

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 touchscreen 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.