



HIT and HSR for Actionable Knowledge: Lessons from Leaders Meeting

**Friday, September 18, 2009
8:00 a.m. - 6:00 p.m.
AcademyHealth Offices, Washington, D.C.**

Internal Meeting Report October 28, 2009

1. Meeting overview

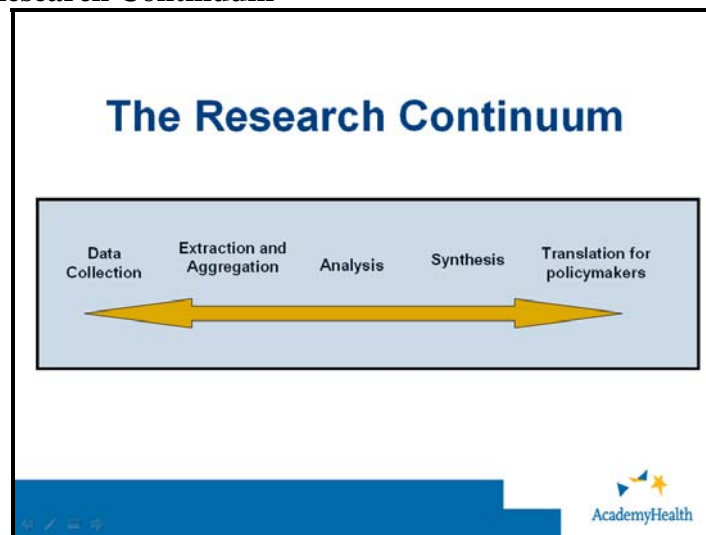
On September 18th, 2009, AcademyHealth convened representatives of six health systems that lead the field in using health information technology (HIT) as well as some of the tools of health services research (HSR) to generate actionable knowledge. The participants in this inaugural meeting sought to facilitate learning and dialogue across organizations, and to collectively identify challenges that partner sites have faced in using electronically generated data to improve health care.

The six partnering health systems are Denver Health, Geisinger Health Plan, Kaiser Permanente (KP), the New York City Primary Care Information Project (PCIP), Palo Alto Medical Foundation (PAMF), and the Veterans Health Administration (VHA). The teams representing each organization were comprised of professionals in clinical practice, research, and information technology. In preparation for the meeting, AcademyHealth worked with each partner to prepare a short description of the organization, its HIT system, and examples of how each is using electronically-generated data to improve processes and care. These descriptions are included in Appendix I.

The full-day meeting provided an opportunity to delve into a wide range of issues surrounding the implementation and use of HIT in these innovative health systems. All innovators, the partners also represent different types of health systems, across a continuum of integrated care delivery, that are seeking to use HIT to improve the quality and effectiveness of the care they provide. Presenters from each partner discussed the design of their IT system, how it supports their organizational mission and operations, the challenges they have faced, and their views about the evolving interface between HIT and HSR.

The meeting started with a brief review and discussion of a general framework for leveraging HIT to build learning health care systems. The framework is illustrated in figure 1.

Figure 1: The Research Continuum



The discussions then addressed, but were not limited to, a core set of questions provided to participants in advance of the meeting:

- What are the main bottlenecks in the research continuum that you have faced?
- What specific challenges have caused the most delay/consternation?
- What approaches have been the most helpful/successful in addressing these challenges?
- How relevant are these experiences to your own organization? Are there some that are more cross-cutting? More specific to your context?

The slide presentations delivered by each of the six partner organizations, as well as other meeting materials are available online at <http://www.academyhealth.org/HIT>.

The following sections summarize major points raised in the presentations, and then describe a general framework for structuring the next steps of the project as articulated by the participants. Within this framework, we list specific questions raised by participants over the course of the meeting. We believe that drawing on the experience of the partner organizations - comparing and contrasting their approaches, successes, and lessons learned - should provide valuable guidance for future efforts to ensure the effective use of HIT in generating actionable knowledge.

2. Summary

While the six health systems are all leading innovators in HIT, and all are clearly focused on using HIT as part of broader efforts to redesign and improve health care delivery, there are some key instructive differences. These differences span organizational mission, structure, resources, and culture.

Examples of these contextual factors raised in the meeting include:

Denver Health is an integrated public health safety net institution, with a closed medical staff. Resources are focused on patient care and quality improvement, and there is limited support for staff or clinician involvement in research per se. Collaborative research efforts with academic institutions are the primary means of leveraging information resources, but the capacity to build a solid infrastructure that could integrate research into strategic planning for quality improvement is limited by budget and staff skill sets.

Geisinger Health System encompasses both Geisinger's health plan and affiliated clinicians located throughout a fairly large, mostly non-urban part of central Pennsylvania. Individual health plans as well as the corporate research

center are engaged in research focused on the organization's mission, and on reengineering health care to improve quality and effectiveness. This gives Geisinger the ability to leverage the advantages of a closed system, but also to work with more loosely affiliated diverse practices, in a "federated" system. This elevates the significance of problems related to standardization of data elements and data systems that are integrated into the central data repositories, or warehouses.

Kaiser Permanente is a very large enterprise, providing care in eight regional systems located across the United States. The plans are predominantly closed systems, and there is strong commitment to supporting collaboration among analysts and researchers within and across the KP regions. But because KP plans are organized as a partnership between the independent Kaiser medical group and the health plan, data ownership poses particularly difficult challenges. In addition to tensions between clinical and research demands on data, and internal versus external use of the data, there are additional challenges associated with meeting the demands of the medical group versus the health plan, and the regional plans versus the national corporate management.

PCIP, a component of the New York City Department of Health and Mental Hygiene, provides an integrated EHR system and technical assistance to participating primary care physicians in offices and clinics serving Medicaid and uninsured patients. The current program includes ambulatory care practices only, and participating practices have a two year contractual agreement with the NYC DPHMH. The public health mission, the voluntary nature of the current program, the relatively small number of records at each of the participating practices, the high variability among practices, and the transience of the patient population amplify methodological and measurement problems, and accentuate issues of data quality, including decisions about case versus aggregate level data, and data ownership.

The Palo Alto Medical Foundation (PAMF) is a large multi-specialty group medical practice in Northern California that merged three existing groups into a single system in 2008. It is also affiliated with a network of nonprofit hospitals. Integrating data from the old groups involves difficult technical and methodological problems stemming from their histories of using different technologies, systems and procedures. Within PAMF's free-standing Research Institute (PAMFRI), there is still a small unit focused on clinical research, even as there is a new focus on health services research and health policy research. PAMF's central operational and clinical staff provide support to PAMFRI staff in using PAMF's data systems, including its HIT system that integrates EHR data from the medical groups. While the interactions between health services research and plan operations present challenges, the structure of PAMF also reflects a corporate decision to support research that draws on outside resources as well as internal support to serve the enterprise's strategic goals.

VHA Informatics Research Initiative works within a vast national program that provides direct health care to more than 5 million patients annually and conducts and supports a very large clinical and health services program in federal and academic health care institutions across the United States. While VHA facilities operate within a closed system, patients can also obtain care outside of the system, often as Medicare beneficiaries, confounding data problems (such as completeness or accuracy of treatment information). Engineering a workable data warehousing system with data from across the nation has involved the integration of 129 different electronic medical records. In addition to the size and diversity of information systems, VHA's mission and its public visibility increase the salience of data ownership, security and privacy concerns; as a large federal agency, VHA is subject to oversight that can result in administrative and budget constraint that can constrain research and innovation.

The discussion of the goals and constraints faced by each of the partners revealed some general issues that will be important to explore in greater depth as the project advances.

First, the partners identified ways that “open” versus “closed” systems differ in their ability to structure data collection, try new things (i.e., play with the data), ensure data quality, and structure incentives to engage active participation by providers and patients in using health data. This includes the ways in which researchers are involved in planning and implementation of these efforts.

Second, the primary mission of public health organizations, including surveillance and rapid response in communities (rather than in closed systems) involves a somewhat different set of priorities regarding case versus aggregate-level data, as well as the mix of administrative requirements related to data access and use (e.g., restrictions on data sharing for research purposes and human subjects protections). Public versus private organizations may also have different opportunities, and face different barriers, in terms of structuring the interface between research and quality improvement, both internally and with outside organizations.

Partners also discussed a related set of issues concerning the design and operation of enterprise data warehouses, and how they can be leveraged for research. They described significantly different systems for extracting, organizing, and making data available to an array of users, both within and outside of their organizations. These differences reflected a) differing data needs: generation of aggregate or case-level events or trends in the incidence or prevalence of conditions, treatment or outcomes; b) differing sources of electronic data that each system has included thus far; c) different needs for/capacity to capture free text and scanned data in clinical records and in other forms of clinician or patient-supplied data; and d) different needs for/capacity to provide technical support for data users.

Despite these areas of difference, participants identified some clearly consistent themes and challenges that they consider to be critical to the future roles of HIT and HSR in creating a learning environment to improve health care.

The commonalities across all presentations and subsequent discussion are summarized in Table 1.

Table 1: Challenges to HIT and HSR for Actionable Knowledge across Partner Organizations

Partner Organization	Challenges
Denver Health	<p>General concerns focus on the need for a robust IT system, with emphasis on the need to ensure that they are populating the system with accurate data and not propagating mistakes. Also grappling with question of how much to rely on vendor applications versus internal data warehouse.</p> <p>Specific bottlenecks or barriers include:</p> <ul style="list-style-type: none"> ▪ The structure and timeframes of the research grants cycle, which may conflict with staffing and planning needs ▪ Professional staff resource limitations and the need for multiple skill sets ▪ Methodological issues, including a lack of stable data definitions and performance metrics; gaps in the precision and utility of data, including challenges in extracting useable information from free text ▪ Various compliance and regulatory demands, including dealing with multiple IRBs, data retention & security issues, and external reporting and accreditation requirements
Geisinger Health System	<p>General concerns focus on the difficulty of obtaining consistent, usable data from highly variable practice sites without overwhelming clinicians; the need to define data and establish standards to facilitate research and to provide feedback to clinicians to ensure consistency and validity of the data; the need to facilitate access to/use of the data, and the most appropriate means of doing that (e.g., when to rely on federated model versus central warehouse); and the need to align/restructure HSR with a business case, and to create models for supporting research that can intersect effectively, within short timeframes, with system innovations (QI, decision support).</p> <p>Specific bottlenecks or barriers include:</p> <ul style="list-style-type: none"> ▪ Difficulty staffing to cover a wide range of skills related to IT, research design, reengineering, communications, etc.; current HSR posts still unfilled ▪ IT data governance issues (compliance – HIPAA, IRBS; ownership, technical assistance) in a complex system with multiple needs, priorities ▪ The dearth of research methods to expand consumers/patient involvement in HIT and decision support ▪ The lack of standard definition of data elements, terminology
Kaiser Permanente	<p>General concerns focus on the importance of facilitating the social as well as organization changes that are essential for effective use of HIT in a large, complex system, where there are multiple and sometimes competing needs for data. Building a data rich environment while respecting the autonomy (and clinical care orientation) of health care providers was also identified as a major issue.</p> <p>Specific bottlenecks or barriers include:</p>

	<ul style="list-style-type: none"> ▪ Technical issues in data organization and storage, and in providing access to data for researchers, plans, and management ▪ Data ownership issues – clinical vs. research, medical group vs. plan, region vs. national, internal vs. external ▪ Research operations issues – assuring compliance/oversight with standards, regulation for human subjects , financial integrity, clinical trials, and quality ▪ Making research relevant – establishing processes for prioritizing research topics, links to resources, generating timely results, results for patients, disseminating findings
<p>New York City Primary Care Information Project</p>	<p>General concerns focus on learning how to leverage technologies to support multiple types of research (e.g., clinical trials, observational studies) and meet multiple public needs (surveillance, alerts, interventions) in an environment shaped by design and resource limitations. Also grapple with challenges of learning to ask questions that the data can answer, and determining when the data are good enough/sufficient to use, and for what purposes/audiences.</p> <p>Specific bottlenecks or barriers include:</p> <ul style="list-style-type: none"> ▪ System limitations – the current project includes ambulatory primary care only, with a voluntary, time limited relationship with providers ▪ The public health mission emphasizes the need for aggregate counts, which means that patient-level data are not available ▪ Methodological issues regarding statistical power, measurement, data standards and definitions, and determination of patient population/appropriate denominator (many of these issues are related to/exacerbated by the relatively small number of observations from highly divergent individual medical practices) ▪ Working within the constraints of a distributed query system ▪ Issues regarding the use of federated data (e.g., multiple IRBs, poor technology practices within discrete provider settings (e.g., no data back up), lack of clarity around who assumes data broker role, developing systems that allow for autonomy but support uniformity) ▪ Issues in linking QI to public health ▪ Limited resources – staff and other ▪ Administrative, legal, ethical issues regarding partnerships with universities and other potential partners.
<p>Palo Alto Medical Foundation Research Institute</p>	<p>General technology concerns focus on using historical (legacy) systems and procedures, as well as the challenges associated with data quality and consistency. Concerns also focus on applying HSR skill sets to the operations side of health delivery, structuring an effective interface between research and quality improvement, and changing concepts of what constitutes good research.</p> <p>Specific bottlenecks or barriers include:</p> <ul style="list-style-type: none"> ▪ Technical and conceptual issues relating to the complexity of leveraging data from multiple electronic systems and multiple organizations ▪ Gaps in comprehensiveness and quality of electronic data (e.g., not digital, structured, or extractable), problems with historical data, calibrations, integration of data from multiple systems

	<ul style="list-style-type: none"> ▪ Data governance, ownership issues ▪ People with all the needed skill sets (IT/Clinical/Research) are hard to find ▪ Need to avoid limits in measurement that can be imposed by HIT and to address gaps in measurement using HIT ▪ Current grant and publications processes are inconsistent with rapid learning cycle
U.S. Veterans Health Administration	<p>General concerns focus on the importance of involving the right set of skills, including research skills, involved in the HIT development cycle, e.g. design, data governance. Major data challenge is inability to use information in text fields for research purposes.</p> <p>Specific bottlenecks or barriers include:</p> <ul style="list-style-type: none"> ▪ The need to build systems that allow different users to get data they need efficiently ▪ Need to better integrate research into the broader efforts to reengineer care and management across large, highly variable delivery system ▪ Resources are limited by budget and administrative priorities (bias in favor of basic science research) ▪ Barriers to timely data access related to privacy, security concerns (data governance, compliance, human subjects protections) ▪ Need for more sophisticated methods to take advantage of data (free text, data on providers, consumer/care-giver preferences, attitudes, data from other system (e.g. Medicare. Medicaid)) ▪ Need to extract relevant data fields without having to know exactly where within the system they reside

As reflected in the above, participants identified both unique and common sets of concerns. We have broadly categorized these as follows:

- **Data Quality.** All of the partners identified data quality as an issue that creates obstacles for researchers seeking to develop actionable knowledge. The challenges center on “how good” the data really are, and whether/when/to what extent they can be used to support decision making. In addition to problems with inconsistent definitions and metrics, participants identified gaps in the types of information typically captured in EHRs. Concerns focused not only on current limitations in technologies for capturing relevant information from scanned data and free text fields, but also making sure structured data are recorded in consistent fields to allow for information exchange.
- **Data Storage.** A number of partners struggle with the challenge of how to build scalable systems that facilitate data access and use across the spectrum of different potential users. Some were grappling with the question of when to rely on vendor applications versus an enterprise data warehouse, and how to build a data warehouse that supports data access and innovation but doesn’t pose a risk to the broader system (i.e., enable users to “play with the data” without breaking the system).
- **Data Stewardship.** A related set of concerns, raised throughout the day, focused on data ownership and governance issues, including responsibility for compliance with institutional standards, and regulatory and statutory compliance regarding security, privacy, and human subjects protections. Partners explained that these issues can become difficult and time consuming, especially when data systems and the researchers seeking to use them span multiple locations and institutions. Partner organizations are working to set up efficient and accountable processes for addressing the complex issues surrounding institutional standards and federal regulations regarding identifiable data, informed consent, and the use of data for research versus public health purposes.
- **Reengineering the Research Function.** Partner organizations are all grappling with how to more systematically integrate research and technology systems into the cycle of strategic planning and quality improvement in real time. Their concerns include establishing the value of integrating relevant information obtained directly from patients and caregivers, information on providers, and an array of environmental factors that may be crucially important in improving health care delivery. They are attempting to learn, from their efforts to date, about how both clinicians and consumers have responded to the availability of actionable knowledge, e.g. changed the way that patients and practitioners interact, or affected participation in decision-support systems or care management programs built on HIT platforms. They also face the challenge of

reconciling the differences in vocabulary and professional incentives and rewards. Related to these are broader strategic issues such as structuring collaborative relationships with outside research organizations, and establishing policies for disseminating research findings derived from HIT in different types of public or private sector health organizations.

3. Learning from Innovation Leaders: approaches and issues in using health services research to generate actionable knowledge from HIT

In the concluding session of the meeting, participants focused on developing a framework to guide the next phases of their work. The overarching goal set out by the participants is to draw on their experience as early innovators, and systematically assess what they have learned about the interface between HSR and HIT in health care improvement. Documenting past lessons from these early adopters could help the next cohort of adopting health systems. It will also begin a broader process of identifying areas where health services research will need to refocus methods and training to support the development of actionable knowledge in a mature HIT environment.

The first step is therefore to review the lessons to-date, then to build on this knowledge by identifying what needs to be done over the next decade to ensure that health services researchers have the skill sets, substantive knowledge, and organizational assets they will need to play an active role in designing as well as using HIT to its full potential.

Based on the meeting discussion, AcademyHealth staff assembled an initial set of questions, grouped into the four categories described above. With additional input from the partner organizations, the group will refine these questions into the topics for papers to be completed in the next phase of the project:¹

For Review: Topics in Learning from the Innovators:

- HIT Data Quality
 - What types of information from EHRs or other sources are included in partner organizations' systems? What are the most salient gaps from the perspective of developing actionable knowledge?
 - What have these organizations learned about the quality of the data and how to improve both quality and usefulness?
 - How have these organizations come to terms with establishing protocols for when data are good enough for specific purposes?

¹A fourth category of questions, which concern research on HIT itself, were also mentioned during the group's conversation. Although very important and not always clearly differentiable from the other categories of questions, they fall outside the scope of this particular project.

- HIT Data Storage
 - How are data warehouses and access to data structured in different systems?
 - How have partners balanced the two objectives of being nimble/flexible but also responsible for the integrity of the broader system?
 - What have partners learned about structuring access to warehoused data for researchers addressing different types of questions, e.g. quality of care, access, effectiveness?

- HIT Data Stewardship
 - What approaches (protocols, systems, etc.) have partners developed to address challenges related to data ownership, compliance with regulatory requirements (e.g. HIPPA compliance, human subjects review), and data retention?
 - What policies have partners needed to develop to deal with access to data, or the development of collaborative arrangements with outside researchers or other organizations?

- How are IT and research being integrated to generate knowledgeable action in Partner Organizations?
 - How have partners built a “business case” for integrating research into operations and strategic planning in their organizations? What are the most significant barriers that they have encountered?
 - What are the organizational models that different partners have developed for formally integrating researchers into strategic planning, system reengineering/redesign, or quality improvement in their organizations? Which skill sets have been identified as most important for reengineering efforts in their organizations?
 - How are organizational decisions concerning what resources to devote to analyzing data for institutional learning made? What impact has the source of those resources had on the choice of issues to analyze and the ultimate use of the results?
 - What types of affiliations with academic or other research organizations have been put in place and what has worked best? What policies have been developed to address the dissemination and/or publication of research findings?

Appendix I. Descriptions of Partnering Health Systems

HIT AND HSR FOR ACTIONABLE KNOWLEDGE: DESCRIPTION OF PARTNERING HEALTH SYSTEMS

PARTNER: Denver Health (DH)

History, Structure, and Size

Denver Health is the principal safety-net provider in Colorado. Founded in 1860 as a single municipal hospital, Denver Health is now an integrated health system comprising 477 hospital beds (~26,000 annual admissions), 8 outpatient clinics, a broad spectrum of subspecialty clinics, 12 school-based clinics (~450,000 annual outpatient visits), and other public health and emergency services. The system employs 700 physicians as well as 3,000 trainees, and it serves 150,000 patients (about 25 percent of Denver's population). Forty-four percent are uninsured. It operates as a part of Denver's municipal government.

HIT Systems

Denver Health operates primarily on a HIT system using Siemens software that supports a single electronic medical record (EMR) for each patient that can be accessed by any Denver Health provider. The full range of data collected by Denver Health are patient demographics, clinical results (laboratory, radiology, pathology), medications (including lists, dispensed, administered), vital signs, immunizations, document form types, and ancillary services studies, patient satisfaction results, and financial and billing information. All data sources get leveraged for research and quality improvement efforts. These data are captured from individual facilities and housed in both a clinical data repository (EMR) and a centralized data warehouse. Other important features of Denver Health's HIT capabilities include the ability to provide point-of-care decision support primarily through the use of computerized provider order entry, and a robust EMR. The data warehouse has improved care through the utilization of comprehensive disease management registries, point-of-care decision support, near real-time clinician alerting for surveillance monitoring, in addition to the use of sophisticated reporting capabilities for operational and financial management needs.

Organization of Research Functions

Denver Health currently maintains a single health services research department that conducts both traditional, grant-supported health services research (especially demonstrations) and supports internal data and information requests. The department reports directly to the Chief Quality Officer and has had strong support from the CEO and CMO since its inception in 1999. In fact, the CEO managed this department for the first six to seven years. In addition, various clinical departments (Emergency, Surgery, Medicine, Public Health, and others) have active clinical research agendas with specific health services research skill sets to support their efforts. Further, the Department of Patient Safety and Quality which leads quality improvement efforts also participates in health services research and responds to internal operational needs of the organization. In addition, a Decision Support Services team provides the ability to produce many internal

management reports and provides ad hoc HIT data inquiry services. In addition, a lead physician (with extensive informatics and biostatistics training) in the Department of Patient Safety and Quality works directly with the HIT data warehouse team.

The HSR staff is made up of professionals with the following background and experiences:

- Director, Health Services Research (full funded by hospital operations)
- Assistant Director, Health Services Research
- 2 Research Project Coordinators
- Part-time administrative support
- Research Staff (varies dependent upon number of grants, but averages ~5 FTE's)

Denver Health is also a contractor under the U.S. Agency for Health Care Research and Quality (AHRQ) ACTION network with the HSR staff taking the lead. Of particular ACTION task orders solicited by AHRQ, Denver Health selects topics that are in areas where they have some experience or interest going forward as an organization. Participation in ACTION also allows Denver Health to connect with other health systems around the country.

In addition, there are other staff that are involved in the use of HIT in health services research and quality improvement efforts on an *ad hoc* basis. Further, there are departmental specific resources involved in similar efforts.

The total annual budget for HSR is currently about \$150,000. External grants and contracts fund an additional ~\$1,000,000 annually. The process for making requests for analysis is centralized through a web-based data request and prioritization process.

The creation of registry capabilities and the data warehouse created a surge of interest among clinicians in doing HSR and clinical research. A major hub of activity has developed around the Data Request Portal, the focal point for researchers to get access to data from the data warehouse. Because resources are limited, an advisory council of 12 physicians, researchers and managers, including an HSR staff representative, prioritizes requests.

Applications of HIT (i.e. ways your organization describes utilization of electronically generated data)

Current applications of HIT at Denver Health include:

- Providing appropriate data, information, and knowledge at the point of care through the use of many clinical applications, including:
 - ELECTRONIC MEDICAL RECORD- called EDM (Enterprise Document Management) (1995)
This is an online, complete, and up to date, “scanned medical record” where hand-written information is scanned into the system and other reports/results are imported electronically. This record is accessible from

all computers and is available 24 x 7 x 365. This is a client-server application.

- **VAXTRAX- Immunization Registry Application (1994)**
This application provides a registry of all Denver Health patients to facilitate efforts to provide appropriate vaccinations to all groups. This is a client-server application that is integrated with the Lifetime Clinical Record.
- **PATIENT MANAGEMENT/PATIENT ACCOUNTING SYSTEM- called INVISION (1997)**
This is the core hospital information system for registration, patient master index, and billing activities.
- **SCHEDULING (1997)**
This is a computerized appointment system for scheduling outpatient visits and radiology exams, and provides capabilities for the management of consults.
- **COMPUTERIZED PATIENT RECORD- we call it LCR (Lifetime Clinical Record) (1999)**
This application is the source application for some elements such as outpatient vital signs, weights, BMIs, medication reconciliation lists and also displays elemental data from laboratory, pharmacy, radiology, other ancillary services systems.
- **DATA WAREHOUSE- comprehensive, multidimensional database used for reporting, research, and management (~2000)**
This application provides a robust data warehouse with information from many sources and includes patient related information such as demographics, utilization, billing, laboratory, pharmacy, radiology results. It is used for reporting, research, quality improvement, disease management, and operations management.
- **SINGLE SIGN-ON PORTAL- called the Clinical Dashboard or Portal (2002)**
This is a web-based application that provides an integrated view of the various clinical applications. Physicians/providers use a “smart card” with an embedded “smart chip” and once authenticated, they have access to the clinical applications like Med Rec Imaging, LCR, CPOE etc., without signing on to each application individually. Deployed SUN solution to provide rapid logon with session persistent technology.
- **E-LIBRARY- electronic medical references (2002)**
This is an Intranet site, and with collaboration with the University of Colorado Health Sciences Center, it offers physicians access to more than 6,000 full-text journals online, ~100 e-textbooks, and multiple other electronic references used in the daily care of patients.
- **COMPUTERIZED PROVIDER ORDER ENTRY- called CPOE (2002)**
This is an application that allows physicians/providers to enter orders into the computer. The major ancillary departments like laboratory, radiology, and pharmacy have bidirectional interfaces which allow for rapid communication of orders, and much less transcribing and reentering of

data (i.e., fewer errors, improved efficiency). This application is run on an Application Service Provider (ASP) model. The rollout of the application is summarized below:

- PICTURE ARCHIVING COMMUNICATION SYSTEM (PACS) - called PACS (2006)
This application digitizes radiology exams and makes them available for viewing on computers throughout the hospital and clinics.
 - NAVICARE BED MONITORING SYSTEM (2006)
This application provides a detailed approach the management of beds on the inpatient areas.
 - MAK- Medication Administration Checking- bar coding (2007)
This application provides support for medication administration with the use of decision support at the point of care utilizing bar coding technology with integrated clinical software.
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- Reporting quality measures. In particular the central data warehouse that receives data from numerous other systems is used.
 - Meeting demands for actionable operational data to improve internal clinical and administrative processes. In particular, as described above Denver Health uses point-of-care solutions and more traditional reporting and analysis functions to assist executives, managers, and practitioners in improving health care for a variety of conditions.
 - Benchmarking. Denver Health participates in benchmarking services with University Health System Consortium and Colorado Hospital Association to assist management in better understanding our care practices. These databases have also been used to help guide research activities.

Plans for the future include expansion of data available in the data warehouse, online documentation by nurses and physicians, and use of business process management software to improve standardization or clinical workflow.

HIT AND HSR FOR ACTIONABLE KNOWLEDGE: DESCRIPTION OF PARTNERING HEALTH SYSTEMS

PARTNER: Geisinger Health System

History, Structure, and Size

Geisinger Health System (GHS) is an integrated delivery system offering healthcare services to residents of 31 of Pennsylvania's 67 counties with a significant presence in central and northeastern Pennsylvania. GHS includes the Geisinger Clinic (GC) that provides ambulatory care, the Geisinger Health Plan (an insurance plan), Geisinger Medical Laboratory (a private lab that services all GHS facilities), a large tertiary care teaching hospital and two other hospitals. GC, formed in 1981, is a Pennsylvania not-for-profit corporation operating a multi-specialty group medical practice. Currently, there are 780 GC physicians and physician's assistants; the practice is growing at more than 7% per year, and treating patients at specialty care clinics, 41 outpatient community practice sites, and two ambulatory surgery centers (i.e., Wilkes-Barre, Danville). The primary care physicians see approximately 350,000 patients annually. Specialty care has approximately 700,000 patients annually. The Geisinger Health Plan, an independent business entity, has approximately 230,000 members; about 50% of the members obtain most of their health care from the Geisinger Clinic.

HIT Systems

Installation of EpicCare began in 1996 in 41 Geisinger Clinic (GC) outpatient locations and in all specialty care ambulatory clinics. Installation in all community practice sites and specialty clinics was complete (i.e., completely paperless operations) by 2001. To date, the EHR database contains information on more than 2.5 million patients. Patient information from a variety of sources is integrated into a common interoperable database that includes:

- Patient demographics, vitals, clinical measures, problem list, medical history, medication history, personal and family histories. Regularly updated and reconciled.
- Encounters (e.g. office visits, hospitalizations, nurse encounters, telephone inquiries and specialty consultations).
- Orders (e.g. labs, meds, imaging and procedures).
- Appointments (for each appointment the entire thread is fully logged, from instantiation to resolution, including rescheduling, cancellations and no-shows).
- Digital imaging (e.g. MRI, CT, X-ray, medical photography).
- Results (e.g. procedure reports, lab results, pathology reports) including clinical notes and summaries, which are increasingly created using smart-sets, or structured protocols.

In 2008 Geisinger installed EpicCare inpatient EHRs and in parallel, collaborated with IBM in completing an enterprise data warehouse (EDW). The EDW is used to integrate EHR, GHP claims, billing, and other data under a single system. The EDW is used by administrators and business analysts, and by the innovations team. Research has a stand alone de-identified version of the EDW that is used to create IRB approved data files for

research. The Center for Health Research manages the research EDW and supports its own investigators, as well as clinicians in the system with research projects.

The Center for Health Research has extensive experience working with Geisinger's IT department and the clinics on research related to re-engineering care processes using a combination of web-based applications and real time I/O transactions with Epic patient records. The approach allows us to link patient data from multiple source systems (e.g., EHR, computerized patient completed questionnaire) in a virtual workspace, apply algorithmic rules, and then execute one or more functions (e.g., export data to the EHR, display results to a web-portal, activate an alert, etc). For example, our real time cardiovascular risk modification module 1) extracts and analyzes discrete data from the patient's electronic health record; 2) creates a web-based patient friendly display of personal cardiovascular risk; 3) captures patient preferences for risk reduction via a touch screen questionnaire; 4) applies algorithm driven decision support to the patient preferences and risk data; and 5) instantaneously creates a visual display of patient risk, risk reduction preferences and decision support tools for physicians at the point of care.

Geisinger has invested in the development of a Research IT Environment (RITE) to allow for testing of new software tools in clinical environments. RITE consists of 3 separate environments (denoted "sandbox", "staging", and "pilot") that vary in the degree of freedom provided to researchers to interact with: 1) stakeholders (e.g., programmers, collaborators, developers, vendors) external to Geisinger, and 2) internal production systems (e.g. scheduling systems, EHR, etc.). In the sandbox, the development environment offers unrestricted access to the external Internet and to a "shadow" instance of Geisinger's production environment. The sandbox has highly restricted access to internal Geisinger systems. The sandbox allows for rapid prototyping of new applications in an environment very similar to the actual production environment. As new tools mature, they are transitioned to a staging environment that imposes greater restrictions on access to stakeholders outside of Geisinger. Typically, if a third party developer is involved on a project, the application will move to the staging environment when it is ready to be transitioned to use in an actual clinic (e.g., during a real patient encounter). In the staging environment, applications can be linked to internal production systems with real patient data. The pilot environment allows for highly controlled and closely monitored access to the external Internet, but broad access to production systems and databases that contain study-relevant patient data (e.g., the EHR). Since its inception, RITE is increasingly being used to develop and test tools for visual display of complex clinical information, patient completed questionnaires, patient guidance, and point of care and patient tailored clinical decision support.

Organization of Research Functions

Geisinger has three research centers. The Weis Center (15 investigators, 65 support staff), started in 1986, focuses on basic sciences with an increasing translation focus. The Center for Health Research (14 investigators and 40 support staff) was launched in 2003 and focuses on health services, epidemiologic, community health, and genetic epidemiologic research. The Center for Health Research also has strong ties to Innovations and to the clinical practice in developing a formal research and development innovation model. The Center for Clinical Studies started in 2006 with focus on clinical

trials and clinical research. Research has a budget of approximately \$16 million dollars. Approximately \$9 million is supported by external funds or by endowment.

Examples of data analytic and HIT projects include:

First and Second Line Antihypertensive Regimens in An Adult Outpatient Cohort: The Geisinger Clinic Population

We conducted a retrospective study to assess the characteristics of patients given common first- and second-line antihypertensive regimens, and the relative efficacy of these treatments. Of 86,758 hypertensive adults aged ≥ 30 years seen between 2001 and 2006, 68% received one drug as first-line therapy; 33,580 patients received immediate or stepped-care second-line treatment. The most common monotherapy was beta-blockers (BB, 33%), followed by angiotensin converting enzyme inhibitors (ACE-I, 29%), thiazides (13%), calcium channel blockers (CCB, 12%), angiotensin receptor blockers (ARB, 6%), loop diuretics (4%) and anti-adrenergics (3%). ACE-I and AA were more commonly ordered for men. Use of CCBs, loop diuretics and combination therapy increased with age while ACE-I, BB and thiazide use decreased with age. In first-line therapy the percentage of visits controlled to JNC-VII standards was highest with BB or combinations. Seven pairs accounted for nearly all two-drug regimens; thiazides were in 4, ACE-I and BB were in 3 each.

Increased Incidence of Renal Disease with Thiazide plus ACE-I Combination Therapy for Hypertension: The Geisinger Clinic Population

Thiazide diuretics are recommended alone or in combination for uncomplicated hypertension (HTN). Most patients require treatment with 2 or more drugs. Based on studies of monotherapy, ACE-I are recommended for patients at risk of renal disease, including diabetics. We hypothesized that thiazide plus ACE-I is associated with a lower incidence of renal disease compared with other common thiazide combinations, but that confounding by indication for diabetes might attenuate this effect. We conducted a retrospective cohort study in all patients ≥ 60 years treated for HTN between 2001 and 2006. Patients with prevalent renal disease, or < 6 months of treatment or follow-up, were excluded. Diabetes was defined as ICD-9 250.*. Renal disease was defined as ICD-9 codes 403.*-404.*, 593.9, 585.*-586.* or an estimated glomerular filtration rate (eGFR) < 60 mL/min/1.73m². Incident renal disease by eGFR required ≥ 2 measurements persisting ≥ 3 months. Among 4700 patients (98% Caucasian, 69% female, mean age 70 yrs, mean follow-up 32.5 months), the incidence of renal disease was 22.7%. Five drug classes, ACE-I, ARB, BB, CCB and Potassium-sparing diuretics accounted for 97% of thiazide combinations. Contrary to expectation, ACE-I with thiazide was associated with an increased incidence of renal disease compared with all other groups except potassium-sparing diuretics. This risk was significantly greater than that observed with BB. The association was only slightly attenuated by accounting for diabetes.

Predicting Heart Failure (HF) Diagnosis in Primary Care

HF is a common, severely disabling disease. It is the most costly disease for CMS. HF is usually detected too late by primary care physicians to change the natural history of the disease, to prevent its occurrence, or to substantially slow progression. To address this

gap, we used longitudinal electronic health record data (EHR) on primary care patients to determine if it was possible to detect HF 12 to 30 months before it is usually diagnosed. In logistic regression modeling, selected diagnoses (e.g., diabetes, AF, PVD, hypertension), use of anti-hypertension medications, and lab measures (i.e., HDL, BUN) predicted diagnosis of HF. The area under the curve for the receiver operator curve for the 6 to 18 month (i.e., prediction window before diagnosis) was validated at 0.80. The model results offer an opportunity to implement an early HF detection program in primary care.

eMigraine

The eMigraine study is a pre-post randomized controlled pilot study to determine if a systematic guideline-based approach to migraine detection and management can improve processes and outcomes and address the gap between what is known in this area and what is practiced at the primary care level. Participants are adults aged 18-45 with a primary care physician at Mt. Pocono Clinic Family Practice and will be randomized into two groups. The intervention group (N=1200) will receive the full protocol of the **Primary Care Headache Management System (PCHMS)**, a set of tools which includes a web-based questionnaire used to screen patients who warrant clinical attention and to look for gaps in care, physician clinical decision support that is tailored to individual patients, and an after-visit summary that provides tailored treatment and management information to patients regarding their headaches. The control group (N=400) will receive an abridged questionnaire and an after-visit summary that provides general guidelines on how to reduce headaches. Analyses will determine how often expert advice was offered and used and evaluate if the PCHMS improved migraine detection, treatment rates, and migraine impact on quality of life.

eCVDII

The eCVDII study uses an integrated IT-based care model to detect and manage cardiovascular disease (CVD) risk at the primary care level. The study includes the automated data capture of behavioral risk factors, an on-line quantitative risk assessment and calculation, CVD risk communication, a patient preference-based care plan, and expert real time clinical decision support. Participants are men aged 45-75, women aged 55-75, and adults over 18 with coronary artery disease. The randomized controlled pilot study is conducted in the family practice departments at Scenery Park and Grays Woods clinics. All eligible patients complete an on-line questionnaire to determine risk of heart attack in the next 10 years. Patients with moderate-high CVD risk and modifiable risk factors will be randomized into two groups. The intervention group (N=100) has the opportunity to select their preferences for managing their risk and their physicians receive clinical decision support that is tailored to the individual patient. The control group (N=100) will not be managed for CVD risk by the study. Analysis will evaluate if the study tools improved detection of CVD risk factors, increased delivery of guideline-based care for the management of CVD risk, improved short-term outcomes in CVD clinical and behavioral measures, and improved patient activation and adherence.

eDiabetes

Similar to eCVDII, the eDiabetes system is a software-based solution designed to screen primary care patients with Type II diabetes for risk of diabetes disease progression based on data from their electronic health record and patient-reported questionnaire data. Participants will be individuals 18 years of age and older who have been diagnosed with Type II diabetes, and the pilot study takes place in the family practice departments at Scenery Park and Grays Woods clinics. Once eligible patients are identified, they complete an online questionnaire to determine their 10-year risk of macrovascular event (i.e., heart attack or stroke), while a background process determines if their most recent HbA1c value is out of control. Patients with moderate to high macrovascular risk or elevated HbA1c levels are next randomized into two groups. As in eCVD-II, the intervention group has the opportunity to select their preferences for managing their specific elevated risk factors. The physicians of these patients receive clinical-decision support tailored to the patient's specific risk factors. Patients randomized to the control group do not receive any type of management from the eDiabetes system. Analyses will be conducted to evaluate if the study tools increased detection of patients with uncontrolled diabetes, increased delivery of guideline-based care for the management of Type II diabetes, improved short-term outcomes in Type II diabetes clinical measures, and improved patient satisfaction and adherence.

Innovations

Geisinger employs a systems learning approach to using data from its HIT system to improve the quality of care. The Center for Health Research conducts traditional health services research that usually has a three- to seven-year time horizon. Geisinger's Innovations team, charged with conducting real-time R&D, is focused on near term needs. The Innovations team works with executive leadership to prioritize new HIT/EHR-related initiatives, while the organization relies on the Geisinger Action Plan (GAP) to set priorities for efficiency and quality improvement. The Innovations team is an internally funded group of clinical and non-clinical consultants charged with improving quality of care, enhancing revenue and improving efficiency through workflow reengineering, EHR development including clinical decision support and automation. Examples of projects include:

Medical Home: For the last two years, case managers (funded by the Geisinger Health Plan) embedded in Primary Care practices facilitate improved quality and coordination of care resulting in substantial clinical improvements including reductions in hospital readmissions by 20%.

ProvenCare: Episodic medical procedures/conditions are reengineered to ensure that patients receive 100% of recommended best practices with resultant decrease in peri-procedural complications. ProvenCare projects include Coronary Artery Bypass Graft surgery, Cataract Surgery, Perinatal Care and Percutaneous Coronary Interventions. Workflows and clinical decision support are embedded in the electronic health record (EHR) to improve reliability and efficiency. The ProvenCare CABG program has resulted in decreases in both mortality and readmissions.

Preventive Care and Chronic Disease Optimization: Systems of care have been implemented that support the delivery of best practices for patients with Diabetes, Coronary Artery Disease, Chronic Kidney Disease and Osteoporosis. Data and the EHR capabilities are leveraged to identify patients with specific care needs and to increase the reliability by which care gaps are closed. Other conditions currently being developed include Heart Failure, Vascular Disease, Obesity and Asthma. Improvements include a five-fold increase in the diabetics receiving all 9 components of recommended care.

HIT AND HSR FOR ACTIONABLE KNOWLEDGE: DESCRIPTION OF PARTNERING HEALTH SYSTEMS

PARTNER: Kaiser Permanente

History, Structure, and Size

Kaiser Permanente (KP) is a not-for-profit health plan and integrated health care delivery system serving eight regions that cover California and selected parts of Colorado, the District of Columbia, Georgia, Hawaii, Maryland, Ohio, Oregon, Virginia, and Washington. The health plan opened to the public in 1945, having grown out of Kaiser Industries' internal health care programs for its workers during World War 2. KP currently provides care to 8.6 million members and employs approximately 175,000 people including 14,600 salaried physicians at 35 hospital medical centers and 431 outpatient medical offices. In addition, Research Centers, associated with each KP region, collectively employ over 1000 investigators and staff, and sustain ongoing research programs in clinical practice, health promotion, and policies to improve health care and health. The Research Centers collectively perform over \$100M in externally funded research annually.

HIT Systems

After over 30 years of regionally based and largely independent HIT initiatives, in 2002 Kaiser Permanente contracted with Epic Systems Corporation to create and implement a program wide integrated EHR, KP HealthConnect. Features include inpatient and outpatient clinical decision support; Web-based access for patients and providers; pharmacy and clinical laboratory support and reporting; emergency department (ED) management; scheduling and billing; and interfaces to other systems, such as archiving and population care management. A web site, <http://www.kp.org>, allows members to access portions of their medical record, send secure messages to clinicians, schedule appointments, and refill medications, as well as to find health information, advice, and tools such as health risk appraisals and interventions for smoking cessation, stress management, and dietary and exercise counseling. An Epic-based system similar to KP HealthConnect has been implemented in Kaiser Permanente's Northwest region beginning in 1994.

While the overall EMR is from a common source and has national governance, each KP region's instance(s) of KP-HealthConnect are somewhat unique due to local needs and implementation choices within those geographies. Substantial effort has been directed at maintaining common data definitions and semantic interoperability through an internally developed medical terminology solution, Convergent Medical Technology (CMT). CMT is semantically congruent with the Systematized Nomenclature of Medicine, Clinical Terminology (SNOMED CT) (and with laboratory Logical Observation Identifiers Names and Codes, or LOINC, and First DataBank drug terminology).

Analytic groups, based in both the Permanente Medical Groups and the Kaiser HealthPlan and Hospitals organizations, are located at the facility, regional and national levels to help use data from the HIT system to improve the quality and efficiency of care.

Traditionally, these groups have been mainly organized to address regional operational and quality improvement needs and have maintained little direct collaboration with each other at a national level. With some exceptions, the operationally oriented analytic activities have also generally been quite separate from the formal clinical, behavioral, and health services research infrastructure of the regionally located research centers. KP is currently trying to break down these barriers. 3 examples include:

- The National Research Council, which includes all of the KP regionally based research centers; a particular new area of alignment and collaboration is the support of Comparative Effectiveness Research
- The nationally based Care Management Institute which has developed an analytic network for performance reporting on aspects of chronic condition care
- A national organization, the Utility for Care Data Analysis, has formed to organize and position for more efficient access and use the vast data being generated by the HER and associated systems.

The full range of types of data collected by each KP regions HIT system are: coded and free text information related to (1) patient demographics, enrollment and benefits, (2) appointments scheduled and kept, (3) encounters (e.g. - outpatient, emergency department, inpatient) including associated diagnosis and procedure codes, (4) medication prescriptions and dispensing, (5) laboratory test orders and results, and (6) longitudinal records of patient vital signs drawn from multiple encounters and, in some cases, patient self-reports (e.g. - height, weight, blood pressure, etc.). There are also detailed data related to specific conditions (e.g. - tumor registries for cancer). Of these, all of these data sources currently get leveraged for research.

Within each KP region, data reside in multiple transactional source systems. Some Regions have created integrated data warehouses that bring together data from multiple source systems to support operational analytics (clinical and financial) and research. (centralized repository, distributed network, hybrid.) Other important features of KP's HIT capabilities include: KP is both a care delivery system and an insurer that pays claims for services provided by non-KP providers. The challenge of integrating data from both these functional areas affects nearly all informatics efforts at KP.

Organization of Research Functions

The embedded QI analytic groups are funded to both create and maintain routine periodic reports and also respond to ad hoc internal KP requests from Health Plan and Medical Group leadership at the facility, Regional and Program levels. This investment has not been formally summarized but likely amounts to several 10's of millions of dollars annually. The staffs are generally made up of professionals with the following background and experiences: BS/MS in a quantitative and/or health-related field. Many have MPH degrees. A small number have PhDs. The process for making requests for analysis is not standardized at all, either within Regions or at the Program-level.

Some of the ways in which KP is working to increase communication and collaboration with the formal research infrastructure are:

- Research into Health Disparities

- Research and characterization of the uses and value realization from implementation of KP-HealthConnect
- Impact of insurance benefit designs on the care seeking behavior of patients
- Facilitate access to KP clinical information through Regional Health Information Organizations
- Involvement of KP Centers within Evidence Based Practice Centers
- Organization for supporting Comparative Effectiveness Research

Applications of HIT (i.e. ways your organization describes utilization of electronically generated data)

Examples of the use of HIT data for systems improvement currently underway or recently completed include:

- The reduction in unwarranted variation in care through the use of EHR dashboard tools supported by analyses of patient panels. In particular, panel support tools for primary care clinicians.
- Using web-based tools for HEDIS measurement and feedback to clinicians. For example, POINT in SCAL, HealthTracker in CO, and primary care dashboard in NW.
- Analysis to describe particular patient populations by linking patient descriptors with particular locations. For example, we are developing standardized algorithms to associate members with facilities at the Medical Office Building level. This will enable us to stratify standardized measures (e.g. - HEDIS) by facility.
- We've also geo-coded KP member addresses; this enables us to integrate member information with external data (e.g. - from census) on environmental influences on health.
- Research to better understand how and which medical personnel use the HIT system.. For example, the Core Value Metrics Report includes information about how Permanente physicians and other clinicians utilize KPHC including, for example, use of after visit summaries, and delays in closing encounters, encounter mix (face-to-face office visits, phone encounters, email usage).

HIT AND HSR FOR ACTIONABLE KNOWLEDGE: DESCRIPTION OF PARTNERING HEALTH SYSTEMS

PARTNER: New York City Primary Care Information Project

History, Structure, and Size

Established in 2005 by the New York City Department of Health and Mental Hygiene, the Primary Care Information Project (PCIP) has supported EHR implementation with a public health focused design. A key feature of the EHR is an unified quality measurement system among 1,500 physicians and other providers in the ambulatory setting that collectively are responsible for the primary care of more than 1.4 million (ten percent) of the city's Medicaid and uninsured population. These numbers are projected to grow to 2,200 providers and 2.2 million patients by the end of 2009.

HIT Systems

PCIP has provided fully integrated electronic health record (EHR) systems and technical assistance to participating physician offices and clinics. The project encompasses providers in all five of the city's boroughs. The project uses EHR software developed by eClinicalWorks. The types of data collected by PCIP are: practice demographics, patient and provider satisfaction surveys, EHR utilization data, aggregated practice management data by CPT code and provider, and aggregated clinical information derived from the EHR (e.g. effectiveness of care measures and syndromic surveillance for influenza like illness and gastro-intestinal illnesses). Of these, all are leveraged to expand their knowledge base related to improving the delivery of preventive health care and public health action.

Within PCIP, summarized data reside (no patient level data) in centralized repositories, known as the Health Quality Information Network (HQIN). Other important key features of the eClinicalWorks EHR version developed with PCIP include: clinical decision support, patient registry with an extensive query function, quality reporting tool, order sets, and smart forms. These additional features are available to all eCW users. Additional functions focusing on interoperability and health information exchange with regional and state organizations are in progress. Aside from working directly with eCW, PCIP is also working with other EHR vendors to report aggregated quality and syndromic data to the HQIN, in order for other practices that may have already adopted an EHR to report to the PCIP.

Organization of the Project

PCIP has received over \$60 million from city, state, and federal government and private funders to support the project. This budget breaks down into spending for the following components: Outreach and Education, EHR Development, Implementation, Privacy and Security, Health Information Exchange, Practice Redesign, and Quality Measurement and Evaluation. Once fully implemented, annual operating costs are estimated around 6 million for existing outreach, implementation, integration, support, development, and reporting related to the EHR.

PCIP maintains a total of 58 full time and a several part time staff and interns. The staff is comprised of a variety of professionals with the following background and experiences: medical doctors, nursing, quality improvement, public health, informatics, care management, public administration, business, and health consulting. PCIP is estimated to require five FTEs at each clinic or provider site to do the following activities: implementation, EMR consulting, billing consulting, quality improvement, and privacy and security. PCIP currently prioritizes analytic projects using data collected through HIT in the following areas:

- Improving the delivery of preventives health services through HIT
- Impact of specific EHR functions or HIE leading more effective and efficient care (including public health announcements for outbreaks or monitoring H1N1)
- Impact of EHR or systems interventions that lead to lower care costs or reduce avoidable costs
- Impact of EHR or systems interventions that lead to improved patient safety and patient engagement in care

Future plans for PCIP include an integrated care management pilot in 2010 and development of infrastructure to better connect primary care providers to their referral networks (e.g. specialists, hospitals, and other health care related facilities).

Applications of HIT (i.e. ways your organization describes utilization of electronically generated data)

PCIP aims to use information from EHRs to enhance the population health of safety-net patients. Among the uses facilitated by HIT, developed by PCIP, are:

- Enhanced patient registries to allow for health tracking of particular populations and provider panels of patients.
- Point of care reminders (based on a clinical decision support system) to help providers act on prevention opportunities
- Monthly reports for all sites by provider on 32 quality measures, several metrics on the use of the EHR system, and daily aggregations of procedures performed to track provider productivity.
- Daily syndromic reports for emerging disease surveillance and public health functions during outbreak or crisis situations

Not currently in use but have been piloted; future plans to be determined:

- Medication reconciliation with 90 day medication fill history
- Bilateral citywide immunization registry

Identified challenges associated with generating and using of electronic data for quality improvement and other research purposes:

- Determining which data are most important to collect, and how to make the case for provider buy in;
- Determining when data are “good enough” and for what purposes;
- Ensuring that providers adhere to structured field utilization / use appropriate fields.

Research-relevant lessons learned through process of establishing distributed data network:

- Importance of determining on the front end what data to request. Though the predominant research mindset has been “data by the pound,” they have found that this would be overwhelming to the participating providers and ultimately counter-productive to their efforts;
- Importance of building systems that allow for provider autonomy and uniqueness, but with ability to support uniformity – an example being that a portion of the EHR for participating providers is “frozen” for all practices as a “community EHR,” and the rest is customizable;
- Importance of presenting an individually compelling case for providers; 80% of their QI is linked back to efficiency / office optimization goals.

HIT AND HSR FOR ACTIONABLE KNOWLEDGE: DESCRIPTION OF PARTNERING HEALTH SYSTEMS

PARTNER: Palo Alto Medical Foundation

History, Structure, and Size

The Palo Alto Medical Foundation for Health Care, Research, and Education (PAMF) is a non-profit multi-specialty group medical practice of more than 900 physicians serving over 600,000 patients in Alameda, Santa Clara, Santa Cruz and San Mateo counties in Northern California. Founded in 1930 as the Palo Alto Medical Clinic, the organization became PAMF in 1981. PAMF became affiliated with Sutter Health, a network of non-profit hospitals and physician organizations that share resources and expertise, in 1993. At the start of 2008, PAMF merged its three separate, geographically-based medical groups (Camino Medical Group, Palo Alto Medical Clinic, and Santa Cruz Medical Clinic) into a single organization.

HIT Systems

Part of the integration into a single medical group has been the adoption of single, networked EHR that can be accessed from any PAMF facility using software from Epic Systems first implemented in 2000. PAMF also uses IDX Software to support scheduling, billing, and managed care. Other systems are employed as well, e.g., for pathology and oncology. The full range of types of data collected by PAMF are: billing, scheduling, managed care, patient encounters, vital signs, lab results, medication orders, pathology, and oncology. Of these, all can be leveraged for research. (Active use of the electronic data bases for research has increased in just the last year.) Within PAMF, data reside in warehouses at both the department and enterprise level at both PAMF and Sutter Health System. Other important features of PAMF's HIT capabilities include: a patient portal, PAMFOnLine, used by over 176,000 patients to securely access aspects of their medical record and allowing those who pay a nominal fee to securely e-mail their clinicians.

Organization of Research Functions

PAMF has maintained a research institute (PAMFRI) since 1950 which is currently comprised of three major departments. The Clinical Research supports relatively small scale clinical trials both initiated at PAMF and externally. The Department of Health Services Research conducts behavioral health research, typically with randomized, but not double blinded methods, focused on understanding and reshaping high-risk behavior among individuals and on motivating providers to try new approaches to patient care. The Department of Health Policy Research conducts a wide range of observational studies, using methods ranging from ethnography to econometrics, focusing mostly on improving the quality and reducing the cost of health care delivery. Research analytic support is provided both centrally and within specific projects. Central staff have expertise in using PAMF's data systems and in applying various economic, epidemiologic, and other methods.

Most of the projects undertaken at the Research Institute are externally funded through federal and foundation grants. The Research Institute receives some funding that enables it to respond to internal PAMF requests. These functions are relatively new and are in a growth phase. In the past year, these efforts included 40% time of a senior clinician with extensive industry experience in IT, three full-time information analysts (with 70 years collective experience) and partial support of a physician expert in using episode-grouping software, a clinical epidemiologist with extensive experience in using routinely collected data to monitor outcomes and a health economist. To date, requests have rarely been formal, but rather have grown out of the Director's active involvement on various PAMF committees and the identification of opportunities in which RI personnel can be of assistance. It is expected that the RI efforts will lead to potentially publishable papers, and it is hoped that the involvement leads to collaborations capable of garnering external funding.

Applications of HIT (i.e. ways your organization describes utilization of electronically generated data)

Examples of projects currently underway or recently completed include:

- Using information technology to promote evidence-based care. In particular, each physician has a set of dashboards available that highlights their performance on a number of key metrics. These metrics include P4P-type measures as well as schedule availability and patient satisfaction measures. An AHRQ-funded Task Order project examined the impact of attaching physician-specific financial incentives to some of the measures.
- Evaluating novel payment strategies for providers that foster better disease prevention and care coordination. In particular, PAMF is currently working on evaluating alternatives to the existing volume (RVU) based compensation for primary care physicians. Measures of panel size with adjustments for clinical severity are being evaluated. For example, work by RI staff has shown that there are better ways of estimating the number people currently on a panel than has been used by PAMF, and that extensive condition-specific measures add nothing to age-sex adjustment of panel size with respect to primary care work effort. HIT plays a role in this project by enabling the analysis of actual panel size/severity and the testing of different factors that measure panel size.
- Finding ways to prevent the development of chronic illnesses such as heart disease, diabetes, and depression. In particular, PAMF has active efforts underway to understand how race and ethnicity impact the onset and treatment of chronic illness, especially among Asian subgroups. Researchers assisted in the design of a routinely collected form on race/ethnicity and language that now allows a focus on the six major Asian subgroups who account for over 25% of PAMF's patients. HIT plays a role in this project by allowing the routine collection of patient-volunteered data and its linkage with clinical measures, providing a platform of historical data to support the retrospective research.

Plans for the future include better linkage of pharmacy-fill data with prescriptions-written data in the EHR, implementation of tools to collect patient reports of functional status and symptoms, and exploration of “date-stamp” information in the EHR to track work processes.

HIT AND HSR FOR ACTIONABLE KNOWLEDGE: DESCRIPTION OF PARTNERING HEALTH SYSTEMS

PARTNER: Veterans Health Administration

History, Structure, and Size

Begun as a nationwide system of rehabilitation hospitals after World War II, the Veterans Health Administration (VHA) currently operates as an integrated health delivery system divided into 21 Veterans Integrated Service Networks (VISNs). The VHA operates with an annual medical-care budget of \$47 billion (FY2009). It has a staff of 239,000 personnel at a total of 1,400 facilities including hospitals, clinics, nursing homes, domiciliaries, and counseling centers. The VHA is the Nation's largest provider of graduate medical education and a significant contributor to medical research.

HIT Systems

The VA maintains its own Computerized Patient Record System (CPRS) within the Veterans Health Information Systems and Technology Architecture (VistA). VistA grew out of a decentralized hospital-based computer system in the 1980s and also supports commercial off-the-shelf software that can be used with existing and future technologies.

VistA is a rich, automated environment that is fundamental to operations at VA healthcare facilities. The primary focus is on supporting the activities of direct patient care. The system stores and manages nearly comprehensive information on all persons treated at VA facilities. Among the few remaining paper-based data sources are selected nursing flow sheets, anesthesia flow sheets, and ophthalmology notes. VistA also handles administrative, financial, and infrastructure-related data.

Data are stored locally and centrally. Most clinical data reside only in the 129 local VistAs. These data are gradually being migrated to 4 Regional Data Processing Centers. A limited set of data elements are collected from all VA facilities and maintained at the Automated Information Technology Center (AITC) in the Health Data Repository. In addition to production data centers, the VHA maintains scores of clinical data repositories to support business intelligence functions and research.

Organization of Research Functions

The VHA has four research services: Biomedical, Clinical Science, Health Services and Rehabilitation. Health Services Research and Development (HSR&D) alone funds more than 300 projects each year and most depend on data from VistA.

Nationally available data repositories such as the National Patient Care Database (NPCD) and VHA Decision Support System (DSS) are extracted on a routine basis and custom data extracts from VistA may be made for research purposes. Knowledge of the specific standards used and possible data values in VistA is required for the researcher to be able to request data and interpret the information returned.

Applications of HIT

A new program, the VA Informatics and Computing Infrastructure (VINCI), is creating an integrated suite of databases from national data that hold particular interest for researchers. Traditionally researchers have been constrained to using structured data elements. New tools and computing power available in the secure, virtual environment of VINCI are allowing researchers to make use of the wealth of information stored throughout the medical record as text in reports, patient history and notes. VINCI will host national data and provide tools for annotation and natural language processing that will allow researchers to extract much more information from the system than was possible before VINCI.

Future plans for health information at the VA include the increased use of standard coding systems and accommodation of new data such as images, results from clinical procedures and genomic data.