Brief Summary of Selected Ongoing CPHIT Projects (6/27/2019)

The Johns Hopkins Center for Population Health Information Technology (CPHIT) seeks to improve the health and well-being of populations by advancing the state-of-the-art of Health IT across public and private health organizations and systems. CPHIT focuses on the application of EHRs, mobile health (m-health) and other HIT tools targeted at communities and populations. We are embarking on a wide range of collaborative research projects at Johns Hopkins, regionally, nationally and globally. (Please read more about CPHIT at www.jhsph.edu/cphit).

Below are brief summaries of several ongoing CPHIT research & development projects. For further information please contact: Prof. Jonathan Weiner (Center Director) jweiner1@jhu.edu or Elyse Lasser (Center Coordinator) elasser1@jhu.edu

Current Portfolio

1) Developing Next Generation EHR-Supported Predictive Modeling: Developing the Johns Hopkins “e-ACG” System

Primary Funding: Internal and JHHC-Solutions
Primary Investigator: Jonathan Weiner

CPHIT and the Johns Hopkins ACG R&D unit housed in CPHIT has a major project underway to use new clinical digital data streams to enhance current predictive and analytic models. This project is being done in collaboration with faculty from the Bloomberg School of Public Health, Johns Hopkins School of Medicine and the Department of Computer Science. Some of the EHR elements that are being incorporated in advanced models include vital signs, lab values, cardiovascular data, clinician notes and patient reports. The goal of this project is to advance the state of the art of EHR based predictive modeling tools for high-risk case detection and management for populations. We will identify EHR and other HIT elements amenable to incorporation with traditional claims-based ACG Measures, and then test how to best integrate a combination of elements with the ACG System to enhance our predictive modeling ability. Over the various phases of this project, we will not only apply structured, readily available EHR/clinical data sources, we will also apply Natural Language Processing (NLP) text mining approaches to capture information from unstructured data sources. We are
2) The Development and Testing of the Frailty Component of a Novel EHR-Based "Geriatric e-risk" Measure for Predictive Modeling

Primary Funding: Internal and Atrius Health
Primary Investigator: Hadi Kharrazi

The initial goal of this project is to develop advanced predictive modeling tools for high risk case detection and management for geriatric populations and understanding the added value of free text to current predictive modeling. This project expanded the JHU ACG frailty metric system using structured data from both claims and EHRs. A unique aspect of this project was an extensive (and very successful) text mining of clinician free text notes extracted from the EHR records of 20,000+ Medicare Advantage patients at the study site. CPHIT used sophisticated "regex" text matching technique to reach very high accuracy levels of geriatric risk identification based on information in the text that was not found in either the structured claims or EHR. JHU Computer science faculty used more complex advanced natural language processing techniques (NLP). Work has expanded to explore social determinants of health in a Medicare and Medicaid population.


Primary Funding: Internal
Primary Investigator: Hadi Kharrazi

The overarching goal of this project is to identify social determinants of health (SDoH) in electronic health records (EHRs) and administrative claims for a Medicare and Medicaid population. We will continue to explore NLP techniques to mine free text of EHR and the clinical notes. We will identify patients who have a mention of an SDoH in EHR and claims such as housing instability or food insecurity. Using the census block group geographic level we can identify patients who live in neighborhoods with high rates of SDoH issues (i.e. food deserts) and compare how neighborhood issues match to individual issues recorded in the EHR. Results from this project will be used to help screen and identify patients with unmet SDoH needs.
4) Social Predictive Modeling/Geographic Database Development

Primary funding: internal, DST, JHHC-Solutions
Primary Investigators: Jonathan Weiner, Hadi Kharrazi

CPHIT is developing a large database of publicly available data at the census tract level. This database will link American Community Survey (ACS), ArcGIS data (as available), road systems, and other geographic level data. The goal is to design a database that can be utilized to understand non-medical factors associated with specific conditions, utilization, cost, etc. We intend on using this community level database both in support of R&D projects at CPHIT and across JHU. Preliminary analysis is being conducted using commercial claims data from the Maryland Healthcare Cost Commission and linking to the Area Deprivation Index (ADI) (a composite score exploring the neighborhood socio-economic status). There are a number of different projects that fall under this large umbrella, for more information see below.

a) DST GSAP

Collaborating with our Industry Partner, DST, we explored predicting hospitalization and Emergency Department (ED) admissions using administrative claims data and the ADI. Preliminary analysis is conducted at the zip code level. More work is needed to explore how non-clinical factors such as the ADI may help in predicting various health outcomes and identify patients with various social needs. We continue to explore various spatial statistical operations and integration techniques

b) ACGSAP

CPHIT is embarking on a potential 3 year project that will allow for the seamless exchange of data from the GSAP platform and ACG Software. This initiative will further explore how non-clinical factors can be used to improve population health, from identifying patients with unmet social needs, to providing patients with information about community organizations that can assist on a variety of social needs. The goal is to provide end users with the desired and needed geo-social variables and markers as well as risk scores that can enhance population health management efforts.

5) Baltimore Falls Reduction Initiative Engaging Neighborhoods and Data (B’FRIEND)

Primary Funding: Robert Wood Johnson Foundation “DASH”, JHU InHealth
Primary Investigator: Hadi Kharrazi
The emergence of new sources of data has created an unprecedented opportunity to improve public health. It is now possible to use real-time information from healthcare systems to assess community health, monitor progress through surveillance, develop advanced models to predict population-based morbidity trajectories, and innovate to deliver meaningful improvements in health outcomes. The B‘FRIEND Initiative is a public-private partnership in Baltimore City based on the innovative use of health data to decrease the rate of falls leading to hospital admissions among elderly. We are developing the methodology to identify falls in elderly patients using case-mix data and are working with the state HIE (CRISP) to implement these methods and start developing reports on when people are falling. Based on this methodology and geo-coded data we will develop methodology to identify where falls are occurring. We are also assessing the quality of GIS-bound datasets for hot-spotting methodology and to test spatiotemporal trajectories. Using both hospital and other community data we will develop a risk score for predicting falls and determine risk factors that may be associated with falls. This information will be shared and we will work with CRISP and the city to implement these risk scores.

6) **Linkage of Rx, Medical, Corrections and Social Data to Identify Persons at Risk for Opioid overdose and other adverse Effects**

Primary Funding: US Department of Justice, Md. Dept. of Health (DHMH) subcontract  
Primary Investigator: Brendan Saloner

This is a "Harold Rogers" Grant from the US Department of Justice (DoJ) Bureau of Justice Assistance to the Maryland Department of Health and Mental Hygiene (DHMH) for the purposes of linking the PDMP (controlled drug prescribing database) and a wide range of medical, public health, social and justice/corrections data in the State of Maryland to develop a predictive model to identify persons at risk for opioid overdose risk. This is a collaborative effort of the DHMH, the State of Maryland Health Information Exchange (HIE) (known as CRISP) and CPHIT. JHU is the technical/methods/analytic lead. We will be developing predictive models using this broad array of risk data that will provide a risk score that can be used by clinicians and public health programs to potentially guide interventions that can decrease the harm to individuals and populations. In addition to data linkage, technical and analytic issues, we will grapple with legal and ethical frameworks for how to appropriately use these sensitive sources of data as well.

7) **Addressing Suicide Research Gaps: Understanding Mortality Outcomes in the Mid-Atlantic Region**

Primary Funding: National Institute of Mental Health  
Primary Investigator: Hadi Kharrazi
The overall goal of this research project is to identify patterns of clinical encounters and characteristics of individuals who have committed suicide. We will link multiple different and novel databases at both the individual and census block group level. Once linked, we will develop methods to find novel patterns and predict suicide. Linked data sources will include: the Office of the Medical Examiner, various claims databases such as in-patient and out-patient data from the Health Service Cost Review Commission, and Electronic Health Record (EHR) from both Johns Hopkins Health System and Sheppard Pratt Health System, and others. We hope to also include other data sources such as the American Community Survey and Child Protective Services. Data linkage will occur in collaboration with the Maryland Health Information Exchange: CRISP. CRISP, using their master patient index will assign a study id to each data set allowing for the individual data sets to be linked at an individual level. The work is still in preliminary phases as we gather all the appropriate approvals for the various data sources.

**Completed projects**

**A) Veteran Health Administration (VHA) collaborations:**

Primary funding: VHA  
Primary Investigators: Jonathan Weiner, Hadi Kharrazi

**a) Population Health Program Development with the VHA Office of Analytics and Business Intelligence**

Working with the VA, we developed a national population health measurement framework and will guide in the implementation of a population health platform. To start, we are linking over 30 million Electronic Health records and USE GIS data to understand population health facets of obesity. At the request of the Deputy Undersecretary for Policy and Services the Office of Analytics and Business Intelligence has collaborated with several offices within the VHA to develop a vision for integrating a population perspective into their strategic planning, program development, and clinical decision-making. We are developing a metadata repository for obesity and will analyze the effect of different population denominators on existing obesity rates among VHA members and develop a series of predictive models to forecast obesity trajectory in a given population.

**b) Developing and Testing an Approach for the Integration of Population and Patient Level Information in Support of Patient Centered Primary Care at the VHA**

PACT is a partnership between each veteran and healthcare professionals working together to plan care and life-long health and wellness. PACT is part of the national “Patient Centered Medical Home” (PCMH) movement, where accountable primary care delivery teams, equipped with comprehensive information support systems, provide coordinated care attuned to the patient’s individual needs. PACT and CPHIT are working together to define, develop, and pilot informatics and analytic tools and methods related to the integration of population health information into the VHA’s patient centered primary care delivery process. We are working to incorporate relevant available community/population level data sources into VHA’s clinical and administrative patient level information systems.
B) Predicting Hospital Readmissions Utilizing Health Information Exchange Real-Time Data

Primary Funding: AHRQ and JHU Faculty Development Fund
Primary Investigator(s): Hadi Kharrazi

CPHIT is currently conducting a research project involving CRISP, Maryland’s health information exchange, and readmission risk predictive models (RRPMs). CRISP has an Encounter Notification System (ENS) to alert primary care providers (PCPs) of sentinel events regarding patients; the ENS lacks a tool to identify risk of readmission. The goal of this project is to develop and evaluate the feasibility of implementation of a real-time system to identify persons discharged from the hospital who are at high risk for readmission. This project, in part, will base its algorithms on the Johns Hopkins ACG® System, which has been used for over two decades across the US and in 15 other countries to generate predictive models of various healthcare events with a high degree of accuracy. As part of this research, a qualitative study will be conducted to evaluate the potential effectiveness and usability of the HIE-derived-and-delivered RRPM among participating PCPs.

C) Developing a Population Health Measurement Framework: SIM Planning

Primary funding: CMS- Subcontractor through CRISP and DHMH
Primary Investigator: Jonathan Weiner

We are developing a framework of population health measures that can be derived over the near term with available electronic data. The goal of these measures is to assess the state of health of target populations/communities before, during, and after the SIM program intervention. CPHIT will conduct a literature review and environmental scan of current population health frameworks. We are also developing population health specific measures based on this framework and will provide updated measure specifications.

(Note – we are also undertaking a related internal project where we are developing population health metrics for the local community around the Johns Hopkins Health System for potential use within population health monitoring by the health system.)
**D) Evaluation of Stage 3 Meaningful Use within Eligible Hospitals in Two States**

Primary Funding: AHRQ  
Primary Investigator(s): Hadi Kharrazi, Peter Pronovost

CPHIT is participating in research to evaluate the feasibility of Stage 3 Meaningful Use (MU3-CC) measures. One key deliverable will be the set of MU3 guidelines and final reports that will serve to guide both policy makers and hospital administrators regarding implementation of MU3-CC measures. This project will be administered and managed by the Johns Hopkins Armstrong Institute for Patient Safety and Quality, with Johns Hopkins CPHIT providing its HIT domain experts. Also contributing expertise are the Johns Hopkins School of Nursing and the Division of Health Sciences and Informatics at the Johns Hopkins School of Medicine.

**E) Identifying High Risk Pregnancies through Natural Language Processing**

Primary Funding: Internal  
Primary Investigator(s): Mark Dredze, Jonathan Weiner

In collaboration with Johns Hopkins Health Care and the Johns Hopkins Whiting School of Engineering, CPHIT is working to identify patients who qualify for the Partners with Moms program. The goal is to identify patients who are at high risk for premature birth and low birth weight. Applying natural language processing and other computer science techniques, we are using physician notes and other unstructured parts of an Electronic Health Record (EHR) to identify high risk markers and flags. This project and the techniques used will help us learn how different parts of an EHR can be used to identify populations for care management programs.

**F) Assessment of the Feasibility of CMS/ONC Quality Metrics Using Office-Based EMRs**

Primary Funding: DHHS-CMS (Sub contract to Mathematica Policy Research)  
Primary Investigator(s): Sydney Dy, Kitty Chan, Jonathan Weiner, Hadi Kharrazi

The integration of electronic health records (EHRs) into ambulatory care offices has created an opportunity to develop and test quality measures at the point of care. The Johns Hopkins CPHIT team and others from the Bloomberg School of Public Health are working with Mathematica (MPR) to evaluate the feasibility and accuracy of quality measures based on processes of care for potential use as part of the CMS/ONC Meaningful Use physicians’ incentive program. Johns Hopkins was an alpha test site for evaluating the measures associated with Medicare's Adult Wellness Visit benefit. Johns Hopkins is also a testing site for evaluating overuse measures associated with dexta scans for osteoporosis screening and use of imaging for uncomplicated headaches.
G) Assessment of added value of consumer/marketing data when linked with claims for predictive modeling

Primary Funding: Internal  
Primary Investigator(s): Jonathan Weiner, David Bodycombe

This is a pilot project where DSS, a health benefits analytics consultant, helped us acquire both claims data and consumer / financial / marketing data for a large cohort of de-identified persons who are in self-insured health plans managed by a number of employers. We are assessing the added value (when added to claims data) of a wide array of individual “consumer” data for predictive modeling. These new sources of data include consumer credit and financial information, family characteristics, neighborhood characteristics, and marketing surveys and personal preferences and hobbies. These new factors are being integrated with “traditional” medical/pharmacy predictive models to assess whether they increase our ability to identify person likely to have high medical risk. We are applying an array of analytic and computer science tools to develop and assess the best models and the potential increased accuracy of the models.