a value proposition. However, after significant review by the coalescing CORHIO community, that did not appear viable in Colorado.

When the eHealth Initiative proposed a value and sustainability model, CORHIO carefully studied those documents, had a site visit by the authors, and then set about rebuilding the plan to match those recommendations. The fundamental concept of a sustainable value proposition became paramount. What CORHIO had promised as an initial delivery in the AHRQ SRD contract was something driven to improve quality of care. The eHI Value and Sustainability Model (VSM) acknowledges the value of exchange to improve quality of care but focuses on services that support and sustain the HIE. Those services included in the point of care model were not the same described as sustaining within the eHI VSM. As we approached new partners (and even the initial four partners) there was concern about whether CORHIO would be able to charge for the point of care services. While clinicians saw value (as described in the eHI VSM), the real desire to join an exchange would revolve around high-volume daily activities. Clinical messaging is that sort of high-volume need and would drive real value across a growing HIE. This paradox meant CORHIO needed to change its evolving order of service deliveries. Instead of building the point of care exchange, then moving to clinical messaging, administrative messaging and finally population and public health services, clinical messaging was a value proposition with which CORHIO should lead. The analysis of the Strategies for Tomorrow Consulting Group (completed November 2008) suggested that there were multiple lessons learned and outputs that could continue to support CORHIO's efforts from the SRD project, such as the legal and policy work as well as the community engagement process and the technical expertise to transition the eMPI efforts moving forward but to approach communities with this technical platform would not generate enough revenue. This stakeholder analysis, presented to the board, suggested that health care providers were willing to pay for clinical messaging services. Thus, the new model focused on clinical messaging as a first step to getting a community wired. This has been the emphasis as CORHIO enters the post-SRD project phase. As stated above, some of the tools, lessons, and knowledge are being applied to this new environment for wiring several communities across the State as CORHIO enters a new growth phase with support from the private and public entities interested in this effort in 2009 and 2010.

Results

Governance

CORHIO was incorporated in Colorado in March 2007 as a nonprofit entity. A board was established with by-laws to operate the corporation as a utility of service to the citizens of Colorado. The initial board was seated with members from a broad spectrum of health care-interested individuals. The initial President was Donna Lynne, CEO and President of Kaiser Permanente. Subsequently, Joan Henneberry, Executive Director of the Colorado Department of Health Care Policy and Financing—the State Medicaid and CHIP agency (a Governor’s cabinet member)—served as Chair and the board’s Chair-elect is Jim Schmerling, President and CEO of The Children’s Hospital. The board consists of 23 individuals (see Appendix) representing many diverse perspectives (government, health care providers, insurance, consumers, safety-net, legal, business, and others).

In 2009, the IRS completed review of the corporate status and application for a nonprofit 501(c)3 status, which was approved in May.

Finance

During the course of the SRD project, the overwhelming source of funding was the AHRQ contract. Several other funding sources were available but none as significant as the AHRQ funding. Grants received included an EHI Connecting Communities (\$300,000), a HealthOne Foundation Grant (now The Colorado Health Foundation—\$100,000), a Colorado Tobacco Tax grant (\$600,000), a series of Health Information Security and Privacy Collaborative subcontracts (total approx. \$800,000), Governor’s Building Blocks for Health Care Reform (\$250,000), support for Democratic National Convention information exchange (\$200,000), and The Colorado Health Foundation (\$1,300,000).

While all AHRQ funding was monitored through the grants and contracts office at the University of Colorado at Denver, the bulk of the other funds were received through CORHIO’s fiscal agent—the Colorado Health Institute. Since CORHIO had not established itself as a 501(c)3 by IRS and was still in the early phases of developing fiscal policy, CHI has continued to serve in that function almost until the end of the AHRQ contract. As stated above, CORHIO currently has its 501(c)3 status.

To date, despite several plans to have CORHIO customers pay for services, all work performed was without any direct payment to CORHIO. The business plan that is currently underway has a fee structure to be implemented once exchange is to occur in several communities. Funding for CORHIO continues with generous support from the Colorado Health Foundation and anticipated funding from HITECH, both the State Health Information Exchange and the Regional Extension Centers grants.

The in-kind funding of the four initial partners cannot be understated. From the investment of time by the Chief Information Officers, to their security, networking, data management, compliance and legal staff, there were innumerable hours and effort spent on this project that were incompletely compensated. Similarly, there were in-kind efforts by many community members who were part of the convening process regarding governance and establishing security and privacy policies. Without these efforts, little of the progress made during the AHRQ SRD funded period would have been possible.

Technical Infrastructure

The technical infrastructure developed was based on a federated HIE where the record locator service (enterprise master patient index [eMPI]) allowed federated queries to be passed to each of the participating health care entities. The eMPI was developed using the Sun JCAPS software (eIndex). Messaging involved passing a series of HL7 messages to a central repository for additions, changes, and deletions from the eMPI.

To the extent that they existed, CORHIO complied with all federally established messaging standards. Messages with clinical information were formatted in accordance with HL7 standards. Data were received and mappings of idiosyncratic codes were maintained centrally so that the final composite picture allowed chronologic aggregation of data for the 100 most common laboratory tests and the 20 most common radiology reports for a unified view that clinicians would see when reviewing the data.

A secure hosted environment was established to make the system available during the period of deployment. More than 20 servers were required to establish development, test, and production environments for securely distributing data and applications. Interface engineers at each institution were involved in the basics of setting up the connectivity with CORHIO. Specific ports were established where a query message could be sent from CORHIO once requested through the Web interface with an authorized and authenticated user. Each organization had its unique environmental issues and solved the query request internally but returned an HL7 conformant message. Interface engineers needed to review and finally agree to the final CORHIO HL7 message specification, build and send test messages, modify the organization and content within those messages based on feedback, and then work with the CORHIO software engineers to ensure data integrity and accuracy. Data needed to be mapped “on the fly” so that the same test with different names across institutions were normalized and properly aggregated. This was an iterative process that took several months to complete. A significant portion of the work related to the lack of depth and clear specification in HL7 implementation across the initial partner institutions. While standards exist, the unique nature of each Electronic Medical Record system at each of the partner organizations required detailed review and adjustments to permit cohesive and meaningful aggregation and data sharing.

Business and Technical Operations

As CORHIO was launched, there were multiple policies and procedures that needed to be developed and adhered to for secure communications. Each partner institution identified a key individual tasked with assuring that any provider considered a legitimate user of CORHIO was properly trained and provided an appropriate user login.

Training was conducted through a Web-based training module with a series of questions to confirm learning. The Web module was developed by one partner and shared with other institutions. Only after successful completion of the training module was a user login and password made available to the trained individual. Serious infractions of abiding by the policies and procedures resulted in loss of access privileges.

Help desk type services were available on a daily basis from 8 to 5 pm through a call number. Typical needs were in resetting passwords for users who forgot their username and login password. Errors were also recorded for the operational team to address during quality improvement and maintenance activities.

Legal/Policy

A data sharing agreement and associated policies were developed for sharing protected health information in a secure manner. These policies addressed user authentication, appropriate access, patient consent, data security, and other issues that arose as the system was created. Significant efforts by CORHIO counsel, State agency privacy officers, and compliance officers were required to develop these. Issues of indemnification and liability were ultimately addressed through acquisition of errors and omissions cyber-insurance. Negotiating these insurance contracts was laborious, and the initial costs were extremely high given constraints requested by the AHRQ SRD fiscal agent (University of Colorado at Denver). However, these legal and policy documents are foundational to CORHIO's future and have benefited not only Colorado communities, but also other organizations around the country as CORHIO has shared its developed expertise with others.

Lessons Learned

CORHIO's enterprise MPI (eMPI) is a core component of CORHIO and any HIE. Much effort went into assuring the accuracy of linking patient identities across institutions. The process by which partners reviewed potential duplicates identified by CORHIO was important to identifying and resolving critical technical and algorithmic problems. Partners were a key part of increasing the value and accuracy of the eMPI. After optimization, partners indicated that the potential duplicate reports were very valuable and that they would like to continue to receive the reports and provide feedback to CORHIO.

The Point of Care System (POC) had limited usage during the production period. Deployment in the emergency departments (ED) showed that busy ED physicians are less likely to seek any additional information unless extremely accessible and of high priority. There is an indirect relationship between urgency and comprehensiveness. In an unpublished study conducted earlier by Dr. Lisa Schilling at The Children's Hospital, primary care physicians were much more likely (20 percent) than ED physicians (2 percent) to consider data or information missing. The initial CORHIO effort was to bring data to the ED providers. Through a focus group session, their primary data needs were electrocardiograms (for adults) and radiographic images (for children). The point of care system used what was available from the partners, where a few systems offered electrocardiograms and only radiology reports were available. Busy ED docs found our process of login and query too time consuming and maintenance of password too cumbersome. They wanted an automated interface that retrieves data without any thought or effort. Auto-population of an electronic medical record (EMR) with external data was not within the scope of our project.

While the process of aggregating data into usable information was shown to be feasible, the deployment just within the busy ED environment might have been a site where we see a more modest benefit. The role of an ED physician is to make time critical decisions, not to be comprehensive in overall care of an individual. These providers do not review all parameters for chronic diseases or preventive health efforts. They want to provide the best care for the immediate problem presented by the patient. Certainly, they would like to support comprehensive care but are typically time-pressured and unable to spend more than the appropriate time for the presenting problem.

During interviews, several users described instances in which use of the POC system improved the quality or efficiency of care. The interface was intuitive but the patient search function could have been improved. The short password lifespan (3 weeks) was a definite impediment to use. An area where CORHIO began to explore remedies was in trying to leverage another system's (e.g., partner institution) authorization and authentication procedure to identify a user within CORHIO. The security assertion markup language is a tool that could support easier user access without the laborious password distribution process. An automated password reset function based on rigorous authentication procedures used within the federated environment should be explored for deployment. Rather than having an end user initiate (i.e., login, confirm compliance with privacy/security, enter patient demographic information, confirm and select results from identity search, and then launch the data aggregation process) all searches for data, once a registration ADT (admit, discharge, transfer) message (e.g., a patient is now present at a partner institution) is received by CORHIO should be automated to effortlessly tell the provider additional information has been found or even seamlessly incorporate it in the EMR. Integration of CORHIO partner clinical information systems (e.g., automated patient search and

then indication of available external data) would have markedly increased use. Ongoing promotion and support of the POC would also have kept service in the mind of potential users.

The iterative process of building policies required significant interaction between the technical workgroup and policy committee. Technical state-of-the-art procedures are needed to assure a reasonably simple process to implement the policy. To assure compliance with CORHIO policies, online tutorials addressed training regarding system policy requirements and appropriate use, and patient consent and authentication standards had to be completed by system users. Health information exchange privacy/security assurances including automatic auditing was a CORHIO requirement. These requirements preceded but are consistent with updated HIPAA regulations for health information exchange systems.

Conclusions

The AHRQ project afforded Colorado and the communities involved in this State and Regional Demonstration project a significant opportunity to explore important areas in developing health information exchange. The successful development of a nonprofit organization, coalition of stakeholders, momentum to continue this effort with a sharply focused business plan, and development of a governance structure and policies to assure compliance with Federal and State regulations are all positive outcomes from this contract.

The landscape of health information exchange has drastically changed from the period when Colorado submitted its application to AHRQ in 2004. An Office of the National Coordinator for Health Information Technology was first established by executive order and now exists by legislative statute. Funding for this office and activities to be carried out in all States is unprecedented. The health care system continues on its ever expanding downward spiral consuming greater portions of the Gross Domestic Product. CORHIO and the experiences of the SRD project have provided Colorado with a real opportunity to move forward based on the lessons learned, organizational progress and capacity, and the new business plan.

A transformed health care system is the target goal. Within Colorado, the environment for reform is primed, and CORHIO is poised to play an essential role in moving this agenda forward. Making a more efficient process of care within health care systems and across the continuum of care, CORHIO will contribute to improved health outcomes for the residents in our State.

Recommendations for Future Research

Future research should focus on the following:

- Improving the process of eMPI development, deployment, and maintenance.
- Continuing to define methods to accurately and, with significantly less effort, standardize data across systems for aggregation.
- Finding the most efficient business model and aligning incentives to that model.
- Developing clearer paths to vigorous secondary use of the data to support public health, research, and quality improvement efforts.
- Assuring the privacy and security of the data without creating extreme barriers to access for those with legitimate needs and uses of the data.

Appendix. Members and Affiliations of the Colorado Regional Health Information Organization Board—2009

- Joan Henneberry, Colorado Dept of Health Care Policy & Financing (ex-officio [EO]), Chair
- Jim Shmerling, The Children’s Hospital, Chair Elect
- Gerry Lewis-Jenkins, COPIC Companies, Secretary
- Forrest M Cason, Ph.D., Mental Health Corporation of Denver, Treasurer
- Arja Adair, Jr., Colorado Foundation for Medical Care (EO)
- Les Berkowitz, Technology & Corporate Law
- B. Ned Calonge, M.D., M.P.H., CO Dept. of Public Health and Environment (EO)
- George DelGrosso, E.D., Colorado Behavioral Health Council
- Dede de Percin, E.D., Colorado Consumer Health Initiative
- Lynn Dierker, R.N., Foundation of Research & Education of AHIMA
- Pam Hanes, Ph.D., Colorado Health Institute
- Marjie Harbrecht, M.D., Colorado Clinical Guidelines Collaborative
- James Hertzfel, Alumni Consulting Group International, Inc.
- Rob Kaufmann, Brownstein Hyatt & Farber
- Bill Jessee, M.D., CEO, MGMA
- Pete Leibig, CEO, Clinica Campesina
- Michael Locatis, State of Colorado, Chief Information Officer (EO)
- Donna Lynne, Kaiser Permanente Colorado
- Lynn Parry, M.D., Colorado Medical Society
- Beth Soberg, UnitedHealthcare
- Steven J. Summer, Colorado Health and Hospital Association
- Dick Thompson, E.D., Quality Health Network
- Mark Wallace, M.D., Weld County Health Department & Northern Colorado Health Alliance